Lebanon Emergency Assistance Project (LEAP)

Rehabilitation of Governmental Hospitals

Tebnine, Nabatieh, Hasbaya and Marjayoun, South Lebanon

Name of Project:	Lebanon Emergency Assistance Project (LEAP)
Contract Title:	Rehabilitation of Governmental Hospitals – Tebnine, Nabatieh, Hasbaya and Marjayoun, South Lebanon
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Part 2 - MEP Works

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SECTION 00 01 10

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SECTION 01 11 00

SUMMARY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Contract description.

B. Contractor's use of site.

C. Coordination.

D. Work sequence.

E. Employer occupancy.

F. Specification conventions.

1.2 CONTRACT DESCRIPTION

A. Scope:
1. This Specification covers the construction and completion of the project as shown on the Drawings, Bill of Quantities, and as detailed in the Contract Documents and directed by the Engineer.
2. The Contract comprises execution, completion of 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 proper execution and completion of the works.
3. Perform Work in accordance with the Contract Documents.
4. The requirements of this Section do not supersede or take precedence over any provision of the “Conditions of Contract”, and should any discrepancy become apparent between the requirements of this Section and the “Conditions of Contract”, the Contractor shall notify the Engineer, in writing, with a copy to the Employer, and the Engineer shall interpret and decide such matters as per the applicable provisions of the Tender Documents.
5. 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 to be performed by any trade.
6. In examining the requirements of any section of the Specifications, the Contractor shall examine all other sections of the Specifications and the other Documents and Drawings which affect the Work of that section.
7. It is the responsibility of the Contractor, to inform the Engineer of any discrepancies in the drawings and specifications before signing the Contract, default of which will make him responsible for any errors or omissions even though they have been approved by the Engineer.

B. Description of the Project:
1. The project location is as shown on the drawings.

2. The project comprises the construction, completion and maintenance during the defects liability period of the project with related structural and architectural works, and electromechanical works.

C. Performance and Standards:
1. The performance required of materials and products and the standards to be complied with shall be as specified in subsequent sections of these Specifications and in accordance with relevant local authorities' standards which ever have more stringent requirements.

D. Cross References:
1. The specifications are prepared based on the Construction Specifications Institute (CSI) master format.
2. The specifications section numbers and titles might be used in the Bill of Quantities as cross-references to help define the part or parts of the Specification which apply to particular kinds of work or parts of the Work.
3. 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. Cross references should not be taken as excluding other relevant information and requirements stated in other parts or sections of the Specifications. The Specifications as a whole shall be taken as applying to the Work as a whole.

1.3 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 Engineer and Employer.

B. The Contractor shall be responsible for safeguarding existing structures and utilities.

C. The Contractor shall be responsible for arranging his own working space, storage of materials, setting of all temporary accommodations, utilities, services, facilities, etc. subject to the approval of the Engineer.

D. The Contractor shall be responsible for keeping driveways and entrances serving the site clear and available to the Employer, other Contractors, the Employer's employees and emergency vehicles at all times. Do not use these areas for parking or storage of materials. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

E. The Contractor shall be responsible for not unreasonably encumber the site with materials/equipment. Confine stockpiling of materials and location of storage sheds to areas proposed by the Contractor at Tender stage, after having received the approval of Engineer. If additional storage is necessary, obtain & pay for such storage off site.

F. The Contractor shall be responsible for locking automotive type vehicles, such as passenger cars, trucks, and other mechanized or motorized construction equipment, when parked and unattended, so as to prevent unauthorized use. Do not leave such vehicles or equipment unattended with the motor running or the ignition key in place.

G. The Contractor shall be responsible for implementing safety measures at all times.

1.4 COORDINATION

A. The Contractor shall be responsible to coordinate the works of all trades (Civil, Architectural and Electro-Mechanical Works) related to the project.

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

C. The Contractor shall fully coordinate and cooperate with other Contractors on site.

1.5 WORK SEQUENCE

A. Construct Work in approved stages and phases.

B. Coordinate construction schedule and operations with Engineer.

1.6 EMPLOYER OCCUPANCY

A. The Employer will be occupying the site and premises during the works together with other contractors executing other works on site.

B. Cooperate with Employer to minimize conflict and facilitate Employer's operations.

C. Schedule the Work with the Engineer to accommodate Employer occupancy.

1.7 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 and no need to mention them in the “Related Sections” of each specifications section; In general, “Related Sections” are only the “Technical Related Sections”.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

Not Applicable.

END OF SECTION

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Coordination and project conditions.

B. Field engineering.

C. Regulatory Requirements.

D. Management and Administration Procedures.

E. Progress meetings.

F. Pre-installation meetings.

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals and Work of various sections of the Project to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.

B. Verify utility requirements and characteristics of operating equipment are compatible with project utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

C. Coordinate space requirements, supports and execution of all trades and works. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.

D. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.

1.3 FIELD ENGINEERING

A. Scope:
   1. This section covers:
      a. Survey and field engineering, quality control, submittals and project record documents of the works.
      b. The Contractor’s responsibility for the accurate setting out of the Works both on drawings and on Site.

B. Related Items:
   1. General Requirements: Execution requirements for project record documents.

C. Performance and Standards:
1. Employ a Certified Land Surveyor acceptable to the Engineer to perform survey work of this section.
2. All setting out, including the setting out and marking of builder's work requirements shall be measured from agreed data.

D. Submittals:
1. Submit name, address, and telephone number of Surveyor before starting survey work.
2. On request, submit documentation verifying accuracy of survey work.
3. Submit a copy of site drawing signed by the Certified Land Surveyor, that the elevations and locations of the Work are in conformance with Contract Documents.
4. Maintain a complete and accurate log of control and survey work as it progresses.

E. Survey Equipment: Provide the following minimum survey equipment for each trade of work.
1. [1 №] Automatic Leveling Instruments with Graduated Magnified 3600 Horizontal Circle and Telescope Magnification of 20 x (minimum).
2. [1 №] Theodolites (to 20 seconds intervals).
3. [2 №] 4m Staff.
4. [8 №] Ranging Rods.
5. [1 №] Linen / Glass Fiber Tape (30m).
6. [1 №] Linen / Glass Fiber/Steel Tape (50m).
7. [1 №] Steel Tapes (coated) (3m).
8. [1 №] Steel Tapes (coated) (5m).
9. [1 №] Builders Spirit Level (1m long).
10. [1 №] Magnetic Pipeline Coating Thickness Tester (0-1000 micron).
11. [1 №] Caliper for Measuring Pipes of Up to 900mm Diameter.
12. [1 №] 1 lb. Claw Hammer.
13. [1 №] 4 lbs. Square Face Hammer.
14. Level Hooks [As Required].
15. [1 №] Chlorine Comparator with Tablets for Testing of Chlorine in Water Samples from 0.1 to 1.0 ppm.
16. Others [As Required].

F. Examination:
1. Verify locations of survey control points prior to starting work.
2. Promptly notify Engineer of any discrepancies discovered.

G. Survey Reference Points:
1. Contractor will locate and protect survey control and reference points.
2. Control datum for survey is that indicated on Drawings or as given by the Engineer.
3. Verify set-backs and easements; confirm drawing dimensions and elevations.
4. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
5. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer.

H. Survey Requirements:
1. Provide field engineering services. Utilize recognized engineering survey practices.
2. Establish a minimum of four permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
3. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   a. Site improvements including pavements; stakes for grading; utility locations, slopes, and invert elevations.
   b. Grid or axis for structures of existing and new structures.
   c. Column locations, ground floor elevations, and roof elevation of existing and new structure.
4. Periodically verify layouts by same means.

I. Existing Levels:
1. The Contractor shall satisfy himself that the levels as shown on the drawings are correct. Should the Contractor wish to dispute any levels he shall submit to the Engineer a schedule of the position of the levels considered to be in error and a set of revised levels. Levels shall not be disturbed during execution without the approval of the Engineer.
2. Claims brought on discrepancies due to non compliance by the Contractor of the aforementioned shall not be considered.

J. Tolerances: Survey tolerance shall be to agreed recognized standards in addition to the local relevant authorities' regulations and standards.

1.4 REGULATORY REQUIREMENTS

A. Scope: This Specification calls attention to the regulations to be observed by the Contractor and the Standards and Codes of Practice to which reference shall be made.

B. Regulations:
1. The Contractor shall carry out the Works in full observance of the local authorities. Special attendance shall be also given to:
   a. General Requirements, Site Administration, Safety, Health and Environmental Regulations.
   b. Regulations and planning of the Municipality or local authority.
2. All agencies and/or authorities involved to which a notice of intent should be declared and from which approvals should be obtained.

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 and current Standards, Standard Codes of Practice and all current amendments thereto.
2. Compliance to be understood to mean that the standard attained shall not be less than that specified in the Standard or Code of Practice and 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.

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 Engineer together with full particulars of the standard in question which will be accepted by the Engineer if he is satisfied as to its provisions.

D. Industry Standards:
1. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents. Such standards are made a part of the Contract Documents by reference.
2. Publication Dates: Comply with standards in effect as of date of the Contract Documents, unless otherwise indicated.
3. Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Applicable standards are not bound with the Contract Documents. Where such standards are specified, obtain these standards directly from available source.

1.5 MANAGEMENT AND ADMINISTRATION PROCEDURES

A. General: Management shall be to agreed recognized standards or manuals.

B. Superintendence:
1. Accept responsibility for coordination, superintendence and administration of the Work including all works by sub-contractors and nominated sub-contractors.
2. Arrange and monitor a programme with each sub-Contractor, supplier and local authority and obtain and supply information as necessary for coordination of the Work.

C. Sub-Contractor’s Site Meeting: Hold meetings with appropriate sub-contractors and suppliers shortly before main site meetings to facilitate accurate reporting of progress.

D. Weather Record: Keep an accurate record of:
1. Daily maximum and minimum air temperature (including overnight)
2. Number of hours per day in which Work is prevented by inclement weather.
3. Weather Condition and Impact on Work Plant and Equipment.
4. Wind Speed and Wind Direction.

1.6 PROGRESS MEETINGS

A. Schedule and administer meetings throughout progress of the Work at weekly intervals unless otherwise directed by the Engineer.

B. Make arrangements for meetings in full coordination with the Engineer; prepare agenda with copies for participants, preside at meetings.

C. Attendance Required: Contractor’s Representative, major subcontractors and suppliers, Employer, and Engineer, as appropriate to agenda topics for each meeting.

D. Agenda:
1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems and decisions.
4. Identification of problems impeding planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Works executed during the last week.
10. Works being executed this week.
11. Planned activities and work progress during succeeding work period.
12. Coordination of projected progress.
13. Maintenance of quality and work standards.
14. Effect of proposed changes on progress schedule and coordination.
15. Site Safety.
16. Site Clearance and Access to Work Location.
17. Other business relating to Work.

E. The Engineer will record minutes and distribute copies within two days after meeting to participants.

1.7 PRE-INSTALLATION MEETINGS

A. When required in individual specification sections, convene pre-installation meetings at Project site prior to commencing work of specific section.

B. Require attendance of parties directly affecting, or affected by, Work of specific section.

C. Notify the Engineer minimum four days in advance of meeting date.

D. Prepare agenda and preside at meeting:
1. Review conditions of installation, preparation and installation procedures.
2. Review coordination with related work.

E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Engineer, Employer and those affected by decisions made.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

Not Applicable.

END OF SECTION

SECTION 01 32 16.13

NETWORK ANALYSIS SCHEDULES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. References.

B. Quality assurance.

C. Format.

D. Construction Program.

E. Submittals.

F. Distribution.

1.2 REFERENCES

A. The Use of CPM in Construction: A Manual for General Contractors and the Construction Industry, Washington, D.C., The Associated General Contractors of America (AGC).

B. CPM in Construction Management: Project Management with CPM, O'Brien, McGraw-Hill Book Company, New York.

1.3 QUALITY ASSURANCE

A. Scheduler: Contractor's personnel or Specialist Consultant specializing in CPM scheduling with ten years minimum experience in scheduling construction work of complexity comparable to this Project, and having use of computer facilities capable of delivering detailed graphic printout within 48 hours of request.

B. Contractor's Administrative Personnel: Ten years minimum experience in using and monitoring CPM schedules on comparable projects.

1.4 FORMAT

A. Use latest edition of "Primavera Project Planner" for preparation of CPM schedule.

B. Listings: Reading from left to right, in ascending order for each activity. Identify each activity with applicable specification section number.

C. Diagram Sheet Size: 600 mm high x 900 mm wide or by the required width.

D. Scale and Spacing: To allow for notations and revisions.

E. Submit soft copies (Primavera Format) of schedule and all revisions and updates.

1.5 CONSTRUCTION PROGRAM

A. The Contractor shall prepare a Construction Program showing the order and method in which he proposes to execute the works and the dates upon which the various elements, trades and sections of the works will be started and completed, including dates for submittal and approval of shop drawings and samples, for procurement and delivery of materials and equipment; for construction, installation, inspection, testing and commissioning.

B. The construction program shall be in the form of Computerized Network Precedence Diagrams incorporating activities for all work to be performed by the Contractor, his Sub-Contractors and other Contractors to be employed in or about the site, supported by computer analysis and schedules and prepared in accordance with the principles of Critical Path Method (CPM) programming.

C. The construction program shall be prepared by a qualified Network Analysis Consultant in collaboration with the Contractor. The Network Analysis Consultant shall be approved by Engineer and shall be skilled and experienced in construction programming of the kind specified for this project. The Network Analysis Consultant shall provide the Engineer access to his database for loading into the Engineer's computer system, whether by means of CDs or data-line communications.

D. The network diagrams shall be clearly and accurately presented with work activities relating to specific locations or levels grouped for ease of reference. Each work activity shall have the following information shown in the diagram:
   1. Activity Number.
   2. Concise Description of the Work.
   3. Specification Reference or Trade Code.
   4. Location of Work or Area Code.
   5. Duration in Calendar day.

E. Computer Analysis:
   1. In addition to the network diagrams the Contractor shall submit the following computer analysis output:
      a. Activity Status Report.
      b. Master Working Report: Chronological listing by early start of all activities and milestones.
      c. Milestone Report: Chronological listing by early start of all milestones.
      d. Contractor Reports: Individual report, sorted chronologically by early start, for each Sub-Contractor. These reports will only have the early start and early finish dates for distribution to Sub-Contractors.
      e. Material Procurement Report: Based on the early start Construction Program, for all material items. This report shall include dates for submittal, approval release for ordering/fabrication, shipping and delivery to site.
      f. Shop Drawings and Samples Reports: This schedule shall detail the dates for submission and approval of shop drawings and samples required by the Contract Documents, including those required from Sub-Contractors, and shall make due allowance for reasonable time of processing of shop drawings by the Engineer.

g. Man Power Report: A listing of all activities displaying estimated crew sizes and manpower requirements for each activity.
h. Current Status Report: A listing of actual start and finish dates, activities already started and completed and percentage completion of activities still in progress.
i. Cash Flow Report: Showing projected monthly and cumulative expenditure.

2. The activity status report shall have the following minimum data for each activity.
   a. Activity Number.
   b. Concise description of the work.
   c. Specification reference or trade code.
   d. Location of work or trade code.
   e. Duration in calendar days.
   f. Early start date (calendar).
   g. Early finish date (calendar).
   h. Late start date (calendar).
   i. Late finish date (calendar).
   j. Total float (calendar days).
   k. Estimate crew size.
   l. Percentage completion.
   m. Remaining duration in calendar days.

F. Supporting Data:
1. The Contractor shall also prepare and submit in narrative form the supporting data noted below with the submittal of his Construction Program. Any changes in this information shall be submitted with successive updates and revision.
   a. The proposed number of working days per week.
   b. The holidays, and other non-working days observed during the duration of the Contract (by date).
   c. The planned number of shifts per day.
   d. The number of hours per shift.
   e. The planned usage of major construction plant and equipment on the site, on a monthly basis.
   f. The planned procurement and delivery of local and imported materials.
   g. The average weekly manpower usage for each trade to be employed for the works.
   h. The productivity rates for each major work sequence or for any specific activities required by the Engineer.
   i. Explanation of all changes in logic, durations, manpower, plant and equipment.
   j. Actual start and finish dates of activities already completed, and percentage completion of activities still in progress.

G. Forty Five (45) Day Program: At monthly intervals, the Contractor shall submit a separate program developed from the approved Construction Program covering a period of forty five calendar days and denoting the Contractor’s and Sub-Contractor’s daily work activities and their interrelationship with the work of other Contractors, if any.

H. Construction Program Revisions and Updates

1. Once the initial Construction Program is submitted and approved by the Engineer, the Network Analysis Consultant shall perform monthly updates in collaboration with the Contractor. The update will follow a visit to the job site where in the presence of the Engineer, the Network Analysis Consultant and the Contractor will record the actual starts and percentages complete and, using this data, update the computer analysis. The updated analysis will be accompanied by a narrative report containing the supporting data referred to herein before, which shall indicate the necessary action dates and requirements for material, labour and plant acquisition. The narrative report shall also focus upon the construction progress and shall particularly note conditions that may delay progress of the work. In the event of such delays, the Contractor shall describe actions proposed to overcome the delay and to maintain the planned construction program.
2. Site Progress meetings attended by the Engineer, the Contractor, the Network Analysis Consultant and the principal Sub-Contractors, will be held monthly, immediately following the monthly site visit referred to in the previous paragraph, specifically to review the progress of the work. At this meeting the latest update of the last approved Construction Program will be examined with reference to the records made during the said site visit in order to verify the following:
    a. Actual start and finish dates of activities completed during the period since the previous update or revision.
    b. Remaining durations and percentage of completion for all activities in progress.
    c. Logic, time and cost data for variation order work that will be incorporated into the Construction Program.
    d. Contractor’s measures to rectify delays from the planned dates.
3. The Contractor shall perform the work in accordance with the latest approved Construction Program. If any work is found not to be on program during any regular review of the work, the Contractor shall immediately advise the Engineer in writing of action proposed to bring the work back on program. The Contractor shall thereupon prepare and submit a revised Construction Program indicating such action, together with a list of revisions to program logic. Correction and updating of the program will be done as often as necessary until the project is back on program.
4. Within 5 working days after receipt of a notice from Engineer, the Contractor shall submit a revised Construction Program for any of the following reasons:
    a. When delays in completion of any activity or group of activities indicates a slippage of the Contract completion date or a milestone date by fourteen (14) calendar days or ten percent (10%) of the remaining duration of the Contract period, whichever is less.
    b. When delays in submittals or deliveries or work stoppage are encountered which make re-planning of the work necessary.
    c. When the program does not represent the actual execution and progress of the work being performed in the field.
    d. Where a change in the work sequence is proposed or has been instituted by the Contractor. Any such change should not, in any case, be made without the Engineer’s approval.
    e. Where the issue of a change order or other instruction would significantly affect the program and/or progress of the works.

5. In the event the Contractor requests an extension of time for completion of the works or requests an extension to the specified milestone dates, he shall furnish such justification and supporting data as the Engineer may deem necessary for the evaluation thereof. Submission of proper substantiation based on revised activity logic, durations and costs is obligatory with any such request.
6. Float belongs to the project and must be used in the best interest of completing the project on time. Accordingly, any existing float shall be used to the maximum extent possible to offset unexpected delays which occur in connection with the Contractor’s work, acts of God (Force Majeur), and authorized variations in the scope of the work.

I. Programming Costs:
   1. All costs in establishing, maintaining, revising and updating the construction program and related software shall be borne by the Contractor.

1.6 SUBMITTALS

A. General Requirements: Submittal procedures.

1.7 DISTRIBUTION

A. Following approvals of revisions and/or monthly updates to the Construction Program, distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Engineer, Employer, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

Not Applicable.

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Scope.

B. Definitions.

C. Submittal Procedures.

D. Engineer’s Representative Review of Submittals.

1.2 SCOPE

A. This section generally specifies procedures regarding submittals and the required submittals for the Contract. However, 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. Submittal preparation and procedure.
4. Product data.
5. Construction program.
6. Design by Contractor.
7. Shop drawings and samples.
8. Design data.
9. Certificates.
10. Test and inspection reports.
11. Manufacturer's instructions.
12. Manufacturer's field reports.
13. Miscellaneous submittals.
14. Site layout organization chart.
15. Progress reports.
16. Correspondence.
17. CAD produced drawings.
18. Photographs of construction progress.

C. The list and schedule of all submittals and approvals should be compatible with the project schedule.

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

1.3 DEFINITIONS

A. The work related to submittals of this section, in addition to the definitions of the conditions of Contract and elsewhere in the Contract Documents, 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, colour 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 all necessary calculations, working drawings and shop drawings.
3. Construction Program shall be in the form of Computerized Network Precedence Diagrams incorporating activities for all work to be performed by the Contractor, his Sub-Contractors and other Sub-Contractors to be employed in or about the Site, supported by computer analysis and schedules and 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 (size A0 for drawings and Schedules, and size A4 for others). 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, both fabricated and unfabricated, in complete units and as smaller portions of units, for visual inspection and where stated, for more detailed testing and analysis. 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 warranties, maintenance agreements, workmanship bonds, survey data and reports, 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.

1.4 SUBMITTAL PROCEDURES

A. General:
1. Transmit each submittal with Engineer accepted form.
2. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
3. Identify Project, Contractor, Sub-Contractor and Supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.
4. 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.
5. Schedule submittals to expedite Project, and deliver to Engineer at business address. Coordinate submission of related items.
6. Identify variations from Contract Documents and product or system limitations which may be detrimental to successful performance of completed Work.
7. Allow space on submittals for Contractor and Engineer review stamps.
8. When revised for resubmission, identify changes made since previous submission.
9. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
10. Submittals not requested will not be recognized or processed.

B. Submittal Schedule:
1. All submittals and correspondence shall be submitted to the Engineer.
2. Any design required by the Contractor, where called for, shall be submitted to the Engineer for approval.
3. All shop drawings, material and samples submittal schedules shall be submitted to the Engineer for approval. In addition the Contractor shall submit Material delivery schedule for Engineer’s approval. The Contractor shall adhere to the approved schedules.
4. Schedule submissions to ensure that the Engineer is allowed a reasonable time to review each submission within the scheduled period of time.
5. Certify that each submittal has been checked and approved by Sub-Contractors, installers, manufacturers and suppliers. Note any deviations from drawings or specifications.
6. No submissions shall be processed without signed & approved certification of Contractor. This certification shall be stated on each submission as follows:
Materials submitted for approval has been checked for conformance with drawings and specifications for this project. Any deviations from plans and specifications have been noted on the material or listed in the transmittal letter.
Signed

_____
(Contractor)

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 Contract Time will be granted because of Contractor's failure to coordinate submissions.

D. Submittal Preparation and Procedure:
1. The Contractor shall prepare and submit to the Engineer for approval any design required by the Contractor where called for, shop drawings including method statements, coordination drawings and final construction details, samples of materials, product data including data sheet and manufacturer's data, catalogues and specifications, and all other submittals stated hereinafter and required in each individual specification section.
2. Each submittal shall be accompanied by a "Transmittal" form whose format shall be to the approval of the Engineer and shall indicate the following:
   a. Contract №: Contractor's name and job number.
   b. Specification Section: The specification section number of item specified. (Do not submit items from more than one specification on the same form).
   c. Submitted by: Name of Contractor's employee responsible for Contractor's review.
   d. Contract Works Title: Name of Contract.
   e. Transmittal №: Numbers shall be consecutive for the Works.
   f. Date Submitted: Date on which any design by the Contractor where called for, shop drawings and sample leave Contractor's office.
   g. Contractor: Name of firm preparing (and/or Supplier) original documents (any Design required by the Contractor where called for, Shop Drawings or Samples).
   h. Submission №: 1st, 2nd, 3rd, etc., depending on previous submission for same items (see re-submittal procedure).
   i. Bill or Division: Item and description.
   j. Specification Section Paragraph: Specific paragraph under which item is specified.
   k. Copies and Type: Number of copies submitted and type of material submitted (print, brochure or sample, etc.).
   l. Drawing №, Description and Date: Number of the Drawing. Title on the submission (where possible) and date on the submission. Where a group of related drawings are submitted as one unit, only one entry need to be made with a general description of what is included. (Drawings should then be numbered consecutively and have the same date).
   m. Contractor's Remarks: Clearly note any exceptions or deviations from the Contract Documents and state reasons for them.
3. The Contractor shall plan the submission process in good time to meet the requirements of the program allowing for twenty one (21) days for engineering review and approval and for extra time for resubmission in the

case of rejection. In all case he should plan to get the approval minimum thirty (30) days prior to the scheduled activity early start or the material purchase order.

4. Resubmission: Re-submittal procedures shall follow the same procedures as the initial submittal with the following exceptions:
   a. Transmittal shall contain the same information as the first transmittal except that transmittal numbers shall run consecutively and the submission number shall indicate 2nd, 3rd, etc. submission. The drawing number/description shall be identical to the initial submission and the date shall be the revised date for that submission.
   b. No new material shall be included on the same transmittal for a resubmission.
   c. Once a sample, whether material or other, is submitted and approved then no alternative shall be submitted unless a valid and necessary reason is given to substantiate the submission of this alternative. Such reason shall be acceptable to the Engineer.
5. Engineer's and Engineer's Representative Action on Transmittal Form: Incomplete or erroneous transmittals will be returned with directives indicated.
6. Submittal Procedures by Contractor:
   a. All correspondence and attachments thereto shall be submitted to the Engineer in one original and five copies and one digital/soft copy.
   b. Six prints and one digital/soft copy of each shop drawing with transmittal forms shall be submitted to the Engineer's Representative.
   c. Two samples of each material or prefabricated component with transmittal forms to the Engineer.
   d. Six copies of brochures, one of which must be original, with transmittal forms to the Engineer.

E. Product Data:
1. Within 14 days after Contract Implementation 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.
4. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

F. Construction Program (Specified in "Network Analysis Schedules" Section):

1. Program Submittal Procedures and Requirements:

a. The Contractor shall submit his initial Construction Program for approval, in four copies and one digital (Primavera Format) within 3 weeks of the Contract implementation commencement date, unless otherwise stated in the Conditions of Contract. Such initial Construction Program shall include the following completed documents:

1) Network Precedence Diagram showing the sequence and interdependence of all items of work required under the Contract and milestone dates.

2) All the computer analysis report required under this Contract.

b. After approval of the Contractor’s initial Construction Program, all subsequent revision and monthly update submittals shall comprise the following:

1) Four (4) prints of the Network Diagrams from the last approved Construction Program, suitably marked up in red ink to show all revisions, and signed by the Contractor and all Sub-Contractors.

2) Four (4) copies of the updated Activity Status Report.

3) Four (4) copies of all supporting data.

4) Four (4) copies of the master working report.

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 to create the revision/updated computer analysis. The data date for the first monthly update shall be one month after approval by the Engineer 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 Sub-Contractors including “Nominated” (if any) before being submitted to the Engineer thereby confirming that they have reviewed the said program. If any Sub-Contractor 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 Engineer with the program submittal for his information. No reservation by any Sub-Contractor, nor the fact of informing the Engineer in respect thereof, shall relieve the Contractor of his responsibilities under the Contract in the time prescribed therein.

e. Submit a weekly report detailing the preparation, submittal and approval status of shop drawings, materials and equipment, samples and mock-ups 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.

G. Design by Contractor:

1. Any design required by the Contractor, where called for, together with all necessary calculations, working and shop drawings, shall be submitted to the Engineer within 15 days after Contract implementation 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 Engineer'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 reproducible transparencies, and using metric units of measurement.
4. The Engineer'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 Engineer's review of the design required by Contractor including calculations, working drawings and shop drawings, and shall resubmit until the "APPROVED" status is achieved. 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 Engineer.
6. No acceptance or approval by the Engineer of any design made by the Contractor, nor any notes, comments, stipulations, requests for clarifications, etc., made by the Engineer 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.

H. Shop Drawings and Samples: Shop drawings shall establish actual details of manufactured/fabricated items and of work to be executed; they shall clearly identify materials, dimensions, thicknesses, components, attachments, relation with adjoining work and spaces, and all other pertinent information; they shall clarify & amplify the design drawings and other design requirements and shall, subject to the Engineer's approval, incorporate minor changes in design or construction as may be necessary or otherwise desirable to suit the requirements of the work. Where the Contract Documents require the Contractor to submit samples, the same shall satisfactorily establish that the quality, construction, workmanship, finish, color, pattern and any other characteristics of the material or equipment to be provided, are in conformance with the Contract requirements and to the Engineer's reasonable satisfaction.

1. The Contractor shall prepare, review, coordinate and submit to the Engineer for his approval such shop drawings and samples as required by the Contract Documents or as may be required by Engineer during the course of works.
2. At the time of making his submission, the Contractor shall inform the Engineer in writing of any deviation between shop drawings and/or samples being submitted and the requirements stipulated or reasonably implied by the Contract Documents.
3. By submitting shop drawings and samples, the Contractor thereby represents that he has determined and verified all dimensions, relation to existing work, coordination with the work to be installed later, coordination with

information in previously submitted shop drawings, and has verified their compliance with the requirements of the Contract Documents. The accuracy of all such information is the responsibility of the Contractor and in reviewing shop drawings and samples, the Engineer shall be entitled to rely upon the Contractor's representation that such information is correct and accurate. The Contractor shall be responsible for and shall make any alterations in the work due to discrepancies, errors or omissions provided that such discrepancies, errors or omissions are not due to incorrect information contained in the Contract Documents or due to inaccurate information furnished to the Contractor in writing by the Engineer. The Contractor shall be responsible for the correct locations of his work, irrespective of approval by the Engineer, 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 Sub-Contractor's drawings and/or samples before submitting to the Engineer. 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 Engineer.
6. 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 Engineer's access for review and approval during the preparation process.
7. Shop drawings and samples shall be prepared after site dimensions have, if possible, been taken. Shop drawings shall be prepared on reproducible transparencies, and using metric units of measurement.
8. 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 Engineer.
9. 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 thereto.
10. 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 Engineer may require in writing that all relevant parts of a system or element be submitted before any component item is approved.
11. Approval by the Engineer shall neither relieve the Contractor of any of his responsibilities under the Contract, nor constitute authorization of any change to the Contract Documents.
12. Except for finish, pattern, color and other matters in respect of which the Engineer's decision is required in accordance with the Contract Documents, the Engineer'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 Contract Documents requirements, unless the Contractor has informed the Engineer in writing of specific deviations and the Engineer has given written approval thereto.

13. In event of written rejection by Engineer to any shop drawing, the Contractor shall resubmit within fourteen (14) days of such rejection, the revised shop drawings for Engineer's approval. This procedure shall be repeated until such time the shop drawing is approved by Engineer. The Engineer approval shall not relieve the Contractor from any of his obligations under the Contract.
14. The Contractor shall make any corrections or amendments required by the Engineer's review of shop drawings and samples, and shall resubmit until the "Approved" status is achieved. All such corrections/amendments to be clearly indicated on the resubmitted drawings and samples by the use of revision numbers in circles or triangles, or other method approved by the Engineer.
15. The Contractor shall direct specific attention in writing or resubmitted shop drawings and samples to revisions other than the corrections requested by the Engineer or previous submissions. Unless such written notice has been given, approval of a resubmitted shop drawing or sample shall not constitute approval of any changes not requested on the prior submission.
16. In the event of written rejection by the Engineer to a particular sample of material, the Contractor shall submit within fourteen (14) days of such rejection, samples of three alternative materials for the Engineer's approval and the Engineer shall reject or approve all or any of these materials within fourteen (14) days of their submission. This procedure shall be repeated until such time as a sample of material is approved by the Engineer. Failure on the part of the Contractor to obtain the Engineer's approval, which shall not be withheld unreasonably, to all or any one sample or material shall in no way relieve the Contractor of his liabilities and obligations under the Contract.
17. The Engineer 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 Engineer all at the expense of the Contractor.
18. No acceptance or approval by the Engineer of any shop drawing or sample submission made by the Contractor, nor any notes, comments, stipulations, requests for clarifications, etc., made by the Engineer 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.

I. Design Data:
   1. Submit for Engineer's knowledge as contract administrator or for Employer.
   2. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

J. Certificates:
1. When specified in any specification section under "Submittals", submit certification by manufacturer, installation or application sub-contractor, or Contractor to Engineer, 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 Engineer.
4. Submit certificates in triplicate for review.

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

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

M. Manufacturer's Field Reports:
1. Submit reports for Engineer's benefit.
2. Submit report in duplicate within 14 days of observation to Engineer for information.
3. Submit for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

N. Miscellaneous Submittals:
1. Refer to each individual specification section and the Contract Documents for additional submittal requirements.

O. Site Layout Organization Chart:
1. The Contractor shall prepare and submit to the Engineer’s Representative for his approval, a site layout organization plan, and any modifications thereafter showing the Contractor’s proposed layout of his temporary construction facilities and controls, and his plant and equipment on site.

P. Progress Reports:
1. Monthly Progress Reports: The Contractor shall submit to the Engineer each month a progress report showing the actual progress of work by identifying activities and works commenced and/or completed during the previous month with progress photographs, activities and works to be carried out during the following month, and the estimated time required to complete all activities and works in relation to the programme of works. Such reports shall be to the satisfaction of the Engineer.
2. Daily/Weekly Progress Reports: To be provided for the work required, if any, where expressly stated in its related specification section.

Q. Correspondence: Except where more are required by the contract, all correspondence shall be through the Engineer, and shall be submitted as follows:
   1. One original and two photocopies of transmittals and letters including attachments/enclosures.

R. CAD Produced Drawings:
   1. The Contractor shall prepare his shop drawings, progress record drawings, and final as-built drawings using computer aided design and drafting techniques (CAD).
   2. All computer hardware, software and computer room necessary for the preparation of drawings using CAD shall be provided by the Contractor at no additional cost.
   3. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Employer.

S. Photographs of Construction Progress:
   1. During the progress of the work, submit in triplicate, colored photographs taken one a month by an approved professional photographer consisting of 20 views, all taken where directed by the Engineer. Prints shall be 130 x 180 mm matt finish, unless otherwise stated in the Conditions of Contract.
   2. At the completion of all work final photographs shall be taken as directed by the Engineer.
   3. Identify each print on back. Identify Name of Project, Contract Number, orientation of view, date and time of view, name and address of photographer, and photographer's numbered identification of exposure.
   4. All negatives or soft copies in case of digital camera shall be delivered to the Employer in their proper order, and shall become the Employer’s property. Include typed table of contents of all photographs in chronological sequence.
   5. The Contractor shall submit photographs for all works to be covered before covering such works to the approval of the Engineer.

T. Penalty for Delays in Submittal of any Document or Schedule: The Engineer may, following written notice to the Contractor, deduct from payments to the Contractor an amount of money as a penalty for each delay in Submittal of any Document or Schedule (minimum 200 US $ per calendar day per document or per schedule).

1.5 ENGINEER’S REPRESENTATIVE REVIEW OF SUBMITTALS

A. The Engineer’s Representative will process the submission and indicate the appropriate action on the submission and the transmittal, and will note major deviations from the Engineer’s Contract Documents or reasons for resubmit if there are not notes on the material submitted.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

Not Applicable.

END OF SECTION

SECTION 01 40 00

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Quality control and control of installation.

B. Tolerances.

C. References.

D. Mock-up requirements.

E. Testing and inspection services.

F. Manufacturers' field services.

G. Examination.

H. Preparation.

1.2 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. The Contractor shall submit Quality Assurance Program consisting of the Quality Assurance Manual, Project Quality Assurance Plan. Such program shall be subject to the Engineer’s approval.

B. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

C. Comply with manufacturers' instructions, including each step in sequence. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

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

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on shop drawings or as instructed by manufacturer.

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

1.3 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; locate before securing products in place.

1.4 REFERENCES

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

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

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

D. Obtain copies of standards where required by product specification sections.

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

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

1.5 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this section and identified in the respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals and finishes.

C. Accepted mock-ups shall be comparison standard for the remaining Work.

D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

E. Submit drawings showing location and details of Mockup plus a description report of Mockup.

F. Submit test certificates for tests to be undertaken.

G. Testing operations may include, but not limited to, weather tests, seismic, water, air, wind resistance, permeability and load safety.

H. Submit test reports for Visual and Tests of Mockups: Indicate substantiating engineering data, test results of previous tests by independent laboratory which purport to meet performance criteria and other supportive data.

1.6 TESTING AND INSPECTION SERVICES

A. Scope:
1. This section covers testing services including selection and payment, contractor submittals, agency responsibilities, agency reports, limits on testing authority, Contractor responsibilities and schedule of tests.
2. Employment and payment for services of an independent testing agency or laboratory to perform specified testing shall be borne by the Contractor.
3. Employment of testing agency or laboratory in no way relieves Contractor's obligation to perform Work in accordance with the requirements of the Contract Documents.

B. Performance and Standards:
1. ASTM C802: Practice for Conducting an Inter-laboratory Test Program to Determine the Precision of Test Methods for Construction.
2. ASTM C1021: Practice for Laboratories Engaged in the Testing of Building Sealants.
3. ASTM C1077: Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
4. ASTM C1093: Practice for Accreditation of Testing Agencies for Unit Masonry.
5. ASTM E329: Practice for Use in the Evaluation of Inspection and Testing Agencies as Used in Construction.
6. ASTM E543: Practice for Determining the Qualification of Nondestructive Testing Agencies.
7. ASTM E548: Practice for Preparation of Criteria for Use in the Evaluation of Testing Laboratories and Inspection Bodies.
8. ASTM E699: Practice for Criteria for Evaluation of Agencies Involved in Testing, and Evaluating Building Components in Accordance with Test Methods Promulgated by ASTM Committee E6.
9. ASTM E779: Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.

C. Submittals:
1. Prior to start of Work, submit testing laboratory name, address, and telephone number and names of full time specialist and responsible officer to the Engineer for approval.
2. Submit copy of report of laboratory facilities inspection made, with memorandum of remedies of any deficiencies reported by the inspection.

D. The independent firm will perform tests, inspections and other services specified in individual specification sections and as required by the Engineer.
1. Laboratory: Authorized to operate at Project location.
2. Laboratory Staff: Maintain full time registered Engineer or specialist on staff to review services.

3. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.

E. Testing, inspections and source quality control may occur on or off project site. Perform off-site testing as required by the Engineer or Employer.

F. Reports will be submitted by independent firm to the Engineer and Contractor, in duplicate, indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents.

G. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
1. Notify the Engineer and the independent firm 24 hours prior to expected time for operations requiring services.
2. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's use.

H. Testing and employment of testing agency or laboratory shall not relieve the Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

I. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same independent firm on instructions by the Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

J. Agency Responsibilities:
1. Test samples of mixes submitted by Contractor.
2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
3. Perform specified sampling and testing of Products in accordance with specified standards.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or Products.
6. Perform additional tests required by Engineer.
7. Attend preconstruction meetings and progress meetings.

K. Agency Reports:
1. After each test, promptly submit four copies of report to Engineer and to Contractor.
2. Include the following:
    a. Date issued.
    b. Project title and number.
    c. Name of inspector.
    d. Date and time of sampling or inspection.
    e. Identification of product and specifications section.
    f. Location in Project.
    g. Type of inspection or test.

h. Date of test.
i. Results of tests.
j. Conformance with Contract Documents.

3. When requested by Engineer, provide interpretation of test results.

L. Limits on Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
2. Agency or laboratory may not approve or accept any portion of the Work.
3. Agency or laboratory may not assume duties of Contractor.
4. Agency or laboratory has no authority to stop the Work.

M. Contractor’s Responsibilities:
1. Deliver to agency or laboratory at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturer’s facilities.
3. Provide incidental labor and facilities:
a. To provide access to Work to be tested.
b. To obtain and handle samples at the site or at source of Products to be tested.
c. To facilitate tests.
d. To provide storage and curing of test samples.
4. Notify Engineer and laboratory 36 hours prior to expected time for operations requiring testing services.

N. Schedule of Tests:
1. Individual Specification Section: Tests required and standards for testing.

1.7 MANUFACTURERS' FIELD SERVICES

A. When specified in individual specification sections, 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, test and adjust and balance of equipment as applicable, and to initiate instructions when necessary.

B. Submit qualifications with CV of observer to the Engineer, thirty (30) days in advance of required observations. The Observer shall be subject to the approval of the Engineer.

C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent Work. Beginning any new Work, means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Verify that utility services are available, of correct characteristics and in the correct locations.

3.2 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. 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 01 50 00

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SCOPE

A. Section includes provision, maintenance during Contract implementation and removal at the end of the entire project of the following:
   1. Temporary Utilities: Electricity, lighting for construction purposes, site lighting, heating, cooling, ventilation, telephone service, facsimile service, water service, and sanitary facilities.
   2. Temporary Controls: Barriers, enclosures, fences and gates, security, traffic safety and regulation, water control, dust control, erosion and sediment control, noise control, pest control, pollution control, rodent control, and first aid facilities.
   3. Construction Facilities: Parking, progress cleaning and waste removal, project identification, field offices and sheds, vehicles, vehicular access, plant and small tools, and scaffolding and hoisting.

1.2 PERFORMANCE AND STANDARDS

A. The Contractor shall abide fully by the provisions and requirements of all regulations imposed by relevant authorities having jurisdiction, which include, but not limited to, all requirements, site administration and regulations, safety, health and environmental regulations, and regulation and planning of the project location with its sectors.

B. The Contractor shall take all precautions necessary to protect persons and property on or off site from injury or damage resulting from work under this Contract.

C. Failure to comply with any of the regulations or requirements shall be considered a breach of Contract by the Contractor and may result in termination of the Contract by the Employer. Nevertheless, should the Contractor fail to comply with such:
   1. The Engineer may suspend the Works or part of the Works until the Contractor has taken necessary steps, to the satisfaction of the Engineer, to comply with the regulations or requirements.
   2. The Engineer may suspend any interim payment certificate until such time as the Contractor has rectified the breach or breaches to the satisfaction of the Engineer. No interest shall be paid on the suspended payments.
   3. The Employer may, following written notice to the Contractor, carry out himself or arrange for another contractor to carry out such measures as he considers appropriate on behalf of the Contractor. Any such actions by the Employer shall not affect or diminish the Contractor's obligations or responsibilities under the Contract.
   4. The Engineer may, following written notice to the Contractor, deduct from payments to the Contractor an amount of money as a penalty for each breach of any regulation or requirement. Such notice shall specify the nature of the failure or failures, and the period after the date of the notice within which the Contractor shall remedy each failure.

D. In the event of the Employer or Engineer taking action based on the above, the Contractor shall not be entitled to any additional costs or extension to the Contract Completion Date.

E. All costs incurred by the Employer pursuant to the above, and the deductions from payments imposed on the Contractor by the Engineer shall be deducted from amounts otherwise due to the Contractor.

1.3 RELATED ITEMS

A. General Requirements: Contractor's use of site, administrative requirements for field engineering, and execution requirements for cleaning.

1.4 STANDARDS AND REGULATIONS

A. In addition to what is stated in this specification section, all temporary utilities, temporary controls and construction facilities shall comply with relevant authorities' standards and regulations for "Site Administration and Rules", "Safety, Health and Environmental Regulations", and all other local authorities' standards and regulations.

B. Moreover, the Contractor is responsible to perform all the necessary process, regarding all temporary services, with all relevant authorities, and shall pay all installation and maintenance fees.

1.5 ELECTRICITY

A. Provide, maintain and pay for power service required for the works from time of project mobilization until handing over.

B. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required.

C. Provide main service disconnect and over-current protection at convenient location.

D. Permanent convenience receptacles may not be utilized during construction.

E. Provide adequate distribution equipment, wiring and outlets to provide single phase branch circuits for power and lighting.
   1. Provide 20 ampere duplex outlets, single phase circuits for power tools for each active work area.
   2. Provide 20 ampere, single phase branch circuits for lighting.

1.6 LIGHTING FOR CONSTRUCTION PURPOSES

A. Provide and maintain incandescent lighting for construction operations to achieve acceptable lighting level.

B. Provide and maintain lighting to exterior staging and storage areas after dark for security purposes.

C. Provide and maintain lighting to interior work areas after dark for security purposes.

D. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails and lamps as required.

E. Maintain lighting and provide routine repairs.

F. Permanent lighting shall not be utilized during construction.

1.7 SITE LIGHTING

A. The Contractor shall install temporary site lighting including but not restricted to perimeter fence, name boards, parking areas and for site safety to the satisfaction of the Engineer and the approval of Statutory Authorities.

1.8 HEATING

A. Existing facilities, if any, shall not be used, unless otherwise directed by the Engineer.

B. Provide and pay for heating devices and heat as needed to maintain specified conditions for construction operations.

C. Prior to operation of permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

D. Unless otherwise directed by the Engineer or indicated in "Product" part in each individual specification sections, maintain minimum ambient temperature of 10ºC in areas where construction is in progress.

1.9 COOLING

A. Existing facilities, if any, shall not be used, unless otherwise directed by the Engineer.

B. Provide and pay for cooling devices and cooling as needed to maintain specified conditions for construction operations.

C. Prior to operation of permanent equipment for temporary cooling purposes, verify installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.10 VENTILATION

A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

B. Reduce the emission of gas to the satisfaction of the Engineer.

1.11 TELEPHONE SERVICE

A. Provide, maintain and pay for telephone service to field office and Engineer's field office from time of project mobilization until completion of the works.

1.12 FACSIMILE SERVICE

A. Provide, maintain and pay for facsimile service and dedicated telephone line to field office and Engineer's field office from time of project mobilization until completion of the works.

1.13 WATER SERVICE

A. Provide, maintain and pay for suitable quality water service required for construction operations and all purposes from time of project mobilization until completion of the works.

B. Extend branch piping with outlets located so water is available by hoses with threaded connections.

C. Make available clean and hygiene potable water for the use of personnel on site.

D. Test to BS 3148 when instructed.

1.14 SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide from time of project mobilization until completion of the works.

B. Sanitary facilities include temporary well aerated toilets, wash facilities and drinking-water fixtures. Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities.
   1. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility.
   2. Provide covered waste containers for used material.
   3. Use of the Employer’s toilet facilities will not be permitted.
   4. Install self-contained toilet units. Shield toilets to ensure privacy Use of pit-type privies will not be permitted.
   5. Provide separate facilities for male and female personnel.
   6. Provide proper sanitation by connecting to the main sewage system.

1.15 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas and to protect facilities and adjacent properties from damage from construction operations.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to any existing adjacent property.

C. Protect non-owned vehicular traffic, stored materials, site and structures from damage.

D. Provide protection for plants designated to remain. Replace damaged plants.

1.16 ENCLOSURES

A. Exterior Enclosures:
   1. Provide temporary scaffolding with approved screens to safeguard the public from dust and fallout as per Engineer Requirement.
   2. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
   3. Provide temporary roofing to the satisfaction of the Engineer.

B. Interior Enclosures:
   1. Provide temporary partitions and ceilings as directed and to the satisfaction of the Engineer, to separate work areas from Employer occupied areas, to prevent penetration of dust and moisture into Employer occupied areas, and to prevent damage to finished and completed work.
   2. Construction: Framing and reinforced polyethylene, plywood or gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces:
      a. Insulated to RSI Standards.
      b. STC rating of 35 in accordance with ASTM E90.
      c. Maximum flame spread rating of 25 in accordance with ASTM E84.
   3. Paint surfaces exposed to view from Employer occupied areas.

1.17 FENCES AND GATES

A. Maintain the site from unauthorized entrant by providing all necessary temporary fences and gates around and within the site.

B. Maintain electrical fixtures including wires, boxes, lamps and switches as directed by the Engineer.

C. Maintain fencing, gates and other temporary items as long as required for safe and proper completion of work, promptly repair or replace in the event of loss or damage.

D. Design fences and gates to withstand 160 km/hr wind velocity. All materials shall be of adequate strength, suitable for use intended, non-staining and non-corrosive.

E. Upon completion of the works, remove fences and gates to areas indicated by the Employer and make good the area to the satisfaction of the Engineer.

1.18 SECURITY

A. Security Program:
   1. Protect Work, existing premises and Employer's operations from theft, vandalism and unauthorized entry.
   2. Initiate program at project mobilization.
   3. Maintain program throughout construction period until Employer occupancy or when directed by the Engineer.

B. Entry Control:
   1. Restrict entrance of persons and vehicles into Project site and facilities.
   2. Allow entrance only to authorized persons with proper identification.
   3. Maintain log of workers and visitors, make available to Employer on request.
   4. Control entrance of persons and vehicles related to Employer's operations.

C. Personnel Identification:
   1. Provide identification badge to each person authorized to enter premises.
   2. Badge to Include: Personal photograph, name and assigned number, Contractor name, and Sub-Contractor name (if any).
   3. Maintain list of accredited persons, submit copy to Employer on request.
   4. Require return of badges at expiration of their employment on the Work.

D. Security Service: Employ uniformed guard service to provide watchpersons at site twenty four hours a day, seven days a week.

E. Restrictions: Do not allow cameras on site or photographs taken except by written approval of Employer.

1.19 TRAFFIC SAFETY AND REGULATION

A. General:
   1. The Contractor shall provide, erect and maintain such traffic signs, traffic control signals and such other measures as may be required by the Construction of the Works to the satisfaction of the Engineer.
   2. The Contractor shall not commence any work which affects public roads until all the traffic safety measures necessitated by the work are fully operational.
   3. The Contractor shall keep clean and legible at all times all traffic signs, lamps, barriers and traffic control signals and he shall position, cover or remove them as required by the progress of the Works.

B. Signs, Signals and Devices:
   1. Post Mounted and Wall Mounted Traffic Control and Informational Signs: As approved by authority having jurisdiction.
   2. Traffic Control Signals: As approved by local jurisdictions.
   3. Traffic Cones and Drums, Flares and Lights: As approved by authority having jurisdiction.
   4. Flag Person Equipment: As required by authority having jurisdiction.

C. Traffic Signs and Signals:
   1. Provide signs at approaches to site, on site, at crossroads, detours, parking areas and elsewhere as needed to direct construction and affected public traffic.
   2. Provide, operate and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.
   3. Relocate as Work progresses, to maintain effective traffic control.

D. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

E. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

F. Haul Routes:
1. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
2. Confine construction traffic to designated haul routes.
3. Provide traffic control at critical areas of haul routes to regulate traffic and to minimize interference with public traffic.

G. Mud:
1. The wheels of all vehicles shall be well washed before being allowed to leave the Site; lay-down area or any other area which the Contractor is utilizing for the purposes of this Contract.
2. Any mud, which is deposited outside the site boundary, is to be removed immediately, and the whole area shall be thoroughly cleaned.

H. Removal:
1. Remove equipment and devices at Substantial Completion or when directed by the Engineer.
2. Remove post settings to depth of 600 mm.
3. Repair damage caused by installation.

1.20 WATER CONTROL

A. Grade site to drain. Maintain excavations free of water. Provide, operate and maintain pumping equipment.

B. Protect site from pudding or running water.

1.21 DUST CONTROL

A. Execute Work by methods to minimize raising dust from construction operations.

B. Provide positive means to prevent air-borne dust from dispersing into atmosphere.

1.22 EROSION AND SEDIMENT CONTROL

A. Plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.

B. Minimize surface area of bare soil exposed at one time.

C. Provide temporary measures including berms, dikes and drains, and other devices to prevent water flow.

D. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.

E. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.

1.23 NOISE CONTROL

A. Provide methods, means and facilities to minimize noise produced by construction operations. Provide sound reducers as necessary to the satisfaction of the Engineer.

1.24 PEST CONTROL

A. Provide methods, means and facilities to prevent pests and insects from damaging the Work and entering facility.

1.25 POLLUTION CONTROL

A. Provide methods, means and facilities to prevent contamination of soil, water and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.

B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

1.26 RODENT CONTROL

A. Provide methods, means and facilities to prevent rodents from accessing or invading premises.

1.27 FIRST AID FACILITIES

A. The Contractor shall provide and maintain on site first aid facilities throughout the Contract period to the approval of the Engineer.

1.28 PARKING

A. Construct temporary paved surface covered parking areas to accommodate Employer, Engineer and Supervision Consultant personnel. Do not use these designated areas of parking facilities used by Employer, Engineer and Supervision Consultant personnel.

B. Locate as indicated on Drawings or as approved by the Engineer.

C. When site space is not adequate, provide additional off-site parking.

D. Use of designated existing on-site streets and driveways used for construction traffic is not permitted. Tracked vehicles not allowed on paved areas.

E. Do not allow heavy vehicles or construction equipment in parking areas.

F. Do not allow vehicle parking on existing pavement.

G. Permanent Pavements and Parking Facilities:
   1. Prior to Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.
   2. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.
   3. Use of permanent parking structures is not permitted.

H. Maintenance:
1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, etc.
2. Maintain paved areas used for construction; promptly repair breaks, potholes, low areas, standing water and other deficiencies, to maintain paving and drainage in original or specified condition.

I. Removal and Repair:
1. Remove temporary materials and construction at Substantial Completion.
2. Remove underground work and compacted materials to depth of 600 mm; fill and grade site as specified.
3. Repair existing and permanent facilities damaged by use, to original and specified condition respectively.

1.29 PROGRESS CLEANING AND WASTE REMOVAL

A. Maintain areas free of waste materials, debris and rubbish; periodically collect, remove and dispose them off-site. Maintain site in clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces and other closed or remote spaces, prior to enclosing spaces.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.30 PROJECT IDENTIFICATION

A. Project Identification Sign:
1. Painted sign of construction, design and location as shown on the Drawings or as directed by the Engineer.
2. Unless otherwise indicated on drawings or directed by the Engineer, the content of the Project Identification Sign shall include the following:
   a. Project number and title, logo and name of Employer as indicated on Contract Documents.
   b. Names and titles of authorities.
   c. Names and titles of Engineer and Supervision Consultants.
   d. Name of Prime Contractor and major Sub-Contractors.

B. Project Informational Signs: Of same colors and lettering as Project Identification Sign, or standard products; size lettering for legibility at 30 m distance.
1. Provide sign at each field office, storage shed and directional signs to direct traffic into and within site. Relocate as Work progress requires.
2. Provide local relevant authorities' directional traffic signs to and within site.
3. No other signs are allowed without Employer permission, except those required by law.

C. Design sign and structure to withstand 160 km/hr wind velocity.

D. Sign Painter: Experienced as professional sign painter for minimum five years.

E. Finishes and Painting: Adequate to withstand weathering, fading and chipping for duration of construction.

F. Submit for Engineer’s approval, shop drawings showing content, layout, lettering, color, foundation, structure and all sizes and dimensions.

G. Sign Materials: Unless otherwise indicated on drawings, or directed by the Engineer:
1. Structure and Framing: Wood or metal, structurally adequate.
2. Sign Surfaces: Exterior grade plywood with medium density overlay, minimum 19 mm thick, standard large sizes to minimize joints.
3. Rough Hardware: Galvanized.
4. Paint and Primers: Exterior quality, two coats; sign background of color as selected by the Engineer.
5. Lettering: Exterior quality paint, colors as selected by the Engineer.

H. Installation:
1. Install project identification sign at designated location within 14 days after Contract implementation commencement date.
2. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
3. Install sign surface plumb and level, with butt joints. Anchor securely.
4. Paint exposed surfaces of sign, supports and framing.

I. Maintenance: Maintain signs and supports clean, repair deterioration and damage.

J. Removal: Remove signs, framing, supports and foundations at completion of Project and restore area.

1.31 FIELD OFFICES AND SHEDS

A. Scope:
1. This section specifies the temporary field offices and sheds, services and facilities required in the construction, completion and maintenance of works.
2. Any proposed change in location or relocation of offices must be preceded by submission for Engineer's approval of a drawing, indicating such change.

B. Offices: Weather tight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture, drawing rack and drawing display table.

C. Provide separate private offices with security fencing around the perimeter, similarly equipped and furnished, for use of the Engineer.

D. Offices shall include the main structure, sheltered car park, temporary water tanks and temporary sewage collection and treatment systems.

E. Locate offices and sheds at minimum required distance from structures.

F. Prepare and submit for Engineer's approval an architectural layout plan of site offices.

G. Do not use permanent or existing facilities for field offices or for storage unless otherwise agreed with Employer.

H. Construction: Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations with steps & landings at entrance.
   1. Construction: Structurally sound, secure and weathertight enclosures. Maintain during progress of Work; remove at completion of Work.
   2. Temperature Transmission Resistance of Floors, Walls and Ceilings: Compatible with occupancy and storage requirements.
   3. Exterior Materials: Weather resistant; color as selected by the Engineer.
   4. Interior Materials in Offices: Sheet type materials for walls and ceilings, pre-finished or painted; resilient floors and bases.
   5. Lighting for Offices: 538 lx at desktop height, exterior lighting at each entrance door.
   6. Fire Extinguishers: Appropriate type fire extinguisher at each office and each storage area.
   7. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.

I. Environmental Control:
   1. Heating, Cooling and Ventilating for Offices: Heat pump split unit systems to maintain 20ºC heating and 23ºC cooling.
   2. Storage Spaces: Heating and ventilation as needed to maintain products in accordance with Contract Documents; and lighting for maintenance and inspection of products.

J. Contractor’s Site Office Schedule:
   1. The site area is limited. The Contractor shall make arrangement to provide and maintain throughout the period of construction in a convenient location approved by the Engineer, adequate heated and air conditioned office accommodation for the Contractor’s use and the use of his Sub-Contractors. Such accommodation shall include proper messing and sanitary facilities and shall be provided with suitable fire fighting facilities and adequate means of escape in case of fire, all to the approval of the Engineer.
   2. The Contractor shall not allow any of his employees or those of his Sub-Contractors to maintain any temporary or permanent living quarters within the construction site.

K. Engineer’s and Employer’s Site Offices Accommodation and Equipment Schedule: The Contractor shall erect, equip, furnish, maintain, service and ensure for the entire construction period until at least the issue of the Taking Over Certificate, or such time as the Engineer may direct, the Engineer’s and Employer Site Offices with the following characteristics, tools, instruments, fire means, equipment and furniture, all to the satisfaction of the Engineer:
   1. Site Offices: **One** prefabricated portable or demountable offices or other as may be approved by the Engineer, **size 3m x 9m**, for the sole use of the Engineer’s Representative and his staff, comprising each:
      a. 2 office rooms.
      b. 1 kitchenette.
      c. 1 toilet.
   2. Meeting Room: **One** prefabricated portable or demountable offices or other as may be approved by the Engineer, **size 3m x 9m.**

3. Site Offices and Meeting Room Furniture and Equipment:
   a. Office Rooms: Each office room shall include the following:
      1) 2 desks with lockable drawers and swivel chairs.
      2) 2 lockable steel filing cabinets.
      3) 4 office chairs.
      4) 1 drawing hanger for 10 sets.
      5) 2 shelves.
      6) 2 pin boards.
      7) 2 waste paper baskets.
      8) 1 reference table.
      9) 2 computers (as defined hereinafter).
   b. Kitchenette:
      1) 1 table for 6 people.
      2) 6 polypropylene chairs.
      3) 1 refrigerator 14 cu. ft. capacity.
      4) 1 coffee machine.
      5) 1 water filter and 20 liters water cooler/hot/cold.
      6) 2 electric boiling rings.
      7) 1 microwave.
      8) 1 stainless steel sink and drainer.
      9) 1 heat resistant worktop.
      10) 1 set of storage cupboards.
      11) 1 set of crockery and cutlery for each member of the staff.
      12) 1 large wastebasket with cover.
      13) All necessary consumables throughout the Contract duration.
   c. Toilet:
      1) 1 w.c. suite.
      2) 1 hose bib.
      3) 1 toilet roll holder.
      4) 1 wash hand basin.
      5) 1 mirror with shelf.
      6) 1 soap dispenser.
      7) 1 automatic electric hand dryer or 1 paper towel holder.
      8) 1 wastebasket with cover.
      9) All necessary consumables throughout the Contract duration.
   d. Meeting Room:
      1) 1 conference table for 15 people.
      2) 15 chairs.
      3) 2 pin boards.
      4) 2 shelves.
      5) 2 waste baskets.
      6) 1 reference table.
      7) 1 projector with projection screen.
      8) 1 computer (as defined hereinafter).
4. Site Offices and Meeting Room Services: The Contractor shall provide and maintain throughout the whole Contract duration, the following minimum services:
   a. Heating and air-conditioning.
   b. Electric power supply and lighting installations.
   c. Water supply.
   d. Drainage system.

e. Portable firefighting extinguishers.
f. Cleaning facilities and general attendance with necessary personnel.
g. One HP Ink Jet colored printer with A4 & A3 papers.
h. One HP Laser Jet printer with A4 papers.
i. One digital camera (Canon, minimum 14 mega pixels with 32 GB memory stick & USB cable).
j. One multifunction colored photocopying machines (digital copier, network printer & network color scanner), size A3 & A4, including all consumables and photocopying papers throughout the Contract duration.
k. One plain paper modern fax machine including all consumables throughout the Contract duration.
l. Telephone Service: Two telephone lines (one mobile cellular line and one fixed telephone line) with machine devices, including cost of installation, maintenance and all rental and local call charges.
m. Facsimile Service: One fixed telephone line shall be dedicated to facsimile machine and shall include direct dialing facility.
n. Computer System:
    1) Two computers, each equipped with the latest Processor Intel, minimum core i7, 500 GB hard disk capacity; video local bus; 512 MB VGA; 56x CD drive (Read/Write); 16x DVD drive (Read/Write); internet and e-mail service modem; English-Arabic keyboard; SVGA Flat, non-interlaced, low power, low radiation 19 inch rotating colored LED monitor; necessary ports; optical mouse; and antistatic dust covers.
    2) One latest laptop.
    3) Software: License for latest version of the following:
        a) Windows and Microsoft Office latest edition.
        b) AutoCAD latest edition (1 standalone).
        c) Primavera latest edition (1 standalone).
        d) Adobe Acrobat Reader/Writer Pro latest edition.
    4) Internet Connection: Minimum speed 4 mbps.
    5) Uninterruptible power supply (UPS) for all above equipment with minimum one-hour backup batteries.
    6) Computer table and chair;
    7) Network installation including all necessary cabling, rack, switches and wireless router to connect all computers, printers, copier and UPS.
    8) All consumables with all stationery and offices supplies throughout the Contract duration.
    9) Maintenance for all equipment throughout Contract duration.
o. At the end of the project, all the above equipment shall remain the property of the Contractor.

L. Storage Areas and Sheds: The Contractor shall provide on-site weatherproof sheds and storage facilities for the materials intended for the Works. The Contractor shall maintain and remove the same on completion of the Works.
    1. Size to storage requirements for products of individual specification sections, allowing for access, and orderly provision for maintenance and for inspection of products.

M. Preparation:
1. Fill and grade sites for temporary structures, facilities and controls.
2. Slope for drainage away from site offices.

N. Installation: Install office spaces ready for occupancy 14 days after Contract implementation commencement date.
1. Parking: Six hard surfaced covered parking spaces for use by Engineer, connected to office by hard surfaced walk.
2. Employee Residential Occupancy: Not allowed on Employer's property.

O. Maintenance, Cleaning and Attendance upon Offices Accommodation:
1. Provide daily cleaning and maintenance for offices and storage areas.
2. Provide full time attendance of the Engineer’s site office accommodation including one cleaner, one tea boy and one messenger. All to attend upon the requirements of the staff. The cost of cleaning materials and consumable such as, paper towels, paper tissues, toilet rolls, cookery and cutlery, tea, coffee, sugar, etc. shall be paid for by the Contractor. The services of the tea boy and messenger, the provision of consumables and cleaning materials and the maintenance of the site office shall be extended to cover the construction duration until completion. Consumables shall be supplied and delivered to the site at regular intervals as directed by the Engineer.
3. Maintain approach walks free of mud, dust, water, etc.

1.32 VEHICLES / TRANSPORTATION

A. Not Applicable.

1.33 VEHICULAR ACCESS

A. Construct temporary access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.

B. Construct temporary ditches and culverts to allow unimpeded drainage.

C. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.

D. Locate as indicated on Drawings, or where directed by the Engineer.

E. Provide unimpeded access for emergency vehicles. Maintain 6 m wide driveways with turning space between and around combustible materials.

F. Provide and maintain access to fire hydrants and control valves free of obstructions.

G. Unless otherwise directed by the Engineer, do not use existing on-site roads for construction traffic.

1.34 PLANT AND SMALL TOOLS

A. The Contractor shall provide all constructional plant and small tools necessary for the proper execution of the Works.

1.35 SCAFFOLDING AND HOISTING

A. The Contractor shall provide, erect and maintain proper and adequate scaffolding, staging, stairs, ladders, chutes, materials hoist, special rigging and the like required for the Work and shall comply with all requests, safety instructions, etc., issued by the Engineer relating thereto. The Contractor shall provide all necessary guards, signals, safety devices and the like required for safety of operations including suitable runways from the hoists to each level and roof.

B. The Contractor shall also provide, erect and maintain personnel hoist adequate to transport all personnel of Employer, Engineer/Supervision Consultant and Contractor.

C. Material hoists shall not be used for transporting personnel and only skilled personnel shall be used for the operation and maintenance of hoists. The construction, maintenance and operation of hoists shall conform to the applicable requirements of the applicable Codes in force. Use of permanent lifts equipment (if any) for transporting materials or personnel will not be allowed except with prior written permission of the Engineer.

D. Location and means of operation of hoist shall be subject to the Engineer’s approval and shall in no way hinder the progress of the work and shall not relieve the Contractor from his duties and obligations under the Contract.

E. Scaffolding shall be of tubular steel construction and designed in accordance with the requirements of BS 5973 and BS 5974.

F. Hoists, chute, scaffolding and the like shall be so constructed as to prevent damage, staining or marring of the Permanent Work. No materials, rubbish or debris shall be permitted to drop free, but shall be removed by use of hoists or fully enclosed rubbish chutes.

G. Provide suitable safety railings for stairs, ladders, ramps, etc.

H. On completion of the Work, clear away and remove all scaffolding and hoisting.

1.36 REMOVAL OF UTILITIES, FACILITIES AND CONTROLS

A. At the end of the entire project, remove temporary utilities, materials, equipment, facilities and controls.
   1. Remove offices with foundations, utility services and debris.
   2. Remove underground installations to minimum depth of 600 mm, unless otherwise indicated on Drawings.
   3. Restore areas and make good all disturbed surfaces.
   4. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.
   5. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

Not Applicable.

END OF SECTION

SECTION 01 60 00

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

A. This section specifies the General Requirements for:
   1. Products.
   2. Product delivery requirements.
   3. Product storage and handling requirements.
   4. Product options.
   5. Product substitution procedures.
   6. Protection.
   7. Equipment electrical characteristics and components.

B. The requirements of this section are augmented by specific clauses specifying quality throughout all sections of the Specification.

1.2 PERFORMANCE AND STANDARDS

A. Neither asbestos containing materials (ACM) nor chromate copper arsenate (CCA) treated timber shall be used in the project.

B. All products shall perform as specified and the handling, transportation and storage thereof shall be as specified and such that the ultimate performance of the products shall in no way be impaired.

C. The quality of products and reference to Standards and Codes of Practice is covered in the "Administrative Requirements" Section.

D. Where, in the course of the Project, materials, products, assemblies, equipment or techniques, are required which are not named, definitively described or implied in the Specification, they shall nonetheless conform to all relevant both as regards Materials and Workmanship and quality, suitability and performance which are not less than implicit in this Specification to the satisfaction of the Engineer.

E. The Contractor shall at all time use his best endeavors to produce materials and work of a consistent and high quality and standard, whether or not such standard is identifiable in the Specification.

F. The Contractor shall abide by the Engineer’s interpretation of the Specification and shall comply with his decisions regarding the quality of Materials and Workmanship.

1.3 RELATED ITEMS

A. General Requirements: Administrative regulatory requirements, submittal procedures, and execution requirements for warranties and bonds.

1.4 SUBMITTALS

A. General Requirements: Submittal procedures.

1.5 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Country of Manufacturer’s origin shall be approved by the Engineer.

C. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

D. Furnish interchangeable components from same manufacturer for components being replaced.

1.6 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions.

B. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.7 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Provide off-site storage and protection when site does not permit on-site storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

H. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

1.8 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Any product meeting those standards, equivalent standards, or description.

B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.9 PRODUCT SUBSTITUTION PROCEDURES

A. The Engineer will consider requests for Substitutions only within 30 days after Contract implementation commencement date.

B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Contractor:
   1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
   2. Will provide same warranty for Substitution as for specified product.
   3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Employer.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse Employer and Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:
   1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
   2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
   3. Engineer will notify Contractor in writing of decision to accept or reject request.

1.10 PROTECTION

A. The Contractor shall provide and maintain until practical completion all necessary protection to be installed to the work and equipment to prevent damage or deterioration.

PART 2 PRODUCTS

2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.

B. Cord and Plug: Furnish minimum 2 m cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

PART 3 EXECUTION

Not Applicable.

END OF SECTION

SECTION 01 70 00

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Closeout procedures.

B. Cleaning.

C. Starting of systems.

D. Demonstration and instructions.

E. Testing, adjusting and balancing.

F. Protecting installed construction.

G. Project record documents.

H. Operation and maintenance data.

I. Manual for materials and finishes.

J. Manual for equipment and systems.

K. Instruction of Employer personnel.

L. Spare parts and maintenance products.

M. Product warranties and product bonds.

N. Maintenance service.

O. Protection and making good.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's review.

B. Provide submittals to the Engineer required by authorities having jurisdiction.

C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments and sum remaining due.

D. Employer will occupy all or portions of the completed works as directed.

1.3 CLEANING

A. General:
1. Execute cleaning during progress of the work and at completion of the work.
2. If the Contractor fails to clean up during or at completion of work, the Employer may do so, and the cost thereof shall be charged to the Contractor.
3. Conduct cleaning and disposal operations to comply with codes, ordinances, and anti-pollution laws.
4. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.
5. Use only those cleaning materials and methods recommended by manufacturer of the surface material to be cleaned.

B. Cleaning during Construction:
1. Execute periodic cleaning to keep the work, the site and adjacent properties free from accumulations of waste material, rubbish and windblown debris, resulting from construction operations.
2. Provide on-site containers for the collection of waste materials, debris, etc.
3. Remove waste materials, debris and rubbish from the site periodically and dispose off at legal disposal areas away from the site.

C. Dust Control:
1. Clean interior spaces to the start of finish painting and continue cleaning on and as-needed basis until painting is finished.
2. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.

D. Final Cleaning:
1. Employ skilled workmen or specialized firm for final cleaning.
2. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels and other foreign materials from sight-exposed interior and exterior surfaces.
3. Clean interior and exterior glass, and surfaces exposed to view; remove temporary labels, stains and foreign substances, wash and shine glazing, and polish transparent and glossy surfaces.
4. Wax and polish finish floors.
5. Clean all hardware with cleaning materials appropriate to surface and material being cleaned.
6. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.
7. Ventilating System: Replace filters of operating equipment; clean ducts, blowers and coils if units were operated without filters during construction.
8. Clean debris from roofs, gutters, downspouts, and drainage systems.
9. Clean site; sweep paved areas, rake clean landscaped surfaces.
10. Comply with all special cleaning instructions contained in the specifications.
11. Remove temporary services, construction equipment, tools and construction facilities, mock-ups, temporary structures, surplus materials, debris, waste, and rubbish from site.
12. Put site in neat, orderly condition, ready for use. Leave all spaces clean and free from debris.
13. Prior to final completion, conduct an inspection of sight-exposed interior and exterior surfaces, and all work areas, to verify that the entire work is clean.

1.4 STARTING OF SYSTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify the Engineer seven days prior to start-up of each item, unless otherwise specified in individual specification sections.

C. Verify each piece of equipment/system has been checked for proper lubrication, drive rotation, belt tension, control sequence and for conditions which may cause damage.

D. Verify tests, meter readings and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable manufacturer's representative and Contractors' personnel in accordance with manufacturers' instructions.

G. When specified in individual specification sections, require manufacturer to provide authorized representative to be present at site to inspect, check and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

H. Submit a written report as specified in the "Submittal Procedures" Section of the General Requirements, that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Employer's personnel two weeks prior to date of substantial completion and/or final inspection.

B. Demonstrate Project equipment and instruct in a classroom environment located at site and instructed by qualified applicable personnel or manufacturer's representative who is knowledgeable about the Project.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Employer's personnel in detail to explain all aspects of operation and maintenance.

E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time and at equipment location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

G. Required instruction time for each item of equipment and system is specified in individual sections.

1.6 TESTING, ADJUSTING AND BALANCING

A. Contractor will appoint, employ and pay for services of an independent firm approved by the Engineer, to perform testing, adjusting and balancing.

B. The independent firm will perform services stated in the Specifications

C. Reports will be submitted by the independent firm to the Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.7 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills and soffit of openings.

D. Protect floors, stairs and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects by protecting with durable sheet materials.

E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

F. Prohibit traffic from landscaped areas.

1.8 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data and Samples.
   6. Manufacturer's instruction for assembly, installation and adjusting.

B. Ensure entries are complete and accurate enabling future reference by Employer.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Contract drawings.

G. Submit documents to the Engineer with claim for final Application for Payment.

1.9 OPERATION AND MAINTENANCE DATA

A. Format:
   1. Prepare instructions and data by personnel experienced in maintenance and operation of described projects.
   2. Prepare data in the form of an instructional manual.
   3. Submit data bound in A4 text pages.
   4. Binders: Commercial quality binders with durable plastic covers. When multiple binders are used, correlate data into related consistent groupings.
   5. Cover: Identify each binder with printed title "Operation and Maintenance Instructions", title of project and subject matter of binder when multiple binders are required.
   6. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
   7. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
   8. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
      a. Part 1: Directory, listing names, addresses and telephone numbers of Engineer, Contractor, Subcontractors and major equipment suppliers.
      b. Part 2: Operation and maintenance instructions arranged by system and subdivided by specification section. For each category, identify names, addresses and telephone numbers of Subcontractors and suppliers. Identify the following:
         1) Significant design criteria.
         2) List of equipment.
         3) Parts list for each component.
         4) Operating instructions.
         5) Maintenance instructions for equipment and systems.
         6) Maintenance instructions for special finishes including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
      c. Part 3: Project documents and certificates, including the following:
         1) Shop drawings and product data.
         2) Air and water balance reports.
         3) Certificates.
         4) Photocopies of warranties
         5) Originals of bonds.

B. Contents, Each Volume:
   1. Table of Contents: Provide title of Project; names, addresses and telephone numbers of Engineer and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.
   2. For each Product or System: List names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
   3. Product Data: Mark each sheet to clearly identify specific products and components parts, and data applicable to installation. Delete inapplicable information.
   4. Drawings: Supplement product data to illustrate relations of components parts of equipment and systems, to show control and flow diagrams.
   5. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer’s instructions specified in the "Quality Requirements" Section of the General Requirements.
   6. Warranties: Bind in copy of each.
   7. Bonds: Bind in original of each.

1.10 MANUAL FOR MATERIALS AND FINISHES

A. Submit four copies of preliminary draft or proposed formats and outlines of contents before start of Work. The Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Employer, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 14 days prior to final inspection. Draft copy will be reviewed and returned after final inspection, with the Engineer’s comments. Revise content of document sets as required prior to final submission.

D. Submit four sets of revised final volumes in final form within 10 days after final inspection.

E. Products, Applied Materials and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom manufactured products.

F. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

G. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition and details of installation. Include recommendations for inspections, maintenance and repair.

H. Additional Requirements: As specified in individual product specification sections.

I. Include listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.11 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit four copies of preliminary draft or proposed formats and outlines of contents before start of Work. The Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Employer, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy will be reviewed and returned after final inspection, with the Engineer’s comments. Revise content of document sets as required prior to final submission.

D. Submit four sets of revised final volumes in final form within 10 days after final inspection.

E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

F. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications.

G. Include color coded wiring diagrams as installed.

H. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.

I. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

J. Include servicing and lubrication schedule, and list of lubricants required.

K. Include manufacturer's printed operation and maintenance instructions.

L. Include sequence of operation by controls manufacturer.

M. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

N. Include control diagrams by controls manufacturer as installed.

O. Include Contractor's coordination drawings, with color coded piping diagrams as installed.

P. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

Q. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

R. Include test and balancing reports as specified in the "Quality Requirements" Section of the General Requirements.

S. Additional Requirements: As specified in individual product specification sections.

T. Include listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.12 INSTRUCTION OF EMPLOYER PERSONNEL

A. Before final inspection, instruct Employer’s designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instructions.

1.13 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance and extra products in quantities specified in individual specification sections.

B. Deliver to Project site and place in location as directed by Employer; obtain receipt prior to final payment.

1.14 PRODUCT WARRANTIES AND PRODUCT BONDS

A. Obtain warranties and bonds executed in duplicate by responsible subcontractors, suppliers and manufacturers, within ten days after completion of applicable item of work.

B. Execute and assemble transferable warranty documents and bonds from subcontractors, suppliers, and manufacturers.

C. Verify documents are in proper form, contain full information and are notarized.

D. Co-execute submittals when required.

E. Include Table of Contents and assemble in binder with durable plastic cover.

F. Submit prior to final Application for Payment.

G. Time of Submittals:
1. For equipment or component parts of equipment put into service during construction with Employer's permission, submit documents within ten days after acceptance.
2. Make other submittals within ten days after Date of Substantial Completion, prior to final Application for Payment.
3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.15 MAINTENANCE SERVICE

A. Furnish service and maintenance of components indicated in specification sections.

B. Examine system components at frequency consistent with reliable operation. Clean, adjust and lubricate as required.

C. Include systematic examination, adjustment and lubrication of components. Repair or replace parts whenever required. Use parts produced by manufacturer of original component.

D. Do not assign or transfer maintenance service to agent or Subcontractor without prior written consent of the Employer.

1.16 PROTECTION AND MAKING GOOD

A. The Contractor shall protect all completed Works from damage until the completion and handing over of the Works to the approval of the Engineer.

B. Should any Works be damaged before handing over of the Works, the Contractor shall at his expense make good or replace as required, to the satisfaction of the Engineer.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

Not Applicable.

END OF SECTION

SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Demolishing designated existing structures with foundations, existing items, equipment, etc.
2. Removing existing designated items for reuse.
3. Protecting existing items designated to remain.
4. Removing demolished materials.
5. Demolishing designated masonry walls and concrete slabs on grade, including saw-cutting and breaking out, for the PET-CT unit at Tebnine Hospital.

1.2 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate demolition and removal sequences, location of items designated for reuse, and location and construction of temporary work.

1.3 CLOSEOUT SUBMITTALS

A. General Requirements: Execution requirements for submittals.

B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition and subsurface obstructions.

C. Operation and Maintenance Data: Submit description of system, inspection data and parts lists.

1.4 QUALITY ASSURANCE

A. Conform to applicable code for demolition work, dust control, and products requiring electrical disconnection and re-connection.

B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.

C. Obtain required permits from authorities having jurisdiction.

D. Perform Work as shown on the drawings and to the satisfaction of the Engineer.

E. Maintain one copy of each document on site.

1.5 PRE-INSTALLATION MEETINGS

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

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

1.6 SEQUENCING

A. General Requirements: Requirements for sequencing.

B. Sequence activities shall be as per approved methodology submitted to the Engineer for approval showing all necessary work orders and stages.

C. Owner will conduct salvage operations before demolition begins to remove materials Owner chooses to retain.

1.7 SCHEDULING

A. General Requirements: Requirements for scheduling.

B. Schedule Work to precede and/or to coincide with new construction.

C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact other and/or Owners operation in adjoining spaces.

D. Perform noisy, malodorous and dusty works between hours and on days approved by the Engineer.

E. Coordinate utility and service interruptions with Owner.
1. Minimize disruption to existing systems.

1.8 PROJECT CONDITIONS

A. Conduct demolition to minimize interference with adjacent and occupied areas.

B. Cease operations immediately if structure appears to be in danger and notify the Engineer. Do not resume operations until directed.

PART 2 PRODUCTS

Not Applicable.

PART 3 EXECUTION

3.1 PREPARATION

A. Notify affected utility companies before starting work and comply with their requirements.

B. Mark location and termination of utilities.

C. Erect and maintain temporary barriers and security devices at approved locations, including warning signs and lights, and similar measures, for protection of the public, Owner and existing improvements indicated to remain.

D. Erect and maintain weatherproof closures.

E. Prevent spreading of dust, odors and noise.

F. Provide appropriate temporary signage.

3.2 SALVAGE REQUIREMENTS

A. Coordinate with Owner to identify all items to be removed and delivered to Owner.

B. Tag items Owner designates for salvage.

C. Protect designated salvage items from demolition operations until items are removed.

D. Carefully remove items indicated to be salvaged.

E. Disassemble as required to permit removal.

F. Package small and loose parts to avoid loss.

G. Mark packaged parts to permit identification and consolidation of each salvaged item.

H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.

I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

3.3 DEMOLITION

A. Conduct demolition to minimize interference with adjacent and occupied areas.

B. Maintain protected egress from and access to adjacent areas at all times.

C. Do not close or obstruct roadways and sidewalks without permits.

D. Cease operations immediately when structure appears to be in danger and notify the Engineer.

E. Disconnect and remove designated utilities within demolition areas.

F. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.

G. Demolish in orderly and careful manner. Protect existing improvements, supporting members and the like.

H. Carefully remove items indicated to be reused.
1. Disassemble items as required to permit removal.
2. Package small and loose parts to avoid loss.
3. Mark items and packaged parts to permit reinstallation.
4. Store items, protected from construction operations, until reinstalled.

I. Masonry Walls and Slabs on Grade:

1. Locate and protect buried and embedded services before breaking out slabs; isolate services in coordination with the hospital.
2. Saw-cut the perimeter of slab areas to be removed to a straight line to protect adjoining slabs and finishes.
3. Break out slabs and walls with low-vibration equipment; do not use percussive equipment near sensitive medical equipment without approval of the Engineer.
4. Enclose the demolition area with dust-tight screens and maintain negative pressure where adjoining clinical areas are occupied, in accordance with the infection control requirements of the hospital.
5. Prepare edges of retained slabs to receive new concrete, with dowels as indicated on drawings.

J. Remove demolished materials from site. Do not burn or bury materials on site.

K. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.

L. Remove temporary Work.

3.4 SCHEDULES

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

END OF SECTION

SECTION 03 10 00

CONCRETE FORMING AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Formwork for cast-in place concrete.
2. Shoring, bracing, and anchorage.
3. Architectural form liners.
4. Form accessories.
5. Form stripping.

B. Related Sections:
1. Section 03 20 00 - Concrete Reinforcing.
2. Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318M - Metric Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.

B. American Forest and Paper Association:
1. AF&PA - National Design Specifications for Wood Construction.

C. The Engineered Wood Association:
1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

D. American Society of Mechanical Engineers:
1. ASME A17.1 - Safety Code for Elevators and Escalators.

E. ASTM International:
1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

F. West Coast Lumber Inspection Bureau:
1. WCLIB - Standard Grading Rules for West Coast Lumber.

1.3 DESIGN REQUIREMENTS

A. Design, engineer and construct formwork, shoring and bracing to conform to design and code requirements to achieve concrete shape, line and dimension as indicated on Drawings.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings:
   1. Submit formwork and shoring shop drawings.
   2. Indicate the following:
      a. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
      b. Means of leakage prevention for concrete exposed to view in finished construction.
      c. Sequence and timing of erection and stripping assumed compressive strength at time of stripping, height of lift and height of drop during placement.
      d. Vertical, horizontal and special loads in accordance with ACI 347, Section 2.2 and camber diagrams, when applicable.
      e. Notes to formwork erector showing size and location of conduits and piping embedded in concrete in accordance with ACI 318M , Section 6.3.

C. Product Data: Submit data on void form materials and installation requirements.

D. Design Data: Indicate design data for formwork and shoring. Include structural calculations to support design.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 347, ACI 301 and ACI 318M.

B. For wood products furnished for work of this Section, comply with AF & PA.

C. Perform Work in accordance with the drawings and to the approval of the Engineer,

D. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Design formwork under direct supervision of Professional Engineer experienced in design of this Work and approved by the Engineer.

1.7 MOCK-UP

A. General Requirements: Quality requirements for mockup.

B. Construct formwork for concrete mockups required in Section 03 30 00, including formwork, form liners and form accessories.

C. Locate where directed by the Engineer.

D. Remove mockup when directed by the Engineer.

1.8 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for storage and handling.

B. Deliver void forms and installation instructions in manufacturer's packaging.

C. Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.9 COORDINATION

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

B. Coordinate this Section with other sections of work, requiring attachment of components to formwork.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Plywood: Sound undamaged sheets with clean, true edges.

B. Lumber Forms:
1. Application: Use for edge forms and unexposed finish concrete.
2. Boards: 150 mm or 200 mm in width, tongue and groove, “Standard” Grade Douglas Fir, conforming to WCLIB Standard Grading Rules for West Coast Lumber. Surface boards on four sides.

C. Plywood Forms:
1. Application: Use for exposed fairfaced finish concrete.
2. Forms: Conform to PS 1; full size 1200 x 2400 mm panels; each panel labeled with grade trademark of APA/EWA.
3. Plywood for Surfaces to Receive Waterproofing Membrane: Minimum 18mm thick; APA/EWA “B-B Plyform Structural I Exterior” grade.
4. Plywood where “Smooth Finish” is required, as indicated on Drawings: APA/EWA “HD Overlay Plyform Structural I Exterior” grade, minimum of 18 mm thick.

2.2 PREFABRICATED FORMS

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

B. Preformed Steel Forms: Minimum 1.5 mm matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished concrete surfaces.

D. Pan Type: Steel or Glass fiber of size and profile required.

E. Tubular Column Type: Round; spirally wound laminated fiber, wood or glass fiber material; surface treated with release agent, non-reusable, sizes as indicated on Drawings.

F. Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; thickness as indicated on drawings.

G. Steel Forms: Sheet steel, suitably reinforced, and designed for particular use indicated on Drawings.

H. Form Liners: Smooth, durable, grainless and non-staining hardboard, unless otherwise indicated on Drawings.

I. Framing, Studding and Bracing: Stud or No. 3 structural light framing grade.

2.3 ARCHITECTURAL FORM LINERS

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

B. Architectural Form Liners: Polystyrene, acrylonitrile butadiene styrene (ABS), or polyurethane; reusable; pattern as indicated on Drawings and/or as selected.

2.4 FORMWORK ACCESSORIES

A. Form Ties: Removable or Snap-off type, galvanized metal, adjustable length, cone type, with waterproofing washer, free of defects capable of leaving holes larger than 25 mm in concrete surface.

B. Spreaders: Standard, non-corrosive metal form clamp assembly, of type acting as spreaders and leaving no metal within 25 mm of concrete face. Wire ties, wood spreaders or through bolts are not permitted.

C. Form Anchors and Hangers:
1. Do not use anchors and hangers exposed concrete leaving exposed metal at concrete surface.
2. Symmetrically arrange hangers supporting forms from structural steel members to minimize twisting or rotation of member.
3. Penetration of structural steel members is not permitted.

D. Form Release Agent: Colorless mineral oil that will not stain concrete, or absorb moisture, or impair natural bonding or color characteristics of coating intended for use on concrete.
   1. Manufacturer: Any recognized manufacturer having an official technical agreement to conformity with standards for the product.

E. Corners: Chamfer, rigid plastic or wood strip type; size as directed by the Engineer; maximum possible lengths.

F. Dovetail Anchor Slot: Galvanized steel, 0.8 mm thick, foam filled or non-filled, release tape sealed slots, anchors for securing to concrete formwork.

G. Flashing Reglets: Galvanized steel, 0.8 mm thick, longest possible lengths, with alignment splines for joints, foam filled or non-filled, release tape sealed slots, anchors for securing to concrete formwork.

H. Vapor Retarder: Where indicated on Drawings, 0.25 mm thick polyethylene sheet.

I. Bituminous Joint Filler: ASTM D1751.

J. Nails, Spikes, Lag Bolts, through Bolts, Anchorages: Size, strength and character to maintain formwork in place while placing concrete.

K. Water Stops: Polyvinyl chloride, minimum 12 MPa tensile strength, minimum +10 ºC to +79 ºC working temperature range, width as indicated on drawings but not less than 250 mm wide, maximum possible lengths, ribbed profile, preformed corner sections, heat welded jointing.

2.5 COATINGS

A. Coatings for Aluminum: Polyamide epoxy finish coat with paint manufacturer's recommended primer for aluminum substrate. Apply one coat primer and one coat finish.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify lines, levels, and centers before proceeding with formwork. Verify dimensions agree with Drawings.

C. Verify concrete cover over reinforcement is as shown on drawings.

3.2 INSTALLATION

A. Earth Forms:
   1. Earth forms are not permitted.

B. Formwork - General:
1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Camber forms where necessary to produce level finished soffits unless otherwise shown on Drawings.
4. Carefully verify horizontal and vertical positions of forms. Correct misaligned or misplaced forms before placing concrete.
5. Complete wedging and bracing before placing concrete.

C. Forms for Smooth Finish Concrete:
1. Use steel, plywood or lined board forms.
2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
3. Install form lining with close-fitting square joints between separate sheets without springing into place.
4. Use full size sheets of form lines and plywood wherever possible.
5. Tape joints to prevent protrusions in concrete.
6. Use care in forming and stripping wood forms to protect corners and edges.
7. Level and continue horizontal joints.
8. Keep wood forms wet until stripped.

D. Architectural Form Liners:
1. Erect architectural side of formwork first.
2. Attach form liner to forms before installing form ties.
3. Install form liners square, with joints and pattern aligned.
4. Seal form liner joints to prevent grout leaks.
5. Dress joints and edges to match form liner pattern and texture.

E. Forms for Surfaces to Receive Membrane Waterproofing: Use plywood or steel forms. After erection of forms, tape form joints to prevent protrusions in concrete.

F. Framing, Studding and Bracing:
1. Space studs at 400 mm on center maximum for boards and 300 mm on center maximum for plywood.
2. Size framing, bracing, centering, and supporting members with sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Construct beam soffits of material minimum of 50 mm thick.
4. Distribute bracing loads over base area on which bracing is erected.
5. When placed on ground, protect against undermining, settlement or accidental impact.

G. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with requirements of ACI 301.

H. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

I. Obtain Engineer’s approval before framing openings in structural members not indicated on Drawings.

J. Chamfer strips on external corners of beams, joists, columns and etc.

K. Install void forms in accordance with manufacturer's recommendations.

L. Reuse formwork after approval of the Engineer. Do not patch formwork.

3.3 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces are indicated to receive special finishes or applied coverings that are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

D. Reuse and Coating of Forms: Thoroughly clean forms and reapply form coating before each reuse. For exposed work, do not reuse forms with damaged faces or edges. Apply form coating to forms in accordance with manufacturer’s specifications. Do not coat forms for concrete indicated to receive “scored finish”. Apply form coatings before placing reinforcing steel.

3.4 INSTALLATION - INSERTS, EMBEDDED PARTS AND OPENINGS

A. Install formed openings for items to be embedded or passing through concrete work.

B. Locate and set in place items required to be cast directly into concrete.

C. Coordinate with Work of other sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

D. Position recessed reglets for brick veneer masonry anchors in accordance with spacing and intervals as indicated on Drawings.

E. Install accessories straight, level, and plumb. Ensure items are not disturbed during concrete placement.

F. Install water stops continuous without displacing reinforcement and in accordance with manufacturer’s instructions.

G. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

H. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

I. Form Ties:
1. Use sufficient strength and sufficient quantity to prevent spreading of forms.
2. Place ties at least 25 mm away from finished surface of concrete.
3. Leave inner rods in concrete when forms are stripped.
4. Space form ties equidistant, symmetrical and aligned vertically and horizontally unless otherwise shown on Drawings.

J. Arrangement: Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.

K. Construction Joints:
1. Install surfaced pouring strip where construction joints intersect exposed surfaces to provide straight line at joints.
2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
3. Show no overlapping of construction joints. Construct joints to present same appearance as butted plywood joints.
4. Arrange joints in continuous line straight, true and sharp.

L. Embedded Items:
1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, water stops, and other features.
2. Do not embed wood or uncoated aluminum in concrete.
3. Obtain installation and setting information for embedded items furnished under other Specification sections.
4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Verify conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318M, Section 6.3.

M. Openings for Items Passing through Concrete:
1. Frame openings in concrete where indicated on Drawings. Establish exact locations, sizes, and other conditions required for openings and attachment of work specified under other sections.
2. Coordinate work to avoid cutting and patching of concrete after placement.
3. Perform cutting and repairing of concrete required as result of failure to provide required openings.

N. Screeds:
1. Set screeds and establish levels for tops of concrete slabs and levels for finish on slabs.
2. Slope slabs to drain where required or as shown on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms. Remove freestanding water.

O. Screed Supports:
1. For concrete over waterproof membranes and vapor barrier membranes, use cradle, pad or base type screed supports which will not puncture membrane.

2. Staking through membrane is not permitted.

P. Cleanouts and Access Panels:
1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris and waste material.
2. Clean forms and surfaces against which concrete is to be placed. Remove chips, saw dust and other debris. Thoroughly blow out forms with compressed air just before concrete is placed.

3.5 FORM CLEANING

A. Clean forms as erection proceeds, to remove foreign matter within forms.

B. Clean formed cavities of debris prior to placing concrete.

C. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.

D. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms, unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.6 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and removal has been approved by the Engineer.

B. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.

C. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

D. Leave forms in place for minimum number of days as specified in ACI 347.

3.7 ERECTION TOLERANCES

A. Construct formwork to maintain tolerances required by ACI 301.

B. Tolerances: Construct formwork to produce completed concrete surfaces within construction tolerances specified in ACI 117.

C. Construct and align formwork for elevator hoistway in accordance with ASME A17.1.

D. Camber slabs and beams 2 mm/m and in accordance with ACI 301.

3.8 FIELD QUALITY CONTROL

A. General Requirements: Quality requirements and execution requirements for field inspecting, testing, adjusting and balancing.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Notify the Engineer after placement of reinforcing steel in forms, but prior to placing concrete.

D. Schedule concrete placement to permit formwork inspection before placing concrete.

3.9 SCHEDULES

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

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Reinforcing bars.
2. Welded wire fabric.
3. Reinforcement accessories.

B. Related Sections:
1. Section 03 10 00 - Concrete Forming and Accessories.
2. Section 03 30 00 - Cast-in-Place Concrete.
3. Division 26 - Electrical: Grounding concrete reinforcement.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 315 - Details and Detailing of Concrete Reinforcement.
3. ACI 318M - Metric Building Code Requirements for Structural Concrete.
4. ACI SP-66 - ACI Detailing Manual.

B. ASTM International:
1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A184/A184M - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
3. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
4. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
5. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
6. ASTM A704/A704M - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
7. ASTM A706/A706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
8. ASTM A767/A767M - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.
9. ASTM A775/A775M - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
10. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
11. ASTM A934/A934M - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.

12. ASTM A996/A996M - Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
13. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
14. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Reinforcing Steel Bars.

C. American Welding Society:
1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

D. Concrete Reinforcing Steel Institute:
1. CRSI - Manual of Standard Practice.
2. CRSI - Placing Reinforcing Bars.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and welded wire fabric, bending and cutting schedules, and supporting and spacing devices.

C. Certificates: Submit AWS qualification certificate for welders employed on the Work.

D. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

E. Submit certified copies of mill test report of reinforcement materials analysis.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with CRSI - Manual of Standard Practice, ACI 301, ACI SP-66, and ACI 318M.

B. Maintain one copy of each document on site.

C. Arrange with access to fabrication plant to facilitate Engineer’s inspection of reinforcement. Notify the Engineer of commencement and duration of shop fabrication in sufficient time to allow inspection.

1.5 QUALIFICATIONS

A. Welders: AWS qualified within previous 12 months.

1.6 COORDINATION

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

B. Coordinate with placement of formwork, formed openings and other Work.

PART 2 PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing steel deformed bars shall conform to the requirements of the following:
   1. ASTM A706/A706M, 420 MPa minimum yield strength; deformed low-alloy steel bars, unfinished.
      OR
   2. ASTM A615/A615M, Grade 60, 420 MPa minimum yield grade; deformed steel bars, unfinished.
   3. Deformed reinforcing bars shall conform to one of the ASTM specifications listed above except that for bars with specified yield strength exceeding 420 MPa, the yield strength shall be taken as the stress corresponding to a strain of 0.35 percent.
   4. The values of reinforcement specified yield strength used in design calculations shall not exceed 550 MPa.

B. Reinforcing Steel Plain Bar Stirrups and Rod Mats: ASTM A704/A704M, ASTM A615/A615M, 280 MPa; steel bars or rods, unfinished.

C. Welded Steel Wire Fabric: To ASTM A497 Deformed Type.

D. The weight of steel bar reinforcement for each bar diameter shall be in accordance with BS 4449: 1997: "Specification for Carbon Steel Bars for the Reinforcement".

2.2 ACCESSORY MATERIALS

A. Tie Wire: Minimum 16 gage annealed type.

B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapor retarder puncture.

C. Special Chairs, Bolsters, Bar Supports, Spacers Adjacent to Weather Exposed Concrete Surfaces: Stainless steel type 316; size and shape to meet Project conditions.

D. Reinforcing Splicing Devices: Mechanical set screw, swaged or threaded type; full tension and compression; sized to fit joined reinforcing.

2.3 FABRICATION

A. Fabricate concrete reinforcement in accordance with CRSI Manual of Practice, ACI SP-66, ACI 318M, and/or ASTM A184/A184M.

B. Weld reinforcement in accordance with AWS D1.4.

C. Galvanized or Epoxy-Coated Reinforcement: Clean surfaces, weld and re-protect welded joint in accordance with CRSI.

D. Locate reinforcement splices not indicated on Drawings, at point of minimum stress. Review location of splices with the Engineer.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place, support and secure reinforcement against displacement. Do not deviate from required position.

B. Do not displace or damage vapor retarder.

C. Accommodate placement of formed openings.

D. Maintain concrete cover around reinforcement as indicated on drawings.

E. Splice reinforcing where indicated on Drawings in accordance with splicing device manufacturer's instructions.

F. Bond and ground reinforcement in accordance with requirements of Division 26.

3.2 REINFORCEMENT TESTS

A. The manufacturer's test certificate for ultimate strength, elongation and cold bending together with the chemical analysis of the steel may be called for by the Engineer for any consignment or reinforcing steel direct from the manufacturer. Where steel is obtained from an indirect supplier, the Engineer may require tests in an approved laboratory to prove compliance with the appropriate American Standards.

B. The frequency of testing shall be as set out in the American Standards. The Contractor shall carry out additional tests as instructed by the Engineer.

C. Any reinforcement which does not comply with the Specification shall be immediately removed from site.

3.3 STORAGE OF MATERIALS

A. Reinforcement of all types shall be stored on site in racks above ground in an approved manner so as to avoid damage.

B. All reinforcement shall be free from loose scale, rust, oil, grease or any other material that may impair the bond between the concrete and the reinforcement. Any reinforcement which has become corroded or pitted to an extent which, in the opinion of the Engineer, will affect its properties shall be removed from site.

C. Mild steel reinforcement shall be stored separately from high yield reinforcement.

3.4 CUTTING AND BENDING

A. Reinforcement shall be bent to the dimensions given in the bar schedules in accordance with latest editions of ASTM A 184, ACI 318 CRSI 63 and CRSI 65 unless otherwise stated. The Contractor should check that schedules have been provided for each part of the structure.

B. No reinforcement shall be heated before bending.

C. Cold worked bars and hot rolled high yield bars shall not be straightened or bent again once having been bent. Where it is necessary to bend mild steel reinforcement already cast in the concrete, the internal radius of bend shall not be less than twice the diameter of the bar.

D. After bending, bars shall be securely tied together in bundles or groups and legibly labeled as set out in CRSI 63 and CRSI 65.

3.5 SPLICING AND WELDING

A. Reinforcement shall not be welded except where required by the Contract or agreed by the Engineer. If welding is employed the procedures shall be as set out in AWS D1.4. Details of all welding techniques to be used shall be submitted for approval and such trials made as are required to demonstrate the effect of the welding. No welding or splicing shall be made to the reinforcement except where described on the drawings, or where approved by the Engineer.

3.6 CLEANING OF REINFORCEMENT

A. Reinforcement shall be free of all loose mill scale, rust, oil, grease, concrete or other harmful matter at the time of concreting.

3.7 FIXING OF REINFORCEMENT

A. All reinforcement shall be accurately placed with the correct cover and securely fixed in the positions shown on the drawings and to the satisfaction of the Engineer, who shall be given reasonable notice of the intention to pour and that the reinforcement fixing is complete.

B. At intersections the reinforcement bars shall be bound together with tying wire and the loose ends of the wire shall be turned towards the inside of the member.

C. The Contractor shall supply and fix all chairs required to support the top mat of slab reinforcement or space the mats of all reinforcement adequately. In particular slab chairs must be close enough to prevent the reinforcement being bent or sagging.

D. The actual concrete cover shall be not less than the required nominal cover minus 5mm. No metal part of any device used for connecting bars or for maintaining reinforcement in the correct position shall remain within the specified minimum cover. The Contractor shall provide adequate mortar or plastic spacers to ensure the correct cover is achieved. The use of spacer blocks will not generally be permitted against a concrete face which is to be permanently exposed in the finished works.

3.8 PROJECTING REINFORCEMENT

A. The Contractor shall protect projecting reinforcement without affecting its bond properties and shall ensure that it does not cause rust staining to any part of the works.

3.9 FIELD QUALITY CONTROL

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

3.10 SCHEDULES

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

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place concrete for all concrete structures, frames, members, elements and beds shown on drawings and where described and directed by the Engineer.

B. Related Sections:
1. Section 03 10 00 - Concrete Forming and Accessories.
2. Section 03 20 00 - Concrete Reinforcing.
3. Section 03 35 00 - Concrete Finishing.
4. Section 03 39 00 - Concrete Curing.
5. Section 07 13 00 - Sheet Waterproofing.
6. Section 07 14 00 - Fluid Applied Waterproofing.
7. Section 07 92 00 - Joint Sealants.
8. Division 22 - Plumbing: Mechanical items for casting into concrete.
9. Division 23 - Heating, Ventilation and Air Conditioning: Mechanical items for casting into concrete.
10. Division 26 - Electrical: Electrical items for casting into concrete.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 305 - Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 318M - Metric Building Code Requirements for Structural Concrete.

B. ASTM International:
1. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
4. ASTM C150 - Standard Specification for Portland Cement.
5. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
6. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
7. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
8. ASTM C595M - Standard Specification for Blended Hydraulic Cements (Metric).
9. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

10. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
11. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
12. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
13. ASTM D994 - Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
14. ASTM D1190 - Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type.
15. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
16. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
17. ASTM E1643 - Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
18. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Submit shop drawings showing proposed location of construction joints for Engineer’s approval.

C. Product Data: Submit data on joint devices, attachment accessories, and admixtures.

D. Design Data:
1. Submit concrete mix design for each concrete strength. Submit separate mix designs when admixtures are required for hot and cold weather concrete work and/or for air entrained concrete work.
2. Identify mix ingredients and proportions, including admixtures.

E. Samples: Submit two 250 x 250 mm long samples of expansion and contraction joints, and for control joint.

F. Manufacturer's Installation Instructions: Submit installation procedures and interface required with adjacent Work.

1.4 CLOSEOUT SUBMITTALS

A. General Requirements: Execution requirements for closeout procedures.

B. Project Record Documents: Accurately record actual locations of embedded utilities and components concealed from view in finished construction.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Maintain one copy of each document on site.

C. Acquire cement and aggregate from sources approved by the Engineer for Work.

D. Conform to ACI 305 when concreting during hot weather.

E. Conform to ACI 306.1 when concreting during cold weather.

1.6 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mockup for architectural concrete surfaces receiving special treatment or finish as result of formwork and including all recesses and window openings.

C. Mockup Panels: Two mockup wall panels of the following size:
1. 8000 mm long x 6000 mm high x 400 mm thick.
2. 4000 mm long x 4000 mm high x 400 mm thick.

D. When requested by the Engineer, cast concrete against sample panel. Obtain acceptance of resultant surface finish prior to erecting formwork.

E. Locate where directed by the Engineer.

F. Remove mockup when directed by the Engineer.

1.7 COORDINATION

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

B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

1.8 DELIVERY AND STORAGE OF AGGREGATES

A. Aggregates shall be delivered to site in clean and suitable vehicles. Different types or sizes of aggregates shall not be delivered in one vehicle.

B. Aggregates shall not be stored in contact with the ground and shall be protected against the intrusion of the ground and other foreign matter. There shall be a physical partition between the store heaps of fine and coarse aggregates and between separate heaped sizes of coarse aggregate which may have been segregated for mix control. When concreting is not being carried out, the store heaps shall be covered to prevent contamination by wind blown material.

C. Aggregates, which in the opinion of the Engineer are not clean or which have become mixed due to defective storage, shall be removed from site immediately.

PART 2 PRODUCTS

2.1 CEMENT

A. Cement shall comply with ASTM C150, Type I (ordinary Portland cement), Type II (moderate sulphate resisting cement), and/or Type V (sulphate resisting cement), all as indicated in the "Concrete Mix" stated below.

B. White or colored cement shall comply with ASTM C150.

C. The cement shall be obtained directly from an approved manufacturer or an approved supplier and shall be delivered either in bulk by purpose built vehicles or in sealed bags. All cement shall be free flowing and free of lumps.

D. The total alkali content of the cement expressed as the sodium oxide equivalent shall not exceed 0.6% by weight.

E. The tricalcium aluminates (C3A) content of any cement shall not exceed 8% and for sulphate resisting cement shall not exceed 5%.

F. The sulphuric anhydride (SO3) content shall not exceed 2.3%.

G. The heat of hydration shall not exceed values listed in ASTM C150.

H. The initial setting time shall be not less than 45 minutes and the final setting time shall be not more than 10 hours.

I. Certificates of cement tests by the manufacturer will be called for by the Engineer. If such certificate is not made available, or if the Engineer considers that the manufacturers tests are inadequate, samples for testing shall be taken from different consignments as the Engineer may direct. Such samples shall weigh not less than 7 kg and shall be selected and tested.

J. Storage of Cement:
   1. Storage of bulk cement shall be in weatherproof silos which shall bear a clear indication of the types of cement contained in them. Different types of cement shall not be mixed in the same silo. Storage silos shall be drawn frequently to prevent cement caking.
   2. Cement in bags shall be stored in a suitable weatherproof structure of which the interior shall be dry and well ventilated at all times. The floor shall be raised above the surrounding ground level and shall be so constructed that no moisture rises through it. Each delivery of cement in bags shall be closely stacked but shall not be stacked against an outside wall. Different types of cement in bags shall be clearly distinguished by visible markings and shall be stored in separate stocks. Cement in bags shall be used in the order in which they are delivered. Cement from broken bags shall not be used in the Permanent Works.
   3. The Contractor shall provide sufficient storage capacity on site to ensure that his anticipated programme of work is not interrupted due to lack of cement.

2.2 AGGREGATES

A. Aggregates for concrete shall conform to the requirements for fine and coarse aggregates in ASTM C33.

B. Aggregates shall consist of crushed or naturally occurring materials having hard, durable, strong particles. All aggregates are to be washed with clean water. The use of marine aggregates will not be approved.

C. At least 45 days before concreting operations are due to commence, the Contractor shall submit for approval the names of the pits, quarries or manufacturing plants from which he proposes to obtain aggregates, together with evidence showing that the material complies with the requirements of ACI 221.

D. Fine aggregate shall either consist of natural sand or be obtained by crushing clean hard rock or be a mixture of these. Fine aggregate shall conform to ASTM C33 in order to achieve an acceptable grading it may be necessary to blend materials from more than one source.

E. Fine aggregate shall contain no excessive quantities of dust, soft or flaky particles, shells, congealed lumps, shale or other contaminations likely to adversely affect the strength or durability of the concrete or to attack the reinforcement.

F. Coarse aggregates shall consist of naturally occurring crushed rock and shall not contain harmful materials in sufficient quantity to affect adversely the strength or durability of the concrete or to attack the reinforcement.

G. Coarse aggregates shall be supplied in the nominal sizes specified and shall be graded in accordance with ASTM C33 for single sized aggregates.

H. Aggregates shall comply with the mechanical properties in ASTM C33. In addition, the flakiness index, when determined by the sieve method described in ASTM C136, shall neither exceed 40 for 40 mm aggregates, nor 35 for 20 mm aggregates.

I. In construction specified on drawings as watertight the coarse aggregates shall not have combined indices for flakiness and elongation exceeding 35, nor shall the flakiness index exceed 15.

J. The sulphate content (SO_3) of both fine and coarse aggregates shall not exceed 0.4% by weight. The total sulphate content of all the ingredients in a mix including cement, water and admixtures shall not exceed 4.0% of the weight of cement within the mix.

K. The chloride content (as Na CI) shall not exceed 0.05% by weight. The total chloride content arising from all ingredients in a mix including cement, water and admixtures shall not exceed the following limits expressed as a percentage of the weight of the cement in the mix:
   1. For prestressed concrete, steam cured concrete or concrete containing sulphate resisting cement: 0.05%.
   2. For any other reinforced concrete: 0.25% in 95% of all test results providing no result is more than 0.4%.

L. The coarse aggregate, when tested, shall have water absorption as defined in ASTM C33. If the proposed aggregate has absorption of more than specified, the Contractor shall demonstrate by trial mixes and tests that the strength and durability of the concrete are not adversely affected and the adequate workability can be maintained during the placing and compacting processes.

M. The “10% Fines” values shall be determined in accordance with ASTM C33. Where aggregates are to be used for concrete wearing surfaces, the “10% Fines” value shall be as specified in ASTM C33.

N. After the magnesium sulphate soundness test, the weight loss shall not be more than 15% for the fine aggregate and 18% for the coarse aggregate.

O. No part of the aggregates shall contain any mineral known to have a potential to cause alkali silica, alkali silicate, alkali carbonate or any other damaging chemical reactions between alkalis and aggregates.

P. The grading of all aggregate, when analyzed, shall be as per ASTM C33 for the nominal size of aggregate specified.

Q. The Contractor shall carry out routine testing of aggregates for compliance with the specification during the period in which concrete is being produced for the Permanent Works. The routine tests include but are not limited to grading, silt and clay content, moisture content, check an organic impurities and chloride content. These tests shall be performed on aggregates from each separate source on the basis of one set of tests for each day on which aggregates are delivered to site provided that no set of tests shall represent more than 250 tones of coarse aggregate and provided also that the aggregates are of uniform quality.

2.3 WATER

A. The water to be used in mixing concrete shall be clean and free from all harmful matter in suspension or solution and shall satisfy the recommendations given in ASTM C94. If directed by the Engineer, the Contractor shall carry out tests in accordance with ASTM C94 to establish compliance with the Specification.

2.4 ADMIXTURES

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

B. Suitable admixtures may be used only with the prior written approval of the Engineer. Both the proposed dosage and method of use shall be submitted to the Engineer together with the following data:
   1. The typical dosage and detrimental effects of under-dosage and over-dosage.
   2. The chemical name(s) of the main active ingredient(s) in the admixtures.
   3. Whether or not the admixtures contain chlorides and, if so, the chloride content of the admixture expressed as a percentage of equivalent anhydrous calcium chloride by weight of admixture.
   4. Whether or not the admixture leads to the entrainment of air when used at the manufacturer’s recommended dosage.

C. Unless otherwise agreed on, an admixture shall comply with one of the following standards:
   1. ASTM C618 - Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
   2. ASTM C260 - Air-Entraining Admixtures for Concrete.
   3. ASTM C494 - Chemical Admixtures for Concrete
   4. ASTM C1240 - Amorphous Silica (Cementitious material other than Portland cement) Micro Silica. Limit percentage by weight in concrete to 7%.
   5. ASTM C1017 - Plasticizing

2.5 ACCESSORIES

A. Bonding Agent: Two component modified epoxy resin bonding agent, mineral filled polysulfide polymer epoxy, unless otherwise indicated on drawings.

B. Vapor Retarder: ASTM E1745; 0.25 mm thick clear polyethylene film; type recommended for below grade application. Furnish joint tape recommended by manufacturer.

C. Non-Shrink Grout: ASTM C1107; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 17 MPa in 48 hours and 48 MPa in 28 days.

D. Concrete Reinforcing Fibers: ASTM C1116, high strength industrial-grade fibers specifically engineered for secondary reinforcement of concrete. Tensile strength 900 MPa; toughness 100 MPa; 19 mm long fibers, 34 million per 0.6 kg/cu m fiber count.

2.6 PLASTIC SHEETING

A. The plastic or polythene sheeting material for placing, where shown, immediately below concrete slabs, foundations, etc., and for other uses as defined elsewhere in the specification, shall be a film of 300 microns nominal thickness and a minimum thickness of 250 microns meeting the requirements of ASTM C171. The material shall be chemically inert and unaffected by subsoil acids and alkalis. The sheeting shall be stored out of the direct rays of the sun. All joints in the plastic sheeting shall be made with jointing tape and minimum laps shall be 300 mm.

2.7 WATERPROOFING MEMBRANE

A. Where indicated on the drawings, waterproofing membrane to horizontal and vertical concrete surfaces below ground level (basements, underground tanks, planters, etc.) shall conform to Section 07 13 00 - Sheet Waterproofing.

2.8 WATERPROOFING PAINT

A. Where indicated on the drawings, waterproofing paint to horizontal and vertical concrete surfaces below ground level shall conform to Section 07 14 00 - Fluid Applied Waterproofing.

2.9 WATERSTOPS

A. Waterstops shall conform to the requirements of Section 03 10 00: Concrete Forms and Accessories.

2.10 REJECTED MATERIALS

A. All materials which have been damaged or are contaminated or unidentifiable or do not in all respects comply with the Specification shall be rejected and removed immediately from the site at the Contractor's expense.

2.11 TESTING LABORATORY AND EQUIPMENT

A. The Contractor shall submit for approval the name of the Testing Authority he proposes to employ in accordance with the quality requirements for testing services of the Specifications General Requirements. He shall, in addition maintain at the site the following apparatus which shall be kept in good repair throughout the Contract:
   1. Apparatus for assessing workability in accordance with ACI 304.
   2. Apparatus for making concrete cylinders in accordance with ASTM C470.
   3. A maximum and minimum thermometer to be kept on the Site close to the Works for measuring atmospheric shade temperature.
   4. Two soil thermometers for measuring concrete and ground temperature.
   5. A wet and dry bulb thermometer for measuring relative humidity.

2.12 TESTS

A. All tests and checks carried out on site shall be in the presence of or as directed by the Engineer. The Contractor shall be responsible for carrying out all tests required by the Specification or called for by the Engineer. Unless otherwise specified the costs of all tests required are to be met by the Contractor whether the test results show the material or workmanship to be satisfactory for the work or not.

B. If the Contractor proposes to adopt a designed concrete mix then he shall be responsible for carrying out the preliminary tests in accordance with this section of the Specification and send the results to the Engineer before placing any structural grade concrete made from the materials to be tested. No structural concrete shall be placed in the works until the relevant mix has been approved by the Engineer. The preliminary tests shall be carried out at the start of the contract on samples of the materials the Contractor intends to use on structural concrete grades. The preliminary tests shall be repeated whenever the Contractor proposes to change his source of supply and whenever in the opinion of the Engineer there was sufficient variation from the previously approved sample that new tests are required.

2.13 JOINT DEVICES AND FILLER MATERIALS

A. Joint Filler: ASTM D1751 and/or ASTM D994; Asphalt impregnated fiberboard or felt, 6 mm thick; tongue and groove profile.

B. Construction Joint Devices: Integral galvanized steel; formed to tongue and groove profile, knockout holes spaced at 150 mm, ribbed steel spikes with tongue to fit top screed edge.

C. Expansion and Contraction Joint Devices: ASTM B221M, extruded aluminum; resilient elastomeric, vinyl or neoprene filler strip with Shore A hardness of 35 to permit plus or minus 25 percent joint movement with full recovery; extruded aluminum or vinyl cover plate, of longest manufactured length at each location, mounted as indicated on drawings; color as selected.

D. Dowels: As specified in section 03 20 00; diameter and length as shown on drawings.

E. Waterstops shall conform to the requirements of Section 03 10 00: Concrete Forms and Accessories.

F. Prefabricated Filling Materials: Type "Celotex" or similar approved; thickness as joint width.

G. Fire Retardant Filler: Fireproof seals as per manufacturer’s recommendations and of approved type.

H. Backing Rod: As per manufacturer’s recommendations and of approved type.

I. Sealant and Primer: Type as specified in Section 07 92 00.

J. Staifix Dowels: Stainless steel type 316, conforming to ASTM A276; minimum tensile strength 850 N/mm²; spaced as shown on detailed drawings.

2.14 CONCRETE MIX

A. Mix and deliver concrete in accordance with ACI 301 and ASTM C94 respectively.

B. Select proportions for normal weight concrete in accordance with ACI 301.

C. Select aggregate proportions for light weight concrete in accordance with ASTM C330, ACI 301 or ACI 318M.

D. Prepare and submit Mix Design and Test Results of Mix Trials to the approval of the Engineer for the following different types/classes of concrete:

Structures and Beds	ASTM C150 Cement	Minimum Compressive Strength at 28 days on		Maximum Slump (±20mm) (mm)	Maximum Water to Cement Ratio	Minimum Cement Content (kg/m³)	Notes
		cylinders (MPa)	cubes (MPa)				
Plain concrete.	Type II	14	18	180	0.60	250	Normal weight Mix.
Reinforced concrete.	Type II & Type I (as indicated)	30	38	180	0.42	375	Normal weight Mix.

E. All concrete exposed surfaces shall have a fairfaced finish at no additional cost.

F. Concrete with only fine aggregate (less than or equal to 9 mm) may be used for highly reinforced elements or for elements with small thicknesses.

G. The concrete slump of the different types/classes of concrete shall be measured in accordance with ASTM C143.

H. Admixtures: Include admixture types and quantities indicated in concrete mix designs approved through submittal process.
   1. Use accelerating admixtures in cold weather. Use of admixtures will not relax cold weather placement requirements.
   2. Use calcium chloride only when directed by the Engineer.
   3. Use set retarding admixtures during hot weather.
   4. Add air entraining agent to normal weight concrete mix for work exposed to exterior.
   5. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete as required for workability.
   6. Use water-reducing admixture for concrete required to be watertight and concrete with a water-cement ratio below 0.50.
   7. Limit water-soluble chloride content in hardened concrete to 0.05 percent by weight of cement.

2.15 CYCLOPEAN CONCRETE

A. Cyclopean concrete shall comprise 60% of the specified concrete and 40% "spalls" ranging in size from 100 to 250 mm.

B. Stone and concrete shall be placed in alternate layers and in such a way that no stone shall be in contact with another or with shuttering sides. All faces of the cyclopean concrete shall show sound well compacted concrete.

C. Spalls or boulders shall be free from sharp or angular edges, clean and free from dirt or earth, and soaked in water prior to incorporated into the concrete.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify requirements for concrete cover over reinforcement.

C. Verify anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely and will not interfere with placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding.

B. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.3 QUALITY CONTROL OF CONCRETE PRODUCTION

A. Three ready mix concrete suppliers shall be submitted for the Engineer one of which will be approved. The Contractor shall submit, for each proposed supplier, plant and

mix results of full scale trial mixes. The average strength obtained in 28 days tests from these trials shall exceed the specified cylinder strength by at least the value given in 5.3.2.2 of ACI 318-95. The average strength (f^1 cr) of delivered concrete shall have an average strength (f^1 cr) equal or exceed the average strength (f^1 cr) of the approval design mixes.

B. The Contractor shall submit standard deviations for each supplier and plant, derived from results tested by an independent agency, on a recent construction project of similar size. All records shall be made available to the Engineer upon request.

C. For each type/class of concrete in production at each plant for use in the Permanent Works, sample of concrete shall be taken at the point of discharge from the mixer or the ready mix delivery vehicle as instructed by the Engineer and in the presence of a representative of the Engineer, all in accordance with the sampling procedures described in ASTM C31. Slump test shall be carried out in accordance with the requirements of ASTM C143 whenever the Engineer may require it.

D. Concrete cylinder shall be 150mm diameter. One sample shall be taken for every twenty cubic meters (20 m^3) of each type/class of concrete placed with a minimum of one sample taken every day on which the mix is used. From each sample three cylinders shall be made, one for testing seven days after casting and two for testing 28 days after casting. The average strength of the two cylinders crushed at 28 days shall be referred to as one test result.

E. Field cured samples shall be provided to ASTM C31 and as directed by Engineer.

F. Concrete shall be deemed to comply with the strength specified if both of the following requirements are met:
   1. Every arithmetic average of any three consecutive strength tests equals or exceeds the average strength (f^1 cr) at 28 days, and
   2. No individual strength test (average of two cylinders) falls below the specified average strength (f^1 cr) at 28 days by more than 3.5 N/mm^2.

G. If any strength test of laboratory-cured cylinders falls below specified value (f^1 cr) by more than 3.5 N/mm^2 or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that load-carrying capacity of the structure is not jeopardized.

H. If the likelihood of low-strength concrete is confirmed and calculations indicate that load-carrying capacity is significantly reduced, tests of cores drilled from the area in question in accordance with ASTM C42 shall be carried out. In such cases, three cores shall be taken for each strength test more than 3.5 N/mm^2 below the specified strength value of (f^1 c).

I. If concrete in structure will be dry under service conditions, cores shall be air dried (temperature 15 to 25ºC, relative humidity less than 60 %) for 7 days before test and shall be tested dry. If concrete in structure will be more than superficially wet under service conditions, cores shall be immersed in water for 40 hrs and be tested wet.

J. Concrete in an area represented by core tests shall be considered structurally adequate if the average of three cores is equal to at least 85 percent of (f'c) and if no single

core is less than 75 percent of (f'c). Additional testing of cores extracted from locations represented by erratic core strength results shall be permitted.

K. If the above criteria are not met and if the structural adequacy remains in doubt, the Engineer's decision for the appropriate action shall be followed.

L. All cylinders shall be clearly marked with the date of casting and accurate records shall be supplied to the Engineer, stating the dates of taking and testing of samples, together with the results of tests and the exact position from which the sample was taken.

3.4 MIXING CONCRETE

A. Unless otherwise agreed by the Engineer concrete shall be mixed in an approved type of mechanical weigh-batcher. No hand mixing will be allowed.

B. The weighing and water-dispensing mechanisms shall be maintained in good order.

C. The weights of cement and each size of aggregate as indicated by the mechanisms employed shall be within a tolerance of +/- 2 percent of the respective weights per batch agreed by the Engineer. The weight of the fine and coarse aggregates shall be adjusted to allow for the free water contained in the fine and coarse aggregates which shall be determined by the Contractor by a method approved by the Engineer immediately before mixing begins, and further as the Engineer requires.

D. The materials shall be mixed until they are uniformly distributed and the mass is of uniform consistency and colour, but in no case shall the mixing time be less that two minutes after all the materials have been added to the drum. The drum on all mixers shall revolve at the speeds recommended by the manufacturer.

E. Mixers which have been out of use for more than 30 minutes shall be thoroughly cleaned before any fresh concrete is mixed. Mixing plant shall be thoroughly cleaned before changing from one type of cement to another.

F. Delivery notes with each batch delivered shall record the following:
1. Date and time of arrival
2. Time and place of mixing
3. Registration of truck and depot
4. Time and place of adding water
5. Mix type/class
6. Details of any approved additives

3.5 TRANSPORT AND PLACING OF CONCRETE

A. The method of transporting and placing concrete shall be to the approval of the Engineer. Concrete shall be so transported and placed that contamination, segregation or loss of constituent materials does not occur.

B. All formwork and reinforcement contained in it shall be clean and free from standing water immediately before the placing of the concrete.

C. Concrete shall not be placed in any part of the structure until the Engineer's approval has been given.

D. If concreting is not started within 24 hours of approval being given, approval shall again be obtained from the Engineer. Concreting shall then proceed continuously over the area between construction joints. Fresh concrete shall not be placed against in situ concrete which has been in position for more than 30-minutes unless a construction joint is formed in accordance with this specification. When in situ concrete has been in place for 4 hours no further concrete shall be placed against it for a further 20 hours.

E. Concrete when deposited shall have a temperature of not less than 5°C and not more than 28°C except with the approval of the Engineer.

F. Except in the case of columns or where otherwise agreed by the Engineer, concrete shall be deposited in horizontal layers to a compacted depth not exceeding 300 mm and each layer shall be well consolidated before the subsequent layer is placed.

G. Except in the case of columns or unless otherwise agreed by the Engineer, concrete shall not be dropped into place from a height exceeding 2 meters. When trunking or chutes are used they shall be kept clean and used in such a way as to avoid segregation.

H. Concrete shall not be pumped or discharge through aluminum or alloy conduits. Concreting shall be carried out continuously and no concrete shall be placed on concrete which has sufficiently set as to cause the formation of seams or planes of weakness with the section. Where concrete cannot be placed continuously, construction joints as specified shall be formed, only where shown on the drawings or approved by the Engineer.

I. The time elapsing between mixing and placing a batch of concrete shall be as short as practicable. The time should be no longer than will permit completion of placing and compaction before the onset of initial set and in any case no longer than one hour from the time the water is added to the mix.

3.6 PLACEMENT OF CONCRETE IN LARGE SECTIONS

A. The Contractor shall submit his proposals for the casting of the large concrete sections, where the minimum dimension is greater than 500mm, which shall include, but not limited to, proposed methods for controlling generated heat of hydration with supporting calculations, temperature monitoring and curing. Proposals shall comply with the recommendations of ACI 207.1, ACI 207.2, ACI 207.4, ACI 211.1 and ACI 224.3. All proposals shall be subject to the Engineer's approval.

B. The temperature of the concrete in large sections shall be monitored through the section by the use of thermocouples. The Contractor shall ensure that the temperature of the concrete does not exceed 70°C and that any temperature differential (centre to surface) across the section does not exceed 30°C. Temperature monitoring shall be continued until the temperature in the hottest part of the section is less than 20°C greater than the minimum daily ambient temperature, unless otherwise agreed with the Engineer.

3.7 INTERRUPTIONS TO PLACING

A. If concrete placing is interrupted for any reason and the duration of the interruption cannot be forecast or is likely to be prolonged, the Contractor shall immediately take the necessary action to form a construction joint so as to eliminate as far as possible feather edges and sloping top surfaces and shall thoroughly compact the concrete already placed. All work on the concrete shall be completed while it is still plastic and it shall not thereafter be disturbed until if is hard enough to resist damage. Plant and materials to comply with this requirement shall be readily available at all times during concrete placing.

B. Before concreting is resumed after such an interruption the Contractor shall cut out and remove all damaged or uncompacted concrete, feather edges or any other undesirable features and shall leave a clean sound surface against which the fresh concrete may be placed.

C. If it becomes possible to resume concrete placing without contravening the Specification and the Engineer consents to a resumption, the new concrete shall be thoroughly worked in and compacted against the existing concrete so as to eliminate any cold joints.

3.8 PUMPED CONCRETE

A. If it is the Contractor’s intention to transport concrete by pumping he is to obtain the Engineer’s written approval at the commencement of the Contract. When submitting his proposals to the Engineer the Contractor must furnish the Engineer with full details of the mix design, the area and volume of concrete that he intends to place in an operation and the distance over which the concrete is to be pumped. The foregoing Clause on mix design will apply equally to a concrete that is designed to be "pumped".

3.9 PLACING CONCRETE - GENERAL

A. Place concrete in accordance with ACI 301 and/or ACI 318M.

B. Notify the Engineer minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, and formed expansion and contraction joints are not disturbed during concrete placement.

D. Install vapor retarder under interior slabs on grade in accordance with ASTM E1643. Lap joints minimum 150 mm and seal watertight by adhesive applied between overlapping edges and ends or by taping edges and ends.

E. Repair vapor barrier damaged during placement of concrete reinforcing. Repair with vapor barrier material; lap over damaged areas minimum 150 mm and seal watertight.

F. Separate slabs on grade from vertical surfaces with joint filler as instructed by the manufacturer.

G. Place joint filler in floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

H. Extend joint filler from bottom of slab to within 13 mm of finished slab surface. Conform to Section 07 92 00 for finish joint sealer requirements.

I. Install construction joint devices in coordination with floor slab pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.

J. Install joint device anchors. Maintain correct position to allow joint cover to be flush with floor and wall finish.

K. Install joint covers in longest practical length, when adjacent construction activity is complete.

L. Apply sealants in joint devices in accordance with Section 07 92 00.

M. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

N. Place concrete continuously between predetermined expansion, control, and construction joints.

O. Do not interrupt successive placement; do not permit cold joints to occur.

P. Place floor slabs in pattern as indicated.

Q. Saw cut joints within 12 hours after placing. Use 3/16-inch thick blade, cut into ¼ depth of slab thickness.

R. Screed floors level, maintaining surface flatness of maximum 6 mm in 3 m.

3.10 SEPARATE FLOOR TOPPINGS

A. Prior to placing floor topping where required, roughen substrate concrete surface and remove deleterious material. Broom and vacuum clean.

B. Place required dividers and other items to be cast in.

C. Apply sand and cement slurry coat on base course, immediately prior to placing toppings.

D. Place concrete floor toppings to required lines and levels.

E. Screed toppings level, maintaining surface flatness of maximum 3 mm /3 m.

3.11 COMPACTION OF CONCRETE

A. All concrete shall be compacted to produce a dense homogeneous mass. Unless otherwise agreed by the Engineer, it shall be compacted with the assistance of mechanical vibratory, and sufficient mechanical vibrators in serviceable condition shall be on site so that spare equipment is always available in the event of breakdown.

B. Mechanical vibrators shall be of the immersion type capable of operating at between 7,000 and 10,000 cycles per minute.

C. No vibrator shall be operated by a workman who has had insufficient training in its use.

D. With immersion vibrators the tubular part of the tool shall be inserted vertically into the full depth of the concrete to be vibrated at points 600mm apart and at least 100mm away from any formwork. The vibrators shall be kept constantly moving whilst in action to prevent segregation. Vibration shall not be applied directly or through the formwork or reinforcement to sections or layers of concrete which have taken their initial set or to concrete which has ceased to become plastic under vibration. Vibration shall be stopped after the decrease in volume is no longer apparent or before localized areas of grout or laitance are formed. Should the supply of concrete from the mixer be interrupted the vibrators should be lifted clear from the work.

E. Care shall be taken to ensure that concrete is fully compacted around waterstops without distorting, displacing or damaging the waterstops.

3.12 CONCRETE FINISHING

A. Provide formed concrete surfaces to be left exposed as indicated on drawings and/or as scheduled.

B. Wood float surfaces receiving quarry tile, ceramic tile, and/or terrazzo with full bed setting system.

C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, thin set quarry tile, and/or thin set ceramic tile.

D. Steel trowel surfaces that are indicated to be exposed.

E. Power float surfaces which are indicated to be exposed and all surfaces which are directed by the Engineer:
   1. Consolidate surface with power driven floats as soon as topping can support equipment and operator.
   2. Re-straighten, cut down high spots, and fill low spots.
   3. Repeat float passes and re-straightening until surface is smooth and uniform in texture, and to the satisfaction of the Engineer.

F. Brush or roll concrete surfaces shown on drawings, or directed by the Engineer:
   1. Apply first trowel finish.
   2. Apply a hardener type "carborandum" or similar approved on fresh poured concrete surfaces.
   3. Brush or roll concrete topping by appropriate tools when concrete surface is hard enough and as soon as topping can support equipment and operator.
      a. Brushing ribs to be perpendicular to traffic, unless otherwise stated.
      b. Rolling stamped pattern to be as shown on drawings or as directed by the Engineer.

G. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.

3.13 PROTECTION OF FRESH CONCRETE

A. Freshly placed concrete shall be protected from rainfall and from water running over the surface until it is sufficiently hard to resist damage from this cause.

B. No traffic shall be allowed on any concrete surface until such time as it is hard enough to resist damage by such traffic.

C. Concrete placed in the Permanent Works shall not be subjected to any structural loading until it has attained at least its minimum average strength defined previously.

3.14 CURING AND PROTECTION

A. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

C. Cure concrete floor surfaces to requirements of Section 03 39 00.

D. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for 7 days.

E. Spraying: Spray water over floor slab areas and maintain wet for 7 days minimum.

3.15 CONCRETING IN HOT WEATHER

A. On exposed concrete surface in high sun temperatures and/or strong drying wind conditions the Contractor shall use a curing method which also shields the concrete and this shall be placed in position no later than half an hour after final tamping. If the surface exhibits cracking while the concrete is still plastic then it shall be retamped to close the cracks.

B. The Contractor shall plan the concreting days in such a manner as to ensure that each bay or panel is completed at a proper construction joint before the temperature rises above the permissible limit.

C. The temperature of fresh mixed concrete at the point of placement shall not exceed 28°C and the Contractor should take all necessary precautions to ensure that the limit is not exceeded. Concrete with a temperature less than 28°C can be produced by combinations of the following methods:

1. Use of sliced, flaked or crushed ice to reduce temperature of mixing water. All ice shall be melted before adding to concrete.
2. Night casting (subject to the prior approval of the Engineer)
3. Shading of aggregates
4. Moistening of aggregates with potable water
5. Cooling of formwork and reinforcement
6. Using cement with a temperature of less than 77°C
7. Use of white or light reflective paint on mixer drums and water storage tanks.
8. Shading of the mixing area.

3.16 PROTECTION TO SUBSTRUCTURE

A. Waterproofing membrane shall be provided to the underside of slabs and vertical faces of concrete walls in basements and underground storage tanks and where indicated on the drawings. Waterproofing membrane shall be installed in accordance with the requirements of Section 07 13 00.

B. Bituminous coating shall be applied with approved primer to concrete surfaces in contact with soil excluding surfaces receiving waterproofing membrane. Bituminous coating shall be applied in accordance with the requirements of Section 07 14 00.

C. Waterstops shall be installed in accordance with Section 03 10 00.

D. Except where indicated otherwise on the drawings or agreed by the Engineer, all buried concrete surfaces, exposed after the removal of formwork, shall be protected using a bituminous paint-on material. It shall consist of bitumen priming coat and a finishing coast of fiber reinforced bitumen. This membrane shall be applied before and in addition to the polythene sheet.

3.17 LIQUID CONTAINING CONSTRUCTION

A. All liquid containing construction shall be tested to ensure no leakage or damp penetration. The testing shall be carried out before waterproofing backing or other finishes are applied to the construction and before back-filling any excavation.

B. The Contractor shall seal completely all drains and fill the construction with clean water to a predetermined level. One filled the level is to be recorded at daily intervals for a period of fourteen days or as otherwise directed by the Engineer. Measures shall be taken by the Contractor to ensure that the level of water is not affected by rainfall or undue evaporation.

C. Should it be apparent from the test results, external inspection or any other source that leakage or damp penetration has occurred, then, remedial work to make the construction completely watertight shall be carried out at the Contractor's expense and to the approval of the Engineer. Construction shall be retested until results are satisfactory.

3.18 PATCHING

A. Allow the Engineer to inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify the Engineer upon discovery.

C. Patch imperfections in accordance with ACI 301.

3.19 DEFECTIVE WORK

A. Any remedial treatment to surfaces shall be agreed with the Engineer following inspection immediately after removing the formwork, and shall be carried out without delay.

B. Any concrete, the surface of which has been treated before being inspected by the Engineer, shall be liable for rejection.

C. Any concrete which in the opinion of the Engineer is damaged or is in any way defective due to lack of compliance with any of the foregoing Clauses, or is not true to an acceptable line or level compatible with the requirements of second fixings and finishes, then this work will be deemed unacceptable and rejected.

D. Where rejected work has to be cut out or re-built, the operation shall be carried out by the Contractor at his own expense and without delay.

E. The extent of work to be removed and the methods to be used in the removal and replacement of work shall be proposed by the Contractor for the Engineer's approval.

F. The Engineer's approval must be obtained before any cutting of concrete is carried out. If such cutting of concrete is carried out without the Engineers approval the affected areas shall be classified as defective. The Contractor is responsible for ensuring that a copy of this clause is given to each of his subcontractors, nominated or otherwise, and that they abide by it.

G. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of the Engineer for each individual area.

3.20 FIELD QUALITY CONTROL

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

B. Field inspection and testing will be performed in accordance with ACI 301 and under the provisions of the quality requirements of the Specifications General Requirements.

C. Provide free access to Work and cooperate with appointed firm.

D. Submit proposed mix design of each type/class of concrete to inspection and testing firm for review prior to commencement of Work.

E. Tests of cement and aggregates may be performed to ensure conformance with specified requirements.

F. One additional concrete test cylinder will be taken during cold weather concreting, cured on job site under same conditions as concrete it represents.

G. One slump test will be taken for each set of concrete test cylinders taken.

H. One air content test will be made for each set of concrete test cylinders taken.

I. Maintain records of concrete placement. Record date, location, quantity, air temperature and test samples taken.

3.21 SCHEDULES

A. Concrete Types and Finishes, and Joint Fillers: As indicated on drawings and where directed by the Engineer.

END OF SECTION

SECTION 03 35 00

CONCRETE FINISHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Finishing concrete floors and floor toppings.
   2. Floor surface treatment.

B. Related Sections:
   1. Section 03 30 00 - Cast-in-Place Concrete.
   2. Section 03 39 00 - Concrete Curing.
   3. Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.

B. ASTM International:
   1. ASTM E1155 - Standard Test Method for Determining Floor Flatness and of Levelness Using the F-number System.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data on concrete hardener, sealer, curing compounds and slip resistant treatment, compatibilities, and limitations.

1.4 CLOSEOUT SUBMITTALS

A. General Requirements: Execution requirements for closeout procedures.

B. Operation and Maintenance Data: Submit data on maintenance renewal of applied coatings.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 302.1.

B. Perform Work in accordance with the drawings and to the satisfaction of the Engineer.

C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum ten years documented experience.

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

1.7 MOCK-UP

A. General Requirements: Quality requirements for mockup.

B. Construct mock-up area under conditions similar to those which will exist during actual placing, 3000 mm long by 3000 mm wide, with specified finishes, and coatings applied.

C. Locate where directed by the Engineer.

D. Remove mockup when directed by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Deliver materials in manufacturer's packaging including application instructions.

1.9 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements for environmental conditions affecting products on site.

B. Temporary Lighting: Minimum 200 W light source, placed 2500 mm above floor surface, for each 40 m^2 of floor being finished.

C. Temporary Heat: Ambient temperature of 10 degrees C minimum.

D. Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.10 COORDINATION

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

B. Coordinate the Work with concrete floor placement and concrete floor curing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

2.2 COMPOUNDS - HARDENERS AND SEALERS

A. Chemical Hardener: Magnesium fluorosilicate and zinc fluorosilicate blend, dry powder or liquid type.

B. Metallic Hardener: Premixed, dry powder, colored, static disseminating, light reflective, oxidizable metallic, and/or spark resistant hardener.

C. Non-Metallic Hardener: Premixed or dry powder, colored or clear, emery aggregate or quartz aggregate, abrasion resistant hardener.

D. Colored Sealer: type as per manufacturer’s recommendations.

E. Exposed Aggregate Retarder for Flat Surfaces: color as selected from manufacturer's standard range, type as per manufacturer’s recommendations.

2.3 SLIP RESISTANT TREATMENT

A. Slip Resistant Finish: Aluminum oxide or Silica sand type, color as selected from manufacturer's standard range.

B. Abrasive Aggregate: 95 percent minimum fused homogeneous aluminum oxide, Crushed emery, minimum 45 percent aluminum oxide, ferric oxide, minimum 25 percent, and/or Silicone carbide.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify floor surfaces are acceptable to receive the Work of this section.

3.2 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.1.

B. Wood float surfaces receiving quarry tile, ceramic tile and cementitious terrazzo with full bed setting system.

C. Steel trowel surfaces receiving carpeting, resilient flooring, seamless flooring, and thin set terrazzo, quarry tile and ceramic tile.

D. Power float surfaces which are indicated to be exposed and all surfaces which are directed by the Engineer:
   1. Consolidate surface with power driven floats as soon as topping can support equipment and operator.
   2. Re-straighten, cut down high spots, and fill low spots.
   3. Repeat float passes and re-straightening until surface is smooth and uniform in texture, and to the satisfaction of the Engineer.

E. Brush or roll concrete surfaces shown on drawings, or directed by the Engineer:
   1. Apply first trowel finish.
   2. Apply a hardener type "carborandum" or similar approved on fresh poured concrete surfaces.
   3. Brush or roll concrete topping by appropriate tools when concrete surface is hard enough and as soon as topping can support equipment and operator.
      a. Brushing ribs to be perpendicular to traffic, unless otherwise stated.
      b. Rolling stamped pattern to be as shown on drawings or as directed by the Engineer.

F. In areas with floor drains, maintain design floor elevation at walls; slope surfaces uniformly to drains as indicated on Drawings.

3.3 FLOOR SURFACE TREATMENT

A. Apply dry shake or liquid hardener on floor surfaces where indicated on drawings.

B. Apply slip resistant finish on floor surfaces where indicated on drawings.

C. Apply sealer on floor surfaces where indicated on drawings.

D. Apply retarder to exposed aggregate or troweled finish on floor surfaces where indicated on drawings.

3.4 TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation of Surface Flatness for Exposed Concrete Floors: 3 mm in 3 m.

C. Maximum Variation of Surface Flatness under Seamless Resilient Flooring: 3 mm in 3 m.

D. Maximum Variation of Surface Flatness under Carpeting: 3 mm in 3 m.

3.5 DEFECTIVE WORK

A. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work.

B. Areas requiring corrective Work shall be identified.

3.6 SCHEDULES

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

END OF SECTION

SECTION 03 39 00

CONCRETE CURING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes initial and final curing of horizontal and vertical concrete surfaces.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete.
2. Section 03 35 00 - Concrete Finishing.

1.2 REFERENCES

A. American Concrete Institute:
1. ACI 301 - Specifications for Structural Concrete.
2. ACI 302.1 - Guide for Concrete Floor and Slab Construction.
3. ACI 308 - Standard Practice for Curing Concrete.

B. ASTM International:
1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data on curing compounds, mats, paper, film, compatibilities, and limitations.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301 and ACI 302.1.

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

C. Maintain one copy of each document on site.

1.5 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Deliver curing materials in manufacturer's packages with application instructions.

PART 2 PRODUCTS

2.1 MATERIALS

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

B. Membrane Curing Compound: ASTM C309.

C. Non-Membrane Forming Curing Compound: Liquid, penetrating siliconate based type; combination curing, hardening and dustproofing compound.

D. Absorptive Mats: ASTM C171.

E. Waterproof Paper: ASTM C171, treated to prevent separation during handling and placing, standard or white color.

F. Polyethylene Film: ASTM C171 and/or ASTM D2103, 0.15 mm thick, color as selected.

G. Water: Potable, not detrimental to concrete.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify substrate surfaces are ready to be cured.

3.2 INSTALLATION - HORIZONTAL SURFACES

A. Cure floor surfaces in accordance with ACI 308.

B. Ponding: Maintain 100 percent coverage of water over floor slab areas, continuously for 7 days.

C. Spraying: Spray water over floor slab areas and maintain wet for 7 days minimum.

D. Absorptive Mat:
   1. Spread jute fabric over floor slab areas. Spray with water until mats are saturated, and maintain in saturated condition for 7 days minimum.
   2. Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place for 7 days minimum.

E. Membrane Curing Compound: Apply curing compound in two coats with second coat applied at right angles to first.

F. Non-Membrane Forming Curing Compound: Apply curing compound in one coat. Maintain surface wet with curing compound, without ponding for time recommended by manufacturer.

G. Polyethylene Film: Spread over floor slab areas, lap edges and sides, seal with pressure sensitive tape and cover with plywood, unless otherwise directed; maintain in place for 7 days.

3.3 INSTALLATION - VERTICAL SURFACES

A. Cure surfaces in accordance with ACI 308.

B. Spraying: Spray water over surfaces and maintain wet for 7 days.

C. Membrane Curing Compound: Apply compound in two coats with second coat applied at right angles to first.

D. Non-Membrane Forming Curing Compound: Apply curing compound in one coat. Maintain surface wet with curing compound, without ponding for time recommended by manufacturer.

3.4 PROTECTION OF FINISHED WORK

A. General Requirements: Execution requirement for protecting finished Work.

B. Do not permit traffic over unprotected floor surface.

3.5 SCHEDULES

A. Unless otherwise indicated on drawings and/or directed by the Engineer:
   1. Storage Area Slabs: Absorptive mats, burlap-polyethylene type.
   2. Retaining Walls: Membrane curing compound, acrylic type, clear color.
   3. Concrete Pavement: Membrane curing compound, opaque color.
   4. Other Floor Areas: Membrane curing compound, acrylic type, translucent color.

END OF SECTION

SECTION 04 05 10

MASONRY MORTARING AND GROUTING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes mortar and grout for masonry.

B. Related Sections:
1. Section 04 20 00 - Unit Masonry.

1.2 REFERENCES

A. ASTM International:
1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
2. ASTM C91 - Standard Specification for Masonry Cement.
3. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
4. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic Cement Concrete.
5. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
6. ASTM C150 - Standard Specification for Portland Cement.
7. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
8. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
9. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
10. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
11. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
12. ASTM C476 - Standard Specification for Grout for Masonry.
13. ASTM C595M - Standard Specification for Blended Hydraulic Cements (Metric).
14. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
15. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
16. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
17. ASTM C1314 - Standard Test Method for Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry.
18. ASTM C1329 - Standard Specification for Mortar Cement.
19. ASTM C1357 - Standard Test Method for Evaluating Masonry Bond Strength.

B. The Masonry Society:
1. TMS MSJC - Building Code for Masonry Structures (ACI 530/ASCE 5/TMS 402), Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602) and Commentaries.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Samples: Submit two samples of mortar, illustrating mortar color and color range.

C. Design Data: Submit design mix when Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.

D. Test Reports:
1. Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 mortar to requirements of ASTM C1142 component mortar materials to requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content, air content, consistency and compressive strength.
2. Submit reports on grout indicating conformance of grout to property requirements of ASTM C476, component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.

E. Manufacturer's Installation Instructions: Submit premix mortar manufacturer's installation instructions.

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

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TMS MSJC Code and TMS MSJC Specification.

B. Maintain one copy of each document on site.

1.5 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Hot and Cold Weather Requirements: TMS MSJC Specification.

PART 2 PRODUCTS

2.1 MORTAR AND MASONRY GROUT

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

2.2 COMPONENTS

A. Portland Cement: ASTM C150, Type I, gray color.

B. Mortar Aggregate: ASTM C144, standard masonry type.

C. Grout Aggregate: ASTM C404, fine and/or coarse.

D. Water: Clean and potable.

E. Calcium chloride is not permitted.

2.3 MIXES

A. Mortar Mixes:
1. Mortar for Structural Masonry: ASTM C270, Type M, S, or N, using Proportion specification.
2. Mortar for Non-Structural Masonry: ASTM C270, Type M, S, N, or O, using Proportion specification.
3. Pointing Mortar: ASTM C270, Type N or O, using Proportion specification.
4. Stain Resistant Pointing Mortar: One part Portland cement, 1/8 part hydrated lime, and two parts graded (80 mesh) aggregate, proportioned by volume. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 percent of Portland cement by weight.
5. Mortar for Glass Unit Masonry: ASTM C270, Type S or N, using Proportion specification.
6. Pointing Mortar for Glass Unit Masonry: ASTM C270, Type O, using Proportion specification; with maximum 2 percent ammonium stearate or calcium stearate per cement weight with beach or silica sand aggregate.

B. Mortar Mixing:
1. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
2. Achieve uniformly damp sand immediately before mixing process.
3. Add admixtures in accordance with manufacturer’s instructions to achieve uniformity of mix and coloration.
4. Re-temper only within two hours of mixing.

C. Grout Mixes:
1. Grout for Non-Structural Masonry: 14 MPa strength at 28 days; 200 to 280 mm slump; mixed in accordance with ASTM C476 fine or coarse grout.
2. Grout for Structural Masonry: 14 MPa strength at 28 days; 200 to 280 mm slump; mixed in accordance with ASTM C476 fine or coarse grout.
3. Application:
   a. Coarse Grout: For grouting spaces with minimum 100 mm dimension in every direction.
   b. Fine Grout: For grouting other spaces.

D. Grout Mixing:
1. Thoroughly mix grout ingredients in quantities needed for immediate use in accordance with ASTM C476.
2. Add admixtures as per manufacturer’s instructions and mix uniformly.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Request inspection of spaces to be grouted.

3.2 PREPARATION

A. Apply bonding agent to existing concrete surfaces in accordance with manufacturer's instructions.

3.3 INSTALLATION

A. Install mortar and grout in accordance with TMS MSJC Specification.

3.4 FIELD QUALITY CONTROL

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

B. Testing of Mortar Mix: In accordance with ASTM C780 for aggregate ratio and water content, air content, consistency and compressive strength.

C. Testing of Grout Mix: In accordance with ASTM C1019 for compressive strength, and in accordance with ASTM C143/C143M for slump.

D. Test flexural bond strength of mortar and masonry units to ASTM C1357; test in conjunction with masonry unit sections specified.

E. Test compressive strength of mortar and masonry to ASTM C1314; test in accordance with masonry unit sections specified.

3.5 SCHEDULES

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

END OF SECTION

SECTION 04 20 00

UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete masonry units.

B. Related Sections:
1. Section 03 20 00 - Concrete Reinforcing.
2. Section 03 30 00 - Cast-in-Place Concrete.
3. Section 04 05 10 - Masonry Mortaring and Grouting.
4. Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

A. ASTM International:
1. ASTM A153/A153M - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
2. ASTM A580/A580M - Standard Specification for Stainless Steel Wire.
3. ASTM A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
6. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
7. ASTM A951 - Standard Specification for Masonry Joint Reinforcement.
8. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
9. ASTM C34 - Standard Specification for Structural Clay Load-Bearing Wall Tile.
10. ASTM C55 - Standard Specification for Concrete Brick.
11. ASTM C56 - Standard Specification for Structural Clay Non-Load-Bearing Tile.
12. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
13. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
14. ASTM C73 - Standard Specification for Calcium Silicate Face Brick (Sand-Lime Brick).
15. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
16. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
17. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.

18. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units.
19. ASTM C150 - Standard Specification for Portland Cement.
20. ASTM C212 - Standard Specification for Structural Clay Facing Tile.
21. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
22. ASTM C315 - Standard Specification for Clay Flue Linings.
23. ASTM C530 - Standard Specification for Structural Clay Non-Loadbearing Screen Tile.
24. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale).
25. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
26. ASTM C1261 - Standard Specification for Firebox Brick for Residential Fireplaces.
27. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.

B. The Masonry Society:
1. TMS MSJC - Building Code for Masonry Structures (ACI 530/ASCE 5/TMS 402), Specification for Masonry Structures (ACI 530.1/ASCE 6/TMS 602) and Commentaries.

1.3 PERFORMANCE REQUIREMENTS FOR BLOCKWORKS

A. Construction Details:
1. Walls shall be built from structural floor to underside of the structural soffit.
2. The cavity between the two wall leaves shall not be bridged, except by means of butterfly wall ties.
3. The separating wall shall have no chases or sockets cut into it.
4. Vertical and horizontal joints within blocks and between blockwork and other constructions shall be filled with mortar to full the depth of the blockwork. There shall be no cavities or holes in the mortar.
5. Where builders work holes are to be created, the Contractor shall ensure that the opening is finished no greater than 50 mm from the service penetration. It must be ensured that the penetration is suitably sealed in order that the acoustic performance of the wall construction is not degraded.
6. Following award of Tender, the Contractor shall submit to the Engineer for approval, all necessary shop drawings of proposed construction details, including all necessary stiffening columns and tie beams for masonry, and including lintel, jambs and sill detail for each opening whether it is shown on drawings or not, and showing all service penetrations and all other details.

1.4 SEISMIC REQUIREMENTS

A. Masonry walls shall comply with Uniform Building Code (UBC) 1997 requirements as concerns resistance to seismic forces and shall have at least the descriptions stated in these Specifications and shown on the Drawings.

1.5 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data for concrete masonry units and fabricated wire reinforcement, wall ties, anchors and all other accessories.

C. Samples: Submit four samples of concrete masonry units to illustrate color, texture and extremes of color range.

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

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with TMS MSJC Code and TMS MSJC Specification.

B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.8 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct masonry wall mockup into a panel sized 2800 x 2000 mm high complete including masonry, mortar, accessories, structural backup, wall openings, flashings, wall insulation, air barrier, vapor retarder, parging and all other related items.

C. Locate where directed by the Engineer.

D. Remove mockup where directed by the Engineer.

1.9 PRE-INSTALLATION MEETINGS

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

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

1.10 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Accept concrete masonry units on site. Inspect for damage.

1.11 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Hot and Cold Weather Requirements: TMS MSJC Specification.

1.12 COORDINATION

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

B. Coordinate masonry work with stone cut veneer, installation of window and door anchors.

1.13 EXTRA MATERIALS

A. General Requirements: Execution requirements for spare parts and maintenance products.

B. Supply 50 of each size, color and type of all units.

PART 2 PRODUCTS

2.1 UNIT MASONRY ASSEMBLIES

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

2.2 COMPONENTS

A. Hollow or Solid Load-Bearing or Non-Load Bearing Concrete Masonry Units: To ASTM C90 or ASTM C129, Type I - Moisture Controlled, or Type II - Non-moisture Controlled; normal, medium, or light weight.
   1. Size and Shape: Of nominal modular size as shown on drawings, or as directed by the Engineer. Furnish special units for 90º corners, bond beams, lintels, coved base and bullnosed corners.

2.3 ACCESSORIES

A. Single Wythe Joint Reinforcement: Truss and/or ladder type; stainless steel type 316, conforming to ASTM A580/A580M, 4.8 mm side rods.

B. Multiple Wythe Joint Reinforcement: Truss or ladder type; with moisture drip; adjustable type, stainless steel type 316, to ASTM A580/A580M, 4.8 mm side rods.

C. Reinforcing Steel: As specified in section 03 20 00.

D. Head Restraints: Austenitic stainless steel Ancon Head Restraints Type IHR-V or approved equal.

E. Strap Anchors: Hot dip galvanized to ASTM A153/A153M "B2" finish.

F. Wall Ties: Corrugated formed sheet metal, hot dip galvanized to ASTM A153/A153M "B2" finish.

G. Wall Ties: Formed steel wire, adjustable and/or eye and pintle type, hot dip galvanized to ASTM A153/A153M "B2" finish.

H. Dovetail Anchors: Bent steel strap, galvanized to ASTM A153/A153M "B2" finish.

I. Anchor Bolts: Headed, J-shaped or L-shaped.

J. Mortar and Grout: As specified in Section 04 05 10.

K. Stainless Steel: ASTM A666, Type 316, soft temper, smooth finish.

L. Lap Sealant: As specified in Section 07 92 00.

M. Preformed Control Joints: Rubber, neoprene or polyvinyl chloride material. Furnish with corner and tee accessories, and fused joints.

N. Joint Filler: Closed cell polyvinyl chloride, polyethylene, polyurethane and/or rubber; oversized 50 percent to joint width; self-expanding.

O. Building Paper: ASTM D226, No. 15 or 30, asphalt saturated felt.

P. Nailing Strips: Softwood, preservative treated for moisture resistance, dovetail shape, sized to masonry joints.

Q. Weeps: Preformed plastic tubes cotton wick filled and/or hollow, vents with sloping louvers, and/or cotton rope.

R. Cavity Vents: Molded polyvinyl chloride grilles and/or Aluminum; insect resistant.

S. Chimney Cap: Precast concrete, sized to cover chimney construction plus additional overhang for drip on four sides, slope from flue opening to edges for natural drainage.

T. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

U. Precast or Cast-in-situ Reinforced Concrete Lintels: Concrete shall be using Ordinary Portland cement to ASTM C150, Type I, 25 MPa strength at 28 days, and as specified in Section 03 30 00; size as indicated on Drawings.

V. Steel Lintels (if any): Size as indicated on Drawings, hot-dip galvanized.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify field conditions are acceptable and are ready to receive work.

C. Verify items provided by other sections of work are properly sized and located.

D. Verify built-in items are in proper location and ready for roughing into masonry work

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied to other sections.

B. Furnish temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent support.

3.3 INSTALLATION

A. Establish lines, levels and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.

C. Coursing of Concrete Masonry Units:
1. Bond: Running or stacked.
2. Coursing: One unit and one mortar joint to equal 200 mm.
3. Mortar Joints: Concave, raked, flush or beveled.

D. Placing and Bonding:
1. Lay solid masonry units in full bed of mortar, with full head joints.
2. Lay hollow masonry units with face shell bedding on head and bed joints.
3. Buttering corners of joints or excessive furrowing of mortar are not permitted
4. Remove excess mortar as work progresses.
5. Interlock intersections and external corners.
6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
7. Perform job site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
8. Cut mortar joints flush where wall tile is scheduled, cement parging is required, resilient base is scheduled, cavity insulation vapor barrier adhesive is applied, or bitumen dampproofing is applied.
9. Isolate masonry from vertical structural framing members with movement joint as indicated on Drawings and/or as directed by the Engineer.
10. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.

E. Weeps and Vents: Furnish weeps and vents in outer wythe at 600 and/or 800 mm oc horizontally above through-wall flashing, above shelf angles and lintels, and/or at bottom of walls.

F. Cavity Wall: Do not permit mortar to drop or accumulate into cavity air space or to plug weeps. Build inner wythe ahead of outer wythe to receive cavity insulation and air/vapor barrier adhesive.

G. Joint Reinforcement and Anchorage - Single Wythe Masonry:
1. Install horizontal joint reinforcement 400 mm oc.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
3. Place joint reinforcement continuous in 1st and 2nd joint below top of walls.
4. Lap joint reinforcement ends minimum 150 mm.

5. Reinforce stack bonded unit joint corners and intersections with strap anchors 400 mm oc.

H. Joint Reinforcement and Anchorage - Masonry Veneer:
1. Install horizontal joint reinforcement 400 mm oc.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
3. Place joint reinforcement continuous in 1st and 2nd joint below top of walls.
4. Lap joint reinforcement ends minimum 150 mm.
5. Embed wall ties in masonry backing to bond veneer for every 0.25m². Place at maximum 75mm oc each way around perimeter of openings, within 300mm of openings.
6. Coordinate following with typical stud spacing of 16 or 24 inch oc.
7. Secure wall ties and rod or strap anchors to stud framed backing and embed into masonry veneer at maximum 400 mm oc vertically and 900 mm oc horizontally. Place at maximum 75 mm oc each way around perimeter of openings, within 300 mm of openings.
8. Reinforce stack bonded unit joint corners and intersections with strap anchors 400 mm oc.

I. Joint Reinforcement and Anchorages - Cavity Wall Masonry:
1. Install horizontal joint reinforcement 400 mm oc.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
3. Place joint reinforcement continuous in 1st and 2nd joint below top of walls.
4. Lap joint reinforcement ends minimum 150 mm.
5. Embed anchors in concrete. Attach to structural steel members.
6. Reinforce stack bonded unit joint corners and intersections with strap anchors 400 mm oc.

J. Reinforcement and Anchorages - Multiple Wythe Unit Masonry:
1. Install horizontal joint reinforcement 400 mm oc.
2. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.
3. Place joint reinforcement continuous in 1st and 2nd joint below top of walls.
4. Lap joint reinforcement ends minimum 150 mm.
5. Support and secure reinforcing bars from displacement. Maintain position within 13 mm of dimensioned position.
6. Embed anchors embedded in concrete or attached to structural steel members. Embed anchorages in every second block and/or sixth brick joint.
7. Reinforce stack bonded unit joint corners and intersections with strap anchors 400 mm oc.

K. Masonry Flashings:
1. Extend flashings horizontally through outer wythe at foundation walls, above ledge or shelf angles and lintels, under parapet caps, and/or at bottom of walls, and turn down on outside face to form drip.
2. Turn flashing up minimum 200 mm and bed into mortar joint of masonry, seal to concrete, or to sheathing over wood, steel stud or framed backing.
3. Lap end joints minimum 150 mm and seal watertight.
4. Turn flashing, fold, and seal at corners, bends, and interruptions.

L. Lintels:
1. Install loose steel or precast or cast-in-situ concrete lintels over openings.
2. Reinforcing bars for lintels shall be as indicated on drawings.
3. Do not splice reinforcing bars.
4. Support and secure reinforcing bars from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Allow lintels to attain the specified strength before removing temporary supports.
7. Bearing on each side of opening shall be as indicated on drawings, but in no case shall be less than 200 mm.

M. Grouted Components:
1. Reinforce bond beam as indicated on drawings.
2. Lap splices bar diameters required by code.
3. Support and secure reinforcing bars from displacement.
4. Place and consolidate grout fill without displacing reinforcing.
5. At bearing locations, fill masonry cores with grout for minimum 300 mm both sides of opening.

N. Reinforced Masonry:
1. Lay masonry units with core and/or cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
2. Place reinforcement bars as indicated on Drawings.
3. Splice reinforcement in accordance with Section 03 20 00.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout in accordance with TMS MSJC Specification.

O. Control and Expansion Joints:
1. Do not continue horizontal joint reinforcement through control and expansion joints.
2. Install preformed control joint device in continuous lengths. Seal butt corner joints.
3. Size control joint as per Section 07 92 00 for sealant performance.
4. Form expansion joint by omitting mortar and cutting unit to form open space.

P. Built-In Work:
1. As work progresses, install built-in metal door and/or glazed frames, fabricated metal frames, window frames, wood nailing strips, fireplace accessories, anchor bolts, plates, and all other items to be built in the work and furnished by other sections.
2. Install built-in items plumb and level.
3. Bed anchors of metal door and/or glazed frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 300 mm from framed openings.
4. Do not build in materials subject to deterioration.

Q. Cutting and Fitting:
1. Cut and fit for chases, pipes, conduit, sleeves, grounds, etc. Coordinate with other sections of work to provide correct size, shape and location.

2. Obtain Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

R. Parging:
1. Dampen masonry walls prior to parging.
2. Scarify each parging coat to ensure full bond to subsequent coat.
3. Parge masonry walls in two uniform coats of mortar to 19 mm total thickness.
4. Steel trowel surface smooth/flat with maximum surface variation of 1mm/m.
5. Strike top edge of parging at 45º.

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

3.4 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation from Alignment of Columns: 6 mm.

C. Maximum Variation from Unit to Adjacent Unit: 1.6 mm.

D. Maximum Variation from Plane of Wall: 6 mm/3 m and 13 mm/6 m or more.

E. Maximum Variation from Plumb: 6 mm per story non-cumulative; 13 mm in two stories or more.

F. Maximum Variation from Level Coursing: 3 mm/m and 6 mm/3 m; 13 mm/9 m.

G. Maximum Variation of Joint Thickness: 3 mm/m.

H. Maximum Variation from Cross Sectional Thickness of Walls: 6 mm.

I. Maximum Variation for Steel Reinforcement:
1. Plus or minus 13 mm when distance from centerline of steel to opposite face of masonry is 200 mm or less.
2. Plus or minus 25 mm when distance is between 200 and 600 mm.
3. Plus or minus 32 mm when distance is greater than 600 mm.
4. Plus or minus 50 mm from location along face of wall.

3.5 FIELD QUALITY CONTROL

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

B. Concrete Masonry Units: Test each type in accordance with ASTM C140.

3.6 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Remove excess mortar and mortar smears as work progresses.

C. Replace defective mortar. Match adjacent work.

D. Clean soiled surfaces with cleaning solution.

E. Use non-metallic tools in cleaning operations.

3.7 SCHEDULES

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

END OF SECTION

SECTION 05 50 00

METAL FABRICATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes shop fabricated metal items.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete.
2. Section 07 14 00 - Fluid Applied Waterproofing.
3. Section 09 90 00 - Painting and Coating.

1.2 REFERENCES

A. Aluminum Association:
1. AA DAF-45 - Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association:
1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
3. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

C. ASTM International:
1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
6. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
7. ASTM A297/A297M - Standard Specification for Steel Castings, Iron-Chromium and Iron-Chromium-Nickel, Heat Resistant, for General Application.
8. ASTM A283/283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60000 PSI Tensile Strength.

10. ASTM A312/A312M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
11. ASTM A325M - Standard Specification for High-Strength Bolts for Structural Steel Joints (Metric).
12. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
13. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
14. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
15. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
16. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings.
17. ASTM B85 - Standard Specification for Aluminum-Alloy Die Castings.
18. ASTM B177 - Standard Guide for Chromium Electroplating on Steel for Engineering Use.
19. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
20. ASTM B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric).
21. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric).
22. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

D. American Welding Society:
1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.
3. AWS D1.6 - Structural Welding Code - Stainless Steel.

E. National Ornamental & Miscellaneous Metals Association:
1. NOMMA Guideline 1 - Joint Finishes.

F. The Society for Protective Coatings (SSPC):
1. SSPC - Steel Structures Painting Manual.
2. SSPC SP 1 - Solvent Cleaning.
3. SSPC SP 2 - Hand Tool Cleaning.
4. SSPC SP 10 - Near-White Blast Cleaning.
5. SSPC Paint 15 - Steel Joist Shop Paint.
6. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic & Type II - Organic).

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.0 welding symbols. Indicate net weld lengths.

C. Shop Drawings for Slab Edge Panels: Indicate dimensions, panel profile and layout, spans, joints, expansion joints, construction details, methods of anchorage, method and sequence of installation and interface with adjacent materials.

D. Samples: Submit two samples of each metalwork type, size as directed by the Engineer, illustrating factory finishes.

E. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

F. Design and Performance Data: Submit panel profile characteristics and dimensions, and structural properties. Submit design calculations.

G. Manufacturer's Installation Instructions: Submit special handling criteria, installation sequence, and cleaning procedures.

1.4 QUALITY ASSURANCE

A. Materials and work shall conform to the latest edition of reference specified herein and to applicable codes and requirements of local authorities having jurisdiction, including the following:
   1. The National Association of Architectural Metal Manufacturers (NAAMM)
      a. Metal Finishes Manual
      b. Metal Bar Grating Manual
      c. Metal Products Outline Manual

B. Qualify welding processes and welding operators in accordance with AWS D1.1 “Structural Welding Code – Steel,” D1.3 “Structural Welding Code – Sheet Steel”, and D1.2 “Structural Welding Code – Aluminum”.

C. Structural Performance: Design, engineer, fabricate and install metal fabrications to withstand structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Comply with the “Performance Criteria” specified hereinafter.

D. Conflicting Requirements: In the event of conflict between pertinent codes and regulations and the requirements of the referenced standards or these specifications, the provisions of the more stringent shall govern.

E. Design cold-formed framing to comply with ASCE-7-95 and Uniform Building Code.
   1. Design Load for Exterior Wall assembly: Not less than 146 kg/m².
   2. Increase size of individual members, including anchorage, or reinforce to resist loads without undue deflection.

F. Maximum Horizontal Deflection at Mid-Plan
   1. At Ceramic Tile: 10mm or L/600 of span based on moment of inertia of stud cross section only, whichever is less.
   2. Increase size of individual members, including anchorage, or reinforce to resist loads without undue deflection.

G. Sloped Sills: Size to resist wind loads plus anticipated live loads of 195 kg/m², but not less than 1.5mm thick.

H. Interior Locations Indicated as Structural Steel Stud: Size to resist anticipated loads, but not less than 0.9mm thick unless otherwise indicated.

I. Differential Movement: Design and construct wall system to accommodate anticipated movement indicated herein, without damage or deterioration to studs or wallboards, without buckling, opening of joints, and cracking.

J. Certifications: Work of this Section shall be performed under the direct supervision of a registered Professional Engineer.

K. Perform Work in accordance with the drawings and to the approval of the Engineer.

L. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Design under direct supervision of Professional Engineer experienced in design of this Work and approved by the Engineer.

B. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

C. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Accept metal fabrications on site in labeled shipments. Inspect for damage.

C. Protect metal fabrications from damage by exposure to weather.

1.7 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on shop drawings, and/or as instructed by the manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Steel Tubing: ASTM A500, Grade B, and/or ASTM A501.

C. Plates: ASTM A283/A283M.

D. Pipe: ASTM A53/A53M, Grade B, Schedule 40.

E. Fasteners: as instructed by the manufacturer.

F. Bolts, Nuts, and Washers: ASTM A325M, A307 and/or galvanized to ASTM A153/A153M for galvanized components.

G. Welding Materials: AWS D1.1; type required for materials being welded.

H. Shop and Touch-Up Primer: SSPC Paint 15, Type 1, red oxide.

I. Touch-Up Primer for Galvanized Surfaces: SSPC Paint 20 Type I Inorganic and/or Type II Organic zinc rich.

2.2 MATERIALS - STAINLESS STEEL

A. Bars and Shapes: ASTM A276, and/or ASTM A479/A479M; Type 316.

B. Tubing: ASTM A269, and/or ASTM A554; Type 316.

C. Pipe: ASTM A312/A312M, seamless and/or welded; Type 316.

D. Plate, Sheet and Strip: ASTM A167; Type 316.

E. Bolts, Nuts, and Washers: ASTM A354.

F. Welding Materials: AWS D1.6; type required for materials being welded.

2.3 MATERIALS - ALUMINUM

A. Extruded Aluminum: ASTM B221M, Alloy 6063, Temper T5.

B. Sheet Aluminum: ASTM B209M.

C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210M, Alloy 6063, Temper T6.

D. Aluminum-Alloy Bars: ASTM B211M, Alloy 6063, Temper T6.

E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.

F. Aluminum-Alloy Die Castings: ASTM B85.

G. Bolts, Nuts, and Washers: Stainless steel type 316.

H. Welding Materials: AWS D1.1; type required for materials being welded.

2.4 ISOLATING NON-CONDUCTIVE MATERIALS BETWEEN DISSIMILAR METALS

A. Contacts between dissimilar metals should be avoided in order to prevent bi-metallic or galvanic corrosion.

B. Dissimilar metals shall be isolated from each other with non-conductive materials. Generally, such isolating elements will take the form of washers and bushes.

C. Isolated Non-Conductive Materials: Neoprene, synthetic resin bonded fiber (SRBF) such as tufnol, polytetrafluoroethylene (PTFE), or hard nylon, depending on fixing:
   1. Load Bearing Fixings: SRBF or PTFE (strong material).
   2. Restraint Fixings: Neoprene or nylon is acceptable.

D. Electrical insulation tape and bitumen paint are considered in low risk short life application, and shall not be used as non-conductive materials unless directed by the Engineer.

2.5 COMPOSITE METAL PANELS

A. Manufacturer: Any internationally recognized manufacturer having an official technical agreement to conformity with standards for the product.
   1. Approved Manufacturer:
      a. Alucobond.
      b. Alucomat.
      c. Or approved equivalent.

B. Exterior Panel and Other Sheet Materials: Pre-coated aluminum panels; 3 mm thick unless otherwise stated; profile as indicated on Drawings.
   1. Pre-Coated Aluminum: ASTM B209M, manufacturer’s standard alloy and temper; anodized to 0.02 mm thick; smooth surface and high performance organic coating finish; exposed exterior surfaces color as selected by the Engineer.

C. Insulated Core: Extruded polystyrene insulation board to ASTM C578, type VII, cellular type:
   1. Board Density: 35 kg/m^3.
   2. Board Size and Thickness: 1200 mm x 2400 mm x 50 mm thick.
   3. Thermal Resistance: RSI of 0.87.
   4. Water Absorption: To ASTM D2842, 0.3 percent by volume maximum.
   5. Compressive Strength: Minimum 175 kPa.
   6. Board Edges: Square, shiplap, or tongue and groove edges.
   7. Flame/Smoke Properties: In accordance with ASTM E84.

D. Trim, Closure Pieces, Caps, Flashings: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

E. Anchors: Stainless steel type 316.

F. Vapor Retarder: Polyethylene film for above grade application, 0.25 mm thick.

G. Air Barrier: Sheet seal of type recommended by the manufacturer.

H. Gaskets: Manufacturer's standard type suitable for use with panel system, permanently resilient; ultraviolet and ozone resistant; color as selected.

I. Sealant: Type recommended by the Manufacturer.

J. Fasteners: Manufacturer's standard type to suit application; stainless steel type 316; fastener cap same color as exterior panel.

K. Power Actuated Fasteners: Hot dip galvanized steel; cap color same as exterior panel.

L. Slots: Provide as necessary and where required for mechanical equipment.

M. Bituminous Paint: Asphalt base as specified in Section 07 14 00.

N. Form sections to shape indicated on Drawings, accurate in size, square, and free from distortion or defects.

O. Form pieces in longest practicable lengths.

P. Panel Profile: Manufacturer’s standard profile and as indicated on Drawings.

2.6 STRUCTURAL SUPPORTS

A. Structural Supports for Miscellaneous Attachments: Steel sections, shape and size as indicated on Drawings, required to support applied loads (Dead & Live) with maximum deflection of 1/200 of the span; prime paint, one coat or mill finish.

2.7 ANCHOR BOLTS

A. ASTM A307; steel bolt, standard J-hook, with nut and washer; unfinished.

2.8 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Continuously seal joined members by intermittent welds and plastic filler and/or continuous welds.

D. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish.

E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with component design, except where specially noted otherwise.

F. Supply components required for anchorage. Fabricate anchors & related components of same material and finish as fabrication, except where specifically noted otherwise.

2.9 FACTORY APPLIED FINISHES - STEEL

A. Prepare surfaces to be primed in accordance with SSPC SP 2.

B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.

C. Do not prime surfaces in contact with concrete or where field welding is required.

D. Prime paint items with one or two coats except where galvanizing is specified.

E. Galvanized Structural Steel Members: Galvanize after fabrication to ASTM A123. Furnish minimum 380 g/sq m galvanized coating.

F. Galvanized Non-structural Items: Galvanized after fabrication to ASTM A123. Furnish minimum 380 and/or 360 g/m² galvanized coating.

G. Chrome Plating: ASTM B177, nickel-chromium alloy, satin and/or polished finish.

2.10 FACTORY APPLIED FINISHES - STAINLESS STEEL

A. Satin Polished Finish: Number 4, satin directional polish parallel with long dimension of finished face. Color: As selected.

B. Mirror Polished Finish: Number 8, mirror polish with preliminary directional polish lines removed. Color: As selected.

2.11 FACTORY APPLIED FINISHES - ALUMINUM

A. Finish coatings to conform to AAMA 2603, 2604, 2605 and/or AAMA 611. Comply with AA DAF-45.

B. Exterior and Interior Aluminum Surfaces: Advanced durability polyester powder coating system; minimum thickness 60 microns; color & gloss percentage as selected.

C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

2.12 FABRICATION TOLERANCES

A. Squareness: 3 mm maximum difference in diagonal measurements.

B. Maximum Offset between Faces: 1.5 mm.

C. Maximum Misalignment of Adjacent Members: 1.5 mm.

D. Maximum Bow: 3 mm in 1.2 m.

E. Maximum Deviation from Plane: 1.5 mm in 1.2 m.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify field conditions are acceptable and are ready to receive Work.

3.2 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

B. Supply steel items required to be cast into concrete, or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

A. Install work of this section square, plumb, straight, true to line or radius, accurately fitted and located, with flush tight hairline joints (except as indicated otherwise or to allow for thermal movement). Provide attachment devices as required for secure and rigid installation.

B. Exposed joints shall be close fitting, and bolts and screws, where exposed, shall be cut off flush with nuts or other adjacent metal. Cutting, drilling, punching and tapping required for the installation and attachment of other work to miscellaneous metal work, except where specified in connection with work under other sections, shall be performed as required.

C. Metal work built-in with concrete or masonry shall be formed for anchorage, or be provided with suitable anchors, expansion shields or other anchoring devices shown on the drawings, or required. Such metal work shall be furnished in ample time for setting and securing in place. Wherever possible fixings shall be built into concrete.

D. Where indicated, install miscellaneous metal items in sleeves (furnished under this section) embedded in concrete with setting grout specified herein.

E. Joints shall be as strong and rigid as adjoining sections. Welding shall be continuous along entire line of contact, except where spot welding is indicated or permitted. Where exposed, welds shall be ground smooth. Where bolted or riveted connections are indicated, such connections may be welded at the Contractor’s option.

F. Where welding is required, it shall conform to requirements for shielded metal arc welding of the Standard Code for Arc and Gas Welding of the American Welding Society. Exposed welds shall be flush and ground smooth.

G. Threaded connections shall be made up tight so that threads are entirely concealed. Abutting bars shall be so shouldered and headed, doweled and pinned. Small bars shall pass through larger bars and pinned. Rivet, bolts and screw heads shall be flat and countersunk in exposed work and elsewhere as required. Removable members shall be carefully machined and fitted and secured, by means of screws or bolts of proper size and approved spacing.

H. Bolts, brackets, sleeves and other items embedded in concrete shall be galvanized.

I. Except where built in fixings cannot be used miscellaneous metal work may be fastened to concrete with expansion bolts and to hollow with toggle bolts. Fastening to wood plugs in concrete or masonry will not be permitted. Holes for plugs or bolts shall be drilled to the exact diameter of the plug or bolt, using a percussion drill for concrete and a rotary drill for masonry. Screws shall be threaded full length to the head of the screw.

J. Provide for adjustments of miscellaneous metal items, with particular attention given to miscellaneous steel supporting the work of other sections, as required during the construction process.

K. Install isolating non-conductive materials between dissimilar metals as per approved methodology.

L. Setting Loose Plates:
   1. Clean concrete and masonry bearing surfaces of any bond-reducing materials, roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
   2. Set loose leveling and bearing plates on wedges, or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the bearing plate before packing with grout.
   3. Pack grout solidly between bearing surfaces & plates. Ensure no voids remain

M. Butt welds or splice butt joints in track. Splices in axial loaded studs shall not be permitted. Welds shall be fillet, plug, butt, or seam.
   1. Secure floor and ceiling runners to structure with power driven anchors spaced not over 400mm on center and 150mm maximum from ends. Closer spacing at discretion of stud manufacturer based on design loads.
   2. Provide elastomeric sealant or sill sealer material between concrete structure and ceiling and floor runner channels at exterior.

N. Slide Clip Detail: Provide flexible connection between studs and building structure to accommodate slab edge deflection and long term building creep without transferring axial load to studs.

O. Obtain approval of the Engineer prior to site cutting or making adjustments not scheduled.

P. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.

3.4 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation from Plumb: 6 mm per story or for every 3.65 m in height whichever is greater, non-cumulative.

C. Maximum Offset from Alignment: 6 mm.

D. Maximum Out-of-Position: 6 mm.

E. Maximum Variation of Wall from Plumb, Level or True-to-Line: 3mm in 3m.

3.5 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Remove site cuttings from finish surfaces.

C. Clean & wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Section includes finish carpentry items; wood door frames, glazed frames; wood casings and moldings; and hardware and attachment accessories.

B. Related Sections:
   1. Section 08 80 00 - Glazing.
   2. Section 09 90 00 - Painting and Coating.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A135.4 - Basic Hardboard.
   2. ANSI A156.9 - Cabinet Hardware.
   3. ANSI A208.1 - Mat-Formed Wood Particleboard.

B. APA-The Engineered Wood Association:
   1. APA/EWA PS 1 - Voluntary Product Standard for Construction and Industrial Plywood.

C. ASTM International:
   1. ASTM C1036 - Standard Specification for Flat Glass.
   2. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
   3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

D. Architectural Woodwork Institute:
   1. AWI - Quality Standards Illustrated.

E. American Wood-Preservers' Association:
   1. AWPA C1 - All Timber Products - Preservative Treatment by Pressure Process.

F. Federal Specification Unit:
   1. FS A-A-1936 - Adhesive, Contact, Neoprene Rubber.

G. Hardwood Plywood and Veneer Association:
   1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

H. National Institute of Standards and Technology:
   1. NIST PS 20 - American Softwood Lumber Standard.

I. National Electrical Manufacturers Association:
   1. NEMA LD 3 - High Pressure Decorative Laminates.

J. Window and Door Manufacturers Association:
   1. WDMA I.S.4 - Water-Repellent Treatment for Millwork.

K. Woodwork Institute of California:
   1. WIC - Manual of Millwork.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories to minimum scale of (1:8).

C. Product Data:
   1. Submit data on fire retardant treatment materials and application instructions.
   2. Submit data on attachment hardware and/or finish hardware.

D. Samples:
   1. Submit two samples of finish plywood, 200 x 250 mm in size illustrating wood grain and specified finish.
   2. Submit two samples of wood trim 250 mm long.
   3. Submit two samples of laminates, pre-finished paneling, synthetic surfacing, hardware items, and shop finishes.

E. Certification: Submit copy of fabricator’s authorization to use AWI Grade Stamps, AWI Quality Certification Program license and Project specific letters and/or WIC certified compliance certificate.

1.4 QUALITY ASSURANCE

A. Perform work to AWI Architectural Woodwork Quality Standards Illustrated, and/or WIC Manual of Millwork; economy, custom or premium grade.

B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Fabricator: Company specializing in fabricating Products specified in this section with minimum ten years documented experience.

1.6 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mockups, full size including all hardware and attachment accessories.

C. Locate where directed by the Engineer.

D. Remove mockup when directed by the Engineer.

1.7 PRE-INSTALLATION MEETINGS

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

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

1.8 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Protect work from moisture damage.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 SEQUENCING

A. Sequence work to ensure utility connections are achieved in orderly and expeditious manner.

1.11 COORDINATION

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

B. Coordinate work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

PART 2 PRODUCTS

2.1 FINISH CARPENTRY

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

2.2 COMPONENTS

A. Softwood and/or Hardwood Lumber: NIST PS 20, or AWI grade III, II or I, WIC economy, custom or premium grade; maximum moisture content of 6 to 8 %.

B. Softwood and/or Hardwood Plywood: APA/EWA PS 1 Grade (C-D) softwood plywood, HPVA HP-1 hardwood plywood, AWI grade B, A, or AA veneer; and/or WIC economy, custom or premium veneer; with particleboard, medium density fiberboard, veneer or lumber core; type of glue recommended for application.

C. High Pressure Decorative Laminate: NEMA LD 3, GP50 for horizontal surfaces, GP28 for vertical surfaces, CL20 for cabinet liner surfaces, BK20 for undecorated backing sheets, PF42 for post forming, FR50 for fire-retardant surfaces; color, pattern, and surface texture as selected and indicated.

D. Pre-finished Paneling: As indicated on drawings.

E. Wood Particleboard: ANSI A208.1 type 1 or 2; composed of wood chips or sawdust, medium density, made with water resistant adhesive; sanded faces.

F. Hardboard: AHA A135.4; Pressed wood fiber with resin binder, standard and/or tempered grade, 6 mm thick, smooth one and/or two sides.

G. Pegboard: Pressed wood fiber with resin binder, standard and/or tempered grade; 3 mm thick 4 mm diameter holes at 25 mm on center and/or 6 mm thick with 7 mm diameter holes at 25 mm on center.

H. Sheet Metal Components: Stainless steel, Type 316 with #4 satin and/or #8 polished finish.

I. Synthetic Surfacing: Synthetic marble of polyester or proprietary resins, with color and design as indicated on drawings, stain resistant to domestic chemicals and cleaners.

2.3 ACCESSORIES

A. Adhesive for High Pressure Decorative Laminates: FS A-A-1936 contact adhesive and/or Type recommended by laminate manufacturer to suit application.

B. Fasteners: Of size and type to suit application; galvanized finish in concealed locations and stainless steel type 316 finish in exposed locations.

C. Concealed Joint Fasteners: Threaded steel.

D. Lumber for Shimming and Blocking: Softwood lumber as indicated.

E. Veneer Edge Band: Standard wood veneer edge band matching face veneer.

F. Plastic Edge Trim: Extruded convex and/or flat shaped; smooth and/or ridged finish; self-locking serrated tongue; of width to match component thickness; color as selected.

G. Aluminum Edge Trim: Extruded convex and/or flat shape; smooth and/or ridged surface finish; self-locking serrated tongue; of width to match component thickness; natural mill, clear anodized and/or bronze anodized finish.

H. Glass: Type as specified in Section 08 80 00.

I. Float and/or Patterned Glass: ASTM C1036 and/or C1048, type, color, pattern, quality and thickness as indicated on drawings.

J. Safety Glass: ASTM C1036 and/or C1048, type, color, pattern, quality and thickness as indicated on drawings.

K. Primer: Alkyd primer sealer.

L. Wood Filler: Solvent and/or oil base, tinted to match surface finish color.

M. Wood Treatment:
1. Fire Retardant (FR-S Type): Chemically treated and pressure impregnated; capable of providing maximum flame spread/smoke development rating in accordance with ASTM E84.
2. Wood Preservative by Pressure Treatment (PT Type): AWPA Treatment C1 using water borne preservative with 0.25 lb/cu ft retention.
3. Water Repellant Preservative Treatment by Dipping Method: WDMA I.S.4, with 0.25 cubic lb/in/ft of chromated copper arsenate.
4. Wood Preservative (Surface Application): color and type as indicated.
5. Shop pressure treat, dip and/or brush apply treatment to wood materials requiring fire rating and/or preservatives to concealed wood blocking.
6. Provide identification on fire retardant treated material.
7. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.
8. Redry and/or Kiln dry wood after pressure treatment to maximum moisture content percentage as instructed by the manufacturer.

N. Hinges: As indicated on drawings.

O. Pulls: As indicated on drawings.

P. Latches: As indicated on drawings.

Q. Shelf Standards: As indicated on drawings.

R. Shelf Brackets: As indicated on drawings.

S. Drawer Slides: As indicated on drawings.

2.4 FABRICATION

A. Fabricate to AWI Economy, Custom and/or Premium standards and/or WIC Economy, Custom and/or Premium standards.

B. Shop assemble work for delivery to site, permitting passage through building openings.

C. Fit exposed sheet material edges with matching hardwood, matching veneer, plastic and/or aluminum edging. Use one piece for full length only.

D. Cap exposed high pressure decorative laminate finish edges with material of same finish and pattern.

E. Shop prepare and identify components for book match grain matching during site erection.

F. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.

G. Apply high pressure decorative laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 600 mm from sink cut-outs.

H. Apply laminate backing sheet to reverse face of high pressure decorative laminate finished surfaces.

2.5 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.

D. Finish work in accordance with AWI - Section 1500 Finish System Transparent and/or Opaque.

E. Finish work in accordance with WIC - Section 25 System (#1) (#2) (#3) (#4) (#5) (#6) (#7) (#8).

F. Stain, seal, and varnish exposed to view surfaces.

G. Seal internal surfaces and semi-concealed surfaces.

H. Prime paint and/or Seal surfaces in contact with cementitious materials.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify adequacy of backing and support framing.

C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.2 EXISTING WORK

A. Modify and extend existing finish carpentry installations using materials and methods as specified.

3.3 INSTALLATION

A. Install work in accordance with AWI, or WIC economy, custom or premium quality standard.

B. Set and secure materials and components in place, plumb and level.

C. Carefully scribe work abutting other components, with maximum gaps of 1 mm. Do not use additional overlay trim to conceal larger gaps.

D. Install components and/or trim with nails, screws and/or bolts with blind fasteners as instructed by the manufacturer, and/or wall adhesive by gun application.

E. Install pre-finished paneling with full bed contact adhesive applied to substrate, and/or nails, screws and/or wall adhesive by bead method as instructed by the manufacturer.

F. Install hardware.

G. Site Applied Wood Treatment:
   1. Apply preservative treatment.
   2. Brush apply one coat of preservative treatment on wood in contact with cementitious materials, and roofing and related metal flashings. Treat site-sawn cuts.
   3. Allow preservative to dry prior to erecting members.

H. Preparation for Site Finishing:
   1. Site Finishing: Refer to Section 09 90 00.
   2. Before installation, prime paint surfaces of items or assemblies to be in contact with cementitious materials.

3.4 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation from Indicated Position: 1.5 mm.

C. Maximum Offset from Alignment with Abutting Materials: 0.7 mm.

3.5 SCHEDULES

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

END OF SECTION

SECTION 06 41 00

ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.1 SUMMARY

A. Section includes custom-fabricated cabinet units; counter tops; cabinet hardware; preparation for installing utilities in cabinets; and shop and/or site finishing.

B. Related Sections:
1. Section 06 20 00 - Finish Carpentry.
2. Section 08 80 00 - Glazing: Glass for casework.
3. Section 09 90 00 - Painting and Coating.
4. Division 22 - Plumbing: Under-top stainless steel sink, mixers, robinet, angle valves and all required mechanical installations.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI A156.9 - Cabinet Hardware.
2. ANSI A208.1 - Mat-Formed Wood Particleboard.

B. Architectural Woodwork Institute:
1. AWI - Quality Standards Illustrated.

C. Federal Specification Unit:
1. FS A-A-1936 - Adhesive, Contact, Neoprene Rubber.

D. National Electrical Manufacturers Association:
1. NEMA LD 3 - High Pressure Decorative Laminates.

E. Woodwork Institute of California:
1. WIC - Manual of Millwork.

F. ASTM International:
1. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate materials, component profiles and elevations, assembly methods, joint details, fastening methods, accessory listings, hardware location and schedule of finishes.

C. Product Data: Submit data for hardware accessories.

D. Samples:
   1. Submit two samples, each size 200 x 250 mm illustrating cabinet finish.
   2. Submit two samples each size 200 x 250 mm illustrating counter top finish.
   3. Submit two samples of drawer pulls, hinges, etc. illustrating hardware finish.

E. Certification: Submit copy of fabricator's authorization to use AWI Grade Stamps, AWI Quality Certification Program license and Project specific letters and/or WIC certified compliance certificate.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with AWI (Architectural Woodwork Institute) Architectural Woodwork Quality Standards Illustrated, Economy, Custom and/or Premium Grade, and/or WIC (Woodwork Institute of California) Manual of Millwork, Economy, Custom and/or Premium Grade.

B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Fabricator: Company specializing in performing Work of this section with minimum ten years documented experience.

1.6 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mockup of full size base cabinet and upper cabinet including plumbing and electrical fixtures, hardware, accessories and fitments.

C. Locate where directed by the Engineer.

D. Remove mockup when directed by the Engineer.

1.7 PRE-INSTALLATION MEETINGS

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

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Protect units from moisture damage.

1.9 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. During and after installation of Work of this section, maintain same temperature and humidity conditions in building spaces as will occur after occupancy.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 CUSTOM CABINETS

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

2.2 COMPONENTS

A. Softwood and/or Hardwood Lumber: AWI Grade III, II and/or I; and/or WIC Economy, Custom and/or Premium Grade; maximum moisture content of 6-8 percent;

B. Softwood and/or Hardwood Plywood: AWI Grade B, A and/or AA veneer; and/or WIC Economy, Custom and/or Premium veneer; with particleboard, medium density fiberboard, veneer and/or lumber core; type of glue recommended for application;

C. Wood Particleboard: ANSI A208.1 Type 1 and/or 2; composed of wood chips or sawdust, medium density, made with water resistant adhesive; sanded faces.

D. High Pressure Decorative Laminate: NEMA LD 3, GP50 for horizontal surfaces, GP28 for vertical surfaces, CL20 for cabinet liner surfaces, BK20 for undecorated backing sheets, PF42 for post forming, and/or FR50 for fire-retardant surfaces; Color, pattern, and surface texture as selected and/or indicated on drawings.

E. Sheet Metal Components: Stainless steel, Type 316 with #4 satin and/or #8 polished finish;

F. Synthetic Surfacing: Synthetic marble of polyester and/or proprietary resins, stain resistant to domestic chemicals and cleaners and as per approved codes and standards.

G. Counter Tops, Back Splash and Side Splash: As per schedule stated hereinafter or as shown on drawings.

H. Service Fittings for Kitchen Cupboards: As per schedule stated hereinafter or as shown on drawings.

I. Electrical Built-in Appliances in Kitchen Cupboards: As per schedule stated hereinafter or as shown on drawings.

2.3 ACCESSORIES

A. Adhesive for High Pressure Decorative Laminates: FS A-A-1936 contact adhesive. Type recommended by laminate manufacturer to suit application.

B. Veneer Edge Band: Standard wood veneer edge band matching face veneer.

C. Plastic Edge Trim: Extruded convex and/or flat shaped; smooth and/or ridged finish; self locking serrated tongue; of width to match component thickness; color as selected and/or as indicated on drawings.

D. Aluminum Edge Trim: Extruded convex and/or flat shape; smooth and/or ridged surface finish; self locking serrated tongue; of width to match component thickness; natural mill, clear anodized and/or bronze anodized finish.

E. Glass: As specified in Section 08 80 00.

F. Fasteners: Size and type to suit application.

G. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized finish in concealed locations and stainless steel type 316 finish in exposed locations.

H. Bolts: Steel and comply with BS916

I. Washers: to BS3410, part 2.

J. Screws:
1. All steel screws shall be finished to resist corrosion by sherardizing, cadmium plating, nickel plating or other approved finish.
2. Screws shall be protected steel, stainless steel type 316, brass silicone bronze, nickel/copper alloy or aluminum as specified on drawings or as appropriate to the work. Screws for fixing hardware shall match the items being fixed.
3. Screw heads shall be for the generality of the work, countersunk slotted. Screw heads in the finished work shall, unless otherwise described, be brass, bronzed finish with matching fully countersunk brass cups. Phillips crosshead screws or pozidrive screws shall be used where so described on drawings.

K. Concealed Joint Fasteners: Threaded steel.

L. Grommets: Plastic, Metal and/or Rubber material for cut-outs.

M. Hardware:
1. Hinges: Plain bearing two knuckle stainless steel type 316 hinges (3 № per door leaf), with soft close.
2. Knob for door panels as selected (1 № per door leaf).
3. Perforations: 25mm diameter to act instead of knobs where indicated.
4. Lock: Cabinet lock for each door panel or couple of panels as appropriate with security cylinder and with two keys for each lock.
5. Knob for drawer as selected (1 № per drawer).
6. Drawer runners: Steel telescopic runners (full width of drawer on both sides).
7. Chrome pins for adjustable shelves.
8. Chrome hanging rods.

N. Shelf Standards and Rests: Formed steel channels and rests, cut for fitted rests spaced as indicated; chrome and/or satin finish.

O. Shelf Brackets: Formed steel brackets, formed for attachment with lugs; chrome and/or satin finish.

P. Drawer and Door Pulls: Extruded aluminum pull, full width of drawer, polished and/or satin finish, "U" shaped pull, steel with chrome and/or satin finish, aluminum with polished and/or satin finish, bronze with satin finish, and/or plastic of color as selected.

Q. Sliding Door Pulls: Circular, Oval and/or Elongated shape, steel with chrome and/or satin finish, aluminum with polished and/or satin finish, bronze with satin finish, and/or plastic of color as selected.

R. Catches: Type as indicated on drawings.

S. Drawer Slides: Galvanized steel construction, ball bearings separating tracks, full extension type.

T. Sliding Door Track Assemblies: Galvanized steel construction, ball bearing carriers fitted within tracks, multiple pendant suspension attachments for door.

2.4 FABRICATION

A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.

B. Fit shelves, doors, and exposed edges with matching veneer, plastic and/or aluminum edging. Use one piece for full length only.

C. Cap exposed high pressure decorative laminate finish edges with material of same finish and pattern.

D. Door and Drawer Fronts: 19 mm thick; flush, overlay and/or reveal overlay style.

E. When necessary to cut and fit on site, fabricate materials with ample allowance for cutting. Furnish trim for scribing and site cutting.

F. Apply high pressure decorative laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Locate counter butt joints minimum 600 mm from sink cut-outs.

G. Apply wood laminate by grain matching adjacent sheets to book, slip, random and/or end matching.

H. Apply laminate backing sheet to reverse side of plastic and/or wood laminate finished surfaces.

I. Fabricate metal counter top surfaces pressure glued to plywood or particle board core backing with butt or welded joints, or without visible joints.

J. Mechanically fasten back splash to counter tops with steel brackets at 400 mm on center.

K. Fabricate cabinets and counter tops with cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Prime paint and/or Seal cut edges.

L. Shop glaze glass materials using Interior Dry, Combination and/or Wet method specified in Section 08 80 00.

2.5 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Apply wood filler in exposed nail and screw indentations.

C. On items to receive transparent finishes, use wood filler matching surrounding surfaces and of types recommended for applied finishes.

D. Finish work in accordance with AWI - Section 1500 Finish System Transparent and/or Opaque.

E. Finish work in accordance with WIC - Section 25 System (#1) (#2) (#3) (#4) (#5) (#6) (#7) (#8).

F. Stain, seal and varnish exposed to view surfaces. Brush and/or Spray apply only.

G. Seal and/or stain and varnish internal exposed to view and semi-concealed surfaces.

H. Seal internal surfaces of cabinets.

I. Prime paint and/or Seal surfaces in contact with cementitious materials.

J. Finish in accordance with Section 09 90 00.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify adequacy of backing and support framing.

C. Verify location and sizes of utility rough-in associated with work of this section.

3.2 INSTALLATION

A. Set and secure casework in place; rigid, plumb and level.

B. Use fixture attachments in concealed locations for wall mounted components.

C. Use concealed joint fasteners to align and secure adjoining cabinet units, counter tops etc.

D. Carefully scribe casework abutting other components, with maximum gaps of 1 mm. Do not use additional overlay trim for this purpose.

E. Secure cabinet and counter bases to floor using appropriate angles and anchorages.

F. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

G. Site glaze glass materials using Interior Dry, Combination or Wet method specified in Section 08 80 00.

3.3 ADJUSTING

A. General Requirements: Execution requirements for testing, adjusting and balancing.

B. Adjust moving or operating parts to function smoothly and correctly.

3.4 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Clean casework, counters, shelves, hardware, fittings and fixtures.

3.5 SCHEDULES

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

END OF SECTION

SECTION 07 13 00

SHEET WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes sheet membrane waterproofing; drainage panels & protective cover.

B. Related Sections:
1. Section 07 21 13 - Board Insulation.
2. Section 07 62 00 - Sheet Metal Flashing and Trim.
3. Section 07 92 00 - Joint Sealants.
4. Division 22 - Plumbing: Plumbing Fixtures and Plumbing Specialties.

1.2 REFERENCES

A. ASTM International:
1. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers -Tension.
2. ASTM D449 - Standard Specification for Asphalt Used in Dampproofing and Waterproofing.
3. ASTM D450 - Standard Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing.
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 D2581 - Standard Specification for Polybutylene (PB) Plastics Molding and Extrusion Materials.
11. ASTM D4068 - Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane.
12. ASTM D4551 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane.
13. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
14. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. National Roofing Contractors Association:
1. NRCA - The NRCA Waterproofing and Dampproofing Manual.

1.3 SYSTEM DESCRIPTION

A. Waterproofing System: Capable of resisting existing water head with the required factor of safety and preventing 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 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. Test material samples in accordance with ASTM D449 and ASTM D450.

C. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Membrane Manufacturer: Company specializing in waterproofing sheet membranes with minimum fifteen years documented experience.

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

1.7 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct Mockup, 10 m² of horizontal and vertical panels; to represent finished work with internal and external corners, seam jointing, attachment method, counterflashing cover, drainage panel, base flashings, control/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 5ºC 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. Provide ten year warranty for each waterproofing system including coverage of materials and installation, and all resulting damage resulting from failure to resist penetration of moisture.

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

PART 2 PRODUCTS

2.1 SHEET MEMBRANE WATERPROOFING

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

2.2 COMPONENTS

A. Rubber Membrane: Butylene conforming to ASTM D2581, EPDM conforming to ASTM D4637 Type I and/or Chloroprene/neoprene conforming to ASTM D4637 Type II; 1.8 mm thick; Class SR: Scrim or fabric internal reinforced, exposed face color and roll width as per manufacturer’s recommendations; with compatible seam tape and termination bar; conforming to following below criteria:

B. Plastic Membrane: PVC conforming to ASTM D4551, HDPE, Ethylene Copolymer, CPE conforming to ASTM D4068, CSPE conforming to ASTM D4068, and/or Hypalon; thickness and roll width as per manufacturer’s recommendations; with compatible seam tape and termination bar; conforming to following below criteria.

C. Modified Bituminous Membrane: Asphalt and polymer modifiers of styrene-butadiene-styrene (SBS), and/or atactic polypropylene (APP) type, reinforced with non-woven polyester, fiber glass, polyethylene and/or polypropylene; smooth surfaced; thickness and roll width as per manufacturer’s recommendations; with compatible seam tape and termination bar; conforming to following below criteria.

D. Composite HDPE/Bentonite Sheet Membrane: Comprised of black/grey or clear HDPE and granular bentonite with spun polypropylene fabric facing; minimum

thickness of 3.8 mm; 1200 mm wide roll; with compatible water stop devices, 100 mm wide rubberized asphalt seam tape, and extruded aluminum termination bar; conforming to following below criteria.

E. Criteria:

	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

F. Seaming Materials: As recommended by membrane manufacturer.

G. Flexible Flashings: As recommended by membrane manufacturer.

2.3 ACCESSORIES

A. Surface Conditioner: type compatible with membrane, as recommended by membrane manufacturer.

B. Adhesives: As recommended by membrane manufacturer.

C. Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

D. Battens: As recommended by membrane manufacturer.

E. Disc Washers and Screws: As recommended by membrane manufacturer.

F. Circular Membrane Discs: As recommended by membrane manufacturer.

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

H. Sealant: As per Section 07 92 00 and as recommended by membrane manufacturer.

I. Mortar Beveled Corners (Fillet) at Intersections:
1. Portland Cement: ASTM C150, Type I, gray color.
2. Fine Aggregate: ASTM C144 and/or C404.
3. Water: Clean and potable.
4. Calcium chloride is not permitted.
5. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
6. Achieve uniformly damp sand immediately before mixing process.
7. Add admixtures in accordance with manufacturer’s instructions to achieve uniformity of mix and coloration.
8. Re-temper only within two hours of mixing.

J. Protective Covers:
   1. For Horizontal Surfaces: Unless otherwise stated or shown on the drawings, heavy duty rigid polypropylene protection boards specified as per in Section 07 21 13, or cement sand screed, mix (1:3).
   2. For Vertical Surfaces: Unless otherwise stated or shown on the drawings, heavy duty rigid polypropylene protection boards specified as per in Section 07 21 13.

K. Cant Strips: Premolded composition material and/or Bitumen impregnated fiberboard.

L. Flexible Flashings: As recommended by membrane manufacturer.

M. Counterflashings: as specified in Section 07 62 00.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

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

D. 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. Execute cement sand mortar at all intersections to make beveled corners (fillet) of size 50 x 50 mm.

D. Do not apply waterproofing to surfaces unacceptable to manufacturer or applicator.

E. Seal cracks and joints with sealant materials using depth to width ratio as recommended by sealant manufacturer and in accordance with Section 07 92 00.

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

3.3 INSTALLATION - GENERAL

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

3.4 INSTALLATION - LOOSE LAID MEMBRANE WATERPROOFING

A. Roll out membrane. Minimize wrinkles and bubbles.

B. Overlap edges and ends and seal by solvent welding, heat welding, contact tape and/or contact adhesive, minimum 75 mm. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

C. Reinforce membrane with multiple thicknesses of membrane material over static or moving joints.

D. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams.

E. Install flexible flashings. Seal watertight to membrane.

F. Seal flashings to adjoining surfaces.

G. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 150 mm above horizontal surface for first ply and as recommended by the manufacturer at subsequent plies laid in shingle fashion.

H. Terminate top edge of membrane and flexible flashing under counterflashings, seal with mastic. Coordinate with metal flashing installation specified in Section 07 62 00.

3.5 INSTALLATION - ADHESIVE BONDED, SELF ADHERED AND TORCH APPLIED MEMBRANE WATERPROOFING

A. Roll out membrane. Minimize wrinkles and bubbles.

B. Remove release paper layer. Roll out on substrate with mechanical roller to encourage full contact bond.

C. Apply adhesive at rate recommended by manufacturer, Bond sheet to substrate except those areas directly over or within 75 mm of control or expansion joint.

D. Apply membrane by torch application, coated side down.

E. Lap sides and ends.

F. Overlap edges and ends and seal with contact adhesive, or by heat sealing, minimum 75 mm. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

G. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.

H. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams. Coordinate with drain installation, Division 22 - Plumbing.

I. Install flexible flashings. Seal watertight to membrane.

J. Seal membrane and flashings to adjoining surfaces.

K. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 150 mm above horizontal surface for first ply and as recommended by the manufacturer at subsequent plies laid in shingle fashion.

L. Seal items protruding to or penetrating through membrane and install Counterflashing membrane material.

3.6 INSTALLATION - MECHANICALLY ATTACHED MEMBRANE WATERPROOFING

A. Roll out membrane. Minimize wrinkles and bubbles.

B. Install mechanical fasteners in accordance with applicable code.

C. Bond sheet to membrane disc.

D. Overlap edges and ends and seal by solvent welding, heat welding, contact tape and/or contact adhesive, minimum 75 mm. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.

E. Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams.

F. Install flexible flashings. Seal watertight to membrane.

G. Seal membrane and flashings to adjoining surfaces.

H. Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 150 mm above horizontal surface for first ply and as recommended by the manufacturer at subsequent plies laid in shingle fashion.

I. Seal items protruding to or penetrating through membrane and install Counterflashing membrane material.

3.7 INSTALLATION - DRAINAGE PANEL AND PROTECTION BOARD

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

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

C. Adhere protection board and drainage panel to substrate with mastic to tacky damp proofing surface. Scribe and cut boards around projections, penetrations, and interruptions.

3.8 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 horizontal membrane installation, dam installation area in preparation for flood testing.

C. Flood to minimum depth of 25 mm with clean water. After 48 hours, inspect for leaks.

D. When leaking is found, remove water, repair 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.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

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

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

C. Protect membrane from damage by adhering protection board over membrane surface. Scribe and cut boards around projections and interruptions.

3.10 SCHEDULES

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

END OF SECTION

SECTION 07 14 00

FLUID APPLIED WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fluid applied rubberized asphalt and/or elastomeric waterproofing coating; and surface dusting and/or protective covering.

B. Related Sections:
1. Section 07 21 13 - Board Insulation.
2. Section 07 62 00 - Sheet Metal Flashing and Trim.
3. Section 07 92 00 - Joint Sealants.
4. Division 22 - Plumbing: Roof drain and plumbing vent flashing flanges.

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 Dampproofing 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 sq 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 recognized manufacturer having an official technical agreement to conformity with standards for the product.

2.2 COMPONENTS

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

B. Cured Coating 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: Premolded 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. Counterflashings: 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 07 21 13.

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 07 92 00.

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 22 - Plumbing.

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 07 21 13

BOARD INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes rigid and semi-rigid board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, exterior walls, etc.

B. Related Sections:
1. Section 07 26 00 - Vapor Retarders.
2. Section 07 27 00 - Air Barriers.

1.2 REFERENCES

A. ASTM International:
1. ASTM C240 - Standard Test Methods of Testing Cellular Glass Insulation Block.
2. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.
3. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
4. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
5. ASTM C1289 - Standard Specification for Faced Rigid Cellular Thermal Insulation Board.
6. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
8. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. National Fire Protection Association:
1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories Inc.:
1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.

1.3 SYSTEM DESCRIPTION

A. Materials of this Section:
1. Provide continuity of thermal barrier at building enclosure elements.
2. Provide thermal protection to vapor retarder in conjunction with vapor retarder materials in Section 07 26 00.
3. Provide thermal protection to air seal materials at building enclosure elements in conjunction with air barrier materials in Section 07 27 00.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data on product characteristics, performance criteria, limitations, and adhesives.

C. Manufacturer's Installation Instructions: Submit special environmental conditions required for installation techniques.

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

1.5 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Do not install adhesives when temperature or weather conditions are detrimental.

1.6 SEQUENCING

A. Sequence Work to ensure fireproofing, firestopping, vapor retarder, and air barrier materials are in place before beginning Work of this section.

1.7 COORDINATION

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

B. Coordinate Work with Section 07 26 00 and Section 07 27 00.

PART 2 PRODUCTS

2.1 BOARD INSULATION

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

2.2 COMPONENTS

A. Polypropylene Protection Board: 5 mm thick; Made up of two layers spaced and joined together with ribs spaced at 10 mm; Unit weight: 650g/m².

B. Extruded Polystyrene Insulation Board: ASTM C578, type VII, cellular type:
1. Board Density: 35 kg/m³.
2. Board Size: 1200 x 2400 mm.
3. Board Thickness: 50mm.
4. Thermal Resistance: RSI of 0.87.
5. Water Absorption: To ASTM D2842, 0.3 percent by volume maximum.
6. Compressive Strength: Minimum 175 kPa.
7. Board Edges: Square, shiplap, or tongue and groove edges.
8. Flame/Smoke Properties: In accordance with ASTM E84.

2.3 ACCESSORIES

A. Adhesive Type 1: Type recommended by insulation manufacturer for application.

B. Adhesive Type 2: Vapor retarder type, trowel consistency; fire retardant compatible with insulation and substrate, as recommended by the manufacturer.

C. Sheet Vapor Retarder: Specified in Section 07 26 00.

D. Tape: Bright aluminum, Polyethylene and/or Polyester self-adhering type, mesh reinforced, 50 mm wide.

E. Insulation Fasteners: Impaling clip as recommended by the manufacturer to be adhered and/or mechanically fastened to surface to receive board insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

F. Protective Boards: As recommended by the manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.

C. Verify substrate surface is flat, free of honeycomb, fins, irregularities, and materials or substances affecting adhesive bond.

3.2 INSTALLATION

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

3.3 PROTECTION OF INSTALLED CONSTRUCTION

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

B. Do not permit damage to insulation prior to covering.

3.4 SCHEDULES

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

END OF SECTION

SECTION 07 26 00

VAPOR RETARDERS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes sheet and sealant materials for controlling vapor diffusion.

B. Related Sections:
   1. Section 07 27 00 - Air Barriers.

1.2 REFERENCES

A. ASTM International:
   1. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
   2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

B. Sealant, Waterproofing and Restoration Institute:
   1. SWRI - Sealant Specification.

1.3 PERFORMANCE REQUIREMENTS

A. Maximum Vapor Permeability (Perm): 1 ng/S/m/Pa measured in accordance with ASTM E96 Method E.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data indicating material characteristics, performance criteria, and limitations.

C. Manufacturer's Installation Instructions: Submit preparation and installation requirements, techniques.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with SWRI - Sealant and Caulking Guide Specification requirements for materials and installation.

1.6 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mock-up, size as directed by the Engineer, of exterior wall, ceiling and attic vapor retarder including vapor retarder installation at typical window, door and wall-ceiling intersection.

C. Locate where directed by the Engineer.

D. Remove mockup when directed by the Engineer.

1.7 SEQUENCING

A. Sequence Work to permit installation of materials in conjunction with other retardant materials and seals, and air barrier assemblies specified in Section 07 27 00. Do not install vapor retarder until items penetrating vapor retarder are in place.

PART 2 PRODUCTS

2.1 VAPOR RETARDERS

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

2.2 COMPONENTS

A. Sheet Retarder: Polyethylene film for above grade application, minimum 0.25 mm thick.

B. Sealant: Type as recommended by the Engineer

C. Primer and Backer Rods: As recommended by sealant manufacturer to suit application.

D. Cleaner: Non-corrosive type; as recommended by sealant manufacturer; compatible with adjacent materials.

E. Mastic Adhesive: asphalt type, compatible with sheet retarder and substrate, as recommended by manufacturer.

F. Adhesive: Compatible with sheet retarder and substrate, permanently non-curing, as recommended by manufacturer.

2.3 ACCESSORIES

A. Thinner and Cleaner: As recommended by sheet material manufacturer.

B. Tape: Bright aluminum, Polyethylene and/or Polyester self-adhering type, mesh reinforced, 50 mm wide, compatible with sheet material.

C. Attachments: Stainless steel type 316 bars and anchors.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove loose or foreign matter capable of impairing adhesion.

B. Clean and prime substrate surfaces to receive adhesive and sealants.

3.2 EXISTING WORK

A. Clean and repair existing construction to provide positive and continuous seal for vapor retarders.

3.3 INSTALLATION

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

3.4 SCHEDULES

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

END OF SECTION

SECTION 07 27 00

AIR BARRIERS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes air leakage criteria for primary air seal building enclosure materials and assemblies; materials and installation methods supplementing other and primary air seal materials and assemblies; and air seal materials to connect and seal openings, joints, and junctions between other air seal materials and assemblies.

B. Related Sections:
1. Section 07 26 00 - Vapor Retarders.
2. Section 07 92 00 - Joint Sealants.
3. Division 3 - Concrete.
4. Division 7 - Thermal and Moisture Protection.
5. Division 8 - Openings.

1.2 REFERENCES

A. American Society of Civil Engineers:
1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM International:
1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
3. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.
4. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

C. Sealant, Waterproofing and Restoration Institute:
1. SWRI - Sealant Specification.

1.3 DEFINITIONS

A. Air Barrier: Continuous network of materials and joints providing air tightness, with adequate strength and stiffness to not deflect excessively under air pressure differences, to which it will be subjected in service. It can be comprised of single material or combination of materials to achieve performance requirements.

1.4 DESIGN REQUIREMENTS

A. Perform design work in accordance with ASCE 7.

1.5 PERFORMANCE REQUIREMENTS

A. Static Test: Resist air leakage caused by static air pressure across exterior wall assemblies and other interruptions to integrity of building enclosure systems; in accordance with ASTM E283 and/or ASTM E330.

B. Dynamic Test: Resist air leakage caused by dynamic air pressure across exterior wall assemblies and other interruptions to integrity of wall and roof systems; in accordance with ASTM E283 and/or ASTM E330.

C. Provide continuity of air seal materials and assemblies in conjunction with materials described in Division 3, Division 7 and Division 8.

1.6 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate special joint conditions.

C. Design Data: Submit design calculations.

D. Product Data: Submit data on material characteristics, performance criteria and limitations.

E. Manufacturer's Installation Instructions: Submit preparation, installation requirements and techniques, product storage and handling criteria.

1.7 QUALITY ASSURANCE

A. Perform Work to SWRI - Sealant and Caulking Guide Specification requirements.

B. Maintain one copy of each document on site.

1.8 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mock-up of air barrier system, which is comprised of variety of materials.

C. Construct typical exterior wall panel, size as directed by the Engineer, incorporating window frame and sill, insulation, building corner condition, junction with roof membrane air seal, and vapor retarder; illustrating materials interface and seals.

D. Locate where directed by the Engineer.

E. Remove mockup when directed by the Engineer.

1.9 PRE-INSTALLATION MEETINGS

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

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

1.10 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Maintain temperature and humidity recommended by materials manufacturers before, during and after installation.

1.11 SEQUENCING

A. Sequence Work to permit installation of materials in conjunction with related materials and seals.

1.12 COORDINATION

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

B. Coordinate the Work of this section with sections referencing this section.

PART 2 PRODUCTS

2.1 AIR BARRIERS

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

2.2 COMPONENTS

A. Sheet Seal: Type as recommended by the manufacturer.

B. Liquid Seal: Type as recommended by the manufacturer.

C. Sealant: Type as recommended by the manufacturer.

D. Polysulfide Sealant: Type as recommended by the manufacturer.

E. Polyurethane Sealant: Type as recommended by the manufacturer.

F. Silicone Sealant: Type as recommended by the manufacturer.

G. Primer: As recommended by the manufacturer.

H. Substrate Cleaner: Non-corrosive, type as recommended by sealant manufacturer, compatible with adjacent materials.

I. Mastic Adhesive: Compatible with sheet seal and substrate, as recommended by the manufacturer.

J. Adhesive: Type compatible with sheet seal and substrate, permanently non-curing; As recommended by the manufacturer.

2.3 ACCESSORIES

A. Thinner and Cleaner for Sheet: As recommended by sheet material manufacturer.

B. Tape: Bright aluminum, Polyethylene and/or Polyester self adhering type, mesh reinforced, 50 mm wide, compatible with sheet material.

C. Attachments: Stainless steel type 316 bars and anchors.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean and prime substrate surfaces to receive adhesive and sealants.

3.2 INSTALLATION

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

3.3 PROTECTION OF INSTALLED CONSTRUCTION

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

B. Do not permit adjacent work to damage work of this section.

3.4 SCHEDULES

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

END OF SECTION

SECTION 07 62 00

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

A. Section includes flashings and counterflashings, sheet metal roofing and fabricated sheet metal items, as indicated in Schedule.
   1. Provide reglets and accessories, precast concrete splash pads, and/or sheet metal splash pans.

B. Related Sections:
   1. Section 03 10 00 - Concrete Forming and Accessories.
   2. Section 07 92 00 - Joint Sealants.
   3. Section 09 90 00 - Painting and Coating.
   4. Division 22 - Plumbing: Hangers and Supports (Roof curbs for mechanical equipment).
   5. Division 23 - Heating, Ventilating and Air Conditioning: Hangers and Supports (Roof curbs for mechanical equipment).

1.2 REFERENCES

A. American Architectural Manufacturers Association:
   1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
   2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
   3. AAMA 2604 - Voluntary specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
   4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

B. ASTM International:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   3. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
   4. ASTM B32 - Standard Specification for Solder Metal.
   5. ASTM B101 - Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction.
   6. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

7. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
8. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
9. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
10. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
11. ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

C. Copper Development Association Inc.:
1. CDA - Copper in Architecture - Handbook.

D. Federal Specification Unit:
1. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.

E. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - Architectural Sheet Metal Manual.

1.3 DESIGN REQUIREMENTS

A. Sheet Metal Flashings: Conform to the criteria of SMACNA "Architectural Sheet Metal Manual" and/or Copper Development Association "Copper in Architecture - Handbook".

B. Gutter and Downspout Components: Conform to SMACNA Manual, CDA Handbook, SSINA Standard Practice, and/or NRCA Details for sizing components for rainfall intensity determined by storm occurrence of 1 in 5 years.

C. Maintain one copy of each document on site.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

C. Product Data: Submit data on manufactured components metal types, finishes, and characteristics.

D. Samples:
1. Submit two samples, size as directed by the Engineer, illustrating seam, external and/or internal corners, valley, ridge, junction to vertical dissimilar surface, material and finish.

1.5 QUALIFICATIONS

A. Fabricator and Installer: Company specializing in sheet metal work with minimum ten years documented experience.

1.6 PRE-INSTALLATION MEETINGS

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

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

1.7 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

C. Prevent contact with materials causing discoloration or staining.

1.8 COORDINATION

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

B. Coordinate with Work of Section 03 10 00 for installing recessed flashing reglets.

PART 2 PRODUCTS

2.1 SHEET METAL FLASHING AND TRIM

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

B. Aluminum Sheet: ASTM B209M, alloy and temper as required for application and finish; 0.8 mm thick; finish and color as selected by the Engineer.

2.2 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal.

B. Underlayment: ASTM D4397, 0.25 mm polyethylene.

C. Slip Sheet: As recommended by manufacturer.

D. Primer: As recommended by manufacturer.

E. Protective Backing Paint: As recommended by manufacturer.

F. Sealant: Type as specified in Section 07 92 00.

G. Plastic Cement: ASTM D4586, Type I.

H. Reglets: As recommended by manufacturer.

I. Splash Pads: Precast concrete type, of sizes and profiles as indicated; minimum 29 MPa at 28 days, with minimum 5 percent air entrainment.

J. Downspout Boots and/or Shoes: As recommended by manufacturer.

K. Solder: ASTM B32; type suitable for application and material being soldered.

2.3 FABRICATION

A. Form sections shape indicated on Drawings, accurate in size, square and free from distortion or defects.

B. Fabricate cleats of same material as sheet metal, interlocking with sheet.

C. Form pieces in single length sheets.

D. Hem exposed edges on underside 13 mm; miter and seam corners.

E. Form material with standing, batten and/or flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

F. Tin edges of copper sheet to be soldered. Solder shop formed metal joints. After soldering, remove flux. Wipe and wash solder joints clean. Weather seal joints.

G. Fabricate corners from one piece with minimum 450 mm long legs; seam and/or solder for rigidity, seal with sealant.

H. Fabricate vertical faces with bottom edge formed outward 6 mm and hemmed to form drip.

I. Fabricate flashings to allow toe to extend 50 mm over roofing gravel and/or paver. Return and brake edges.

J. Fabricate snow guards as detailed on drawings.

K. Fabricate gutters to profile and size indicated.

L. Fabricate downspouts to profile and size indicated.

M. Fabricate accessories in profile and size to suit gutters and downspouts.
1. Anchorage Devices: Type recommended by fabricator.
2. Gutter Supports: Type recommended by fabricator.
3. Downspout Supports: Type recommended by fabricator.

N. Fabricate splash pans of same metal type as downspouts, dimension as recommended by fabricator.

O. Seal metal joints.

2.4 FACTORY FINISHING

A. Factory Finish: as recommended by finish system manufacturer.

B. Primer Coat: Finish concealed side of metal sheets with primer compatible with finish system, as recommended by finish system manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

C. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets to lines and levels indicated on Drawings. Seal top of reglets with sealant.

C. Paint concealed metal surfaces with protective backing paint to minimum dry film thickness of 0.4 mm.

3.3 INSTALLATION

A. Install work in accordance with the drawings, to the manufacturer’s recommendations 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. Inspection will involve surveillance of Work during installation to ascertain compliance with specified requirements.

3.5 SCHEDULES

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

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes firestopping materials and accessories; firestopping tops of fire rated walls; and smoke sealing at joints between floor slabs and exterior walls; firestop mortar and sealant systems in shafts at each floor level; firestop filling system for openings in fire rated walls at limits of fire zones; and firestop jackets, plugs and coating systems for pipes and cables passing through fire rated walls at limits of fire zones.

B. Related Sections:
1. Section 07 26 00 - Vapor Retarders.
2. Section 07 27 00 - Air Barriers.
3. Section 09 21 16 - Gypsum Board Assemblies.
4. Division 21 - Fire Supervision.
5. Division 22 - Plumbing.
6. Division 23 - Heating, Ventilating and Air Conditioning.
7. Division 26 - Electrical.
8. Division 27 - Communications.
9. Division 28 - Electronic Safety and Security.

1.2 REFERENCES

A. ASTM International:
1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.

B. Underwriters Laboratories Inc.:
1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL - Fire Resistance Directory.

C. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263 and/or UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1-hour fire rating.
   1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.

B. Surface Burning: ASTM E84 and/or UL 723 with maximum flame spread / smoke developed rating of 25/450.

C. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479 to achieve a fire rating as noted on Drawings.

B. Surface Burning: Conforming to ASTM E84 products shall have a zero (0) smoke and interruptions to fire rated assembly materials, and components.

C. Fire Rated Construction Design Requirements: Maintain barrier and structural floor fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
   1. Latex and acrylic based sealants are not acceptable. Use only urethanes or silicone base materials.

D. Smoke Barrier Construction Design Requirements: Maintain barrier and structural floor resistance to cold smoke at all penetrations, connections with other surfaces and types of construction and at all separations required to permit building movement and sound or vibration absorption, and at other construction gaps.

E. Assembly designs are specified generally under UL system categories by penetrating item. Manufacturer’s product applications must have specific UL system designations.

Penetrating Item	**Concrete**	**Gypsum**	**Wood**
Plastic Pipe	CAJ2000 FA2000	WL2000	FC2000
Metal Pipe	CAJ1000 WJ1000 FA1000	WL1000	FC1000
Insulated Metal Pipe	CAJ5000 CBJ5000 FA5000	WL5000	FC5000

Penetrating Item	Concrete	Gypsum	Wood
Insulated Cable	CAJ2000	WL2000 WL3000	FC3000
	CAJ3000		
	CBJ3000		
	FA3000		
Cable Tray	CAJ4000	WL4000	
	CBJ4000		
Busway	CAJ6000		
	FA6000		
Glass Pipe	CAJ2000		
Blank	CAJ2000	WL2000	
	CAJ0000		
	CBJ0000		
	FA0000		
Construction Gap	FF-S1000		
	WW-S-1000		
	W-S-1000		
Mixed Penetrating Items	CAJ8000	WL8000	
	CBJ8000		
	FA8000		
Misc. Mechanical (Vent Ducts)	CA7000		

F. Wall to floor Joints: UL system HW-D-0000.

G. Duct Damper Penetration: Complete fill annular space with mineral wool safing and seal with flexible firestop sealant. Comply with duct damper manufacturer's requirements.

H. Systems or devices listed in the UL Fire-Resistance Directory under categories XHCR and ZHEZ may be used, providing that they conform to the construction type, penetrate type, annular space requirements, and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.
   1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the product, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

I. Through-Penetration Smoke-Stopping: Any system complying with requirements for through-penetration firestopping in fire rated construction, as specified in this Section, is acceptable, provided system provides a smoke deal.
   1. Latex and acrylic based sealants are not acceptable. Use only urethanes or silicone base materials.

J. Construction-gap Smoke-Stopping: Any system complying with requirements for construction-gap firestopping in fire rated construction, as specified in this Section, is acceptable, provided system provides a smoke seal.

K. Firestop all interruptions to fire rated assemblies, materials, and components.

L. Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data on product characteristics, performance and limitation criteria.

C. Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.

D. Manufacturer's Installation Instructions: Submit preparation and installation instructions.

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

F. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum five years documented experience.

1.8 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Apply ⅓ lm of each type of linear firestopping material to representative substrate surface.

C. Apply one of each unit type of firestopping material, such as penetrations through fire rated partition, to representative application.

D. Locate where directed by the Engineer.

E. Remove mockup when directed by the Engineer.

1.9 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Do not apply materials when temperature of substrate material and ambient air is below 15ºC. Maintain this minimum temperature before, during, and for 3 days minimum after installation of materials.

C. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 FIRESTOPPING

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

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
1. Silicone Firestopping Elastomeric Firestopping: Single/multiple component silicone elastomeric compound and compatible silicone sealant.
2. Foam Firestopping Compounds: Single/multiple component foam compound.
3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
4. Fiber Stuffing and Sealant Firestopping: Composite of mineral and/or ceramic fiber stuffing insulation with silicone elastomer for smoke stopping.
5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel type 316 jacket, joined with collars, penetration sealed with flanged stops.
6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
7. Firestop Pillows: Formed mineral fiber pillows.
8. Firestop Mortar.
9. Firestop Bricks.

C. Color: As selected from manufacturer’s full range of colors.

2.2 MATERIALS

A. General: Provide Firestopping as a complete system for each opening or location which shall stop fire, smoke, fumes, hot gases, and water through fire-rated wall and floor penetrations. Provide systems for use from a single manufacturer to the greatest extent possible, except provide additional systems by other manufacturer.

B. Fire-Rated Silicone Sealant: Silicone sealant shall cure in the presence of atmospheric moisture to produce durable and flexible seal. It shall form airtight and watertight bonds with most common building materials in any combination including cement, masonry, steel and aluminum. Sealant single component with consistency of soft caulk at temperatures ranging from -40 to +75ºC, and extension and compression properties of ± 40% of original gap.

C. Fire Rated Intumescing Caulk: Single component water based materials.

D. Fire Barrier Sheet: Galvanized sheet metal/intumescent fire barrier/wire mesh composite for filling large openings in fire-rated construction.

E. Devices: Steel sheet collars with tabs for mounting to decking and slabs to retain integral preformed firestopping materials. Assembles shall allow additions and deletions as required.

F. Intumescent Putty: One component mouldable compound, non-shrinking, which remains flexible, and can be reused when adding or changing penetrating items including preformed intumescent strips.

G. Firestop Mortar: Portland cement based, non-asbestos, through-penetration firestop mortar.

H. Firestop Pillows: Mineral fiber treated with intumescent coating enclosed in 4 mil polyethylene bag.

I. Mineral Wool Safing: Fire Safing Insulation shall conform to Federal Specifications HH-I-521F, Type I, Class A and shall be one of the following. Use for UL approved curtain wall applications.

J. Intumescent Collars: Provide where necessary to all pipe penetrations through fire rated structures steel intumescent pipe collars.

2.3 ACCESSORIES

A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.

B. Dam Material: Permanent:
1. Mineral fiberboard.
2. Mineral fiber matting.
3. Sheet metal.
4. Plywood or particle board.
5. Alumina silicate fire board.

C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Install backing and/or damming materials to arrest liquid material leakage.

3.3 APPLICATION

A. Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

B. Install materials to door, window and other access openings where required.

C. Apply materials in accordance with manufacturer’s instructions.

D. Apply firestopping material in sufficient thickness to achieve rating.

E. Compress fibred material to achieve a density of 25 percent of its uncompressed density.

F. 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.

B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.5 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

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

B. Protect adjacent surfaces from damage by material installation.

3.7 SCHEDULES

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

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes sealants and joint backing, precompressed foam sealers, hollow gaskets and accessories.

B. Related Sections:
1. Section 07 26 00 - Vapor Retarders.
2. Section 07 27 00 - Air Barriers.
3. Section 09 21 16 - Gypsum Board Assemblies.
4. Section 09 30 00 - Tiling.

1.2 REFERENCES

A. ASTM International:
1. ASTM C834 - Standard Specification for Latex Sealants.
2. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications.
3. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
4. ASTM C1193 - Standard Guide for Use of Joint Sealants.
5. ASTM D1056 - Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
6. ASTM D1667 - Standard Specification for Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
7. ASTM D2628 - Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Products Data: Submit data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and color availability.

C. Samples: Submit samples illustrating sealant colors for selection.

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

E. Warranty: Include coverage for installed sealants and accessories failing to achieve airtight seal or watertight seal, exhibit loss of adhesion or cohesion, and sealants which do not cure.

1.4 QUALITY ASSURANCE

A. General Joint Sealer Performance Requirements: Select materials for compatibility with joint surfaces and other indicated exposures.
   1. Select modulus of elasticity and hardness or grade recommended by manufacturer for each application indicated.
   2. Where exposed to foot traffic, select materials of sufficient strength and hardness to withstand stiletto heel traffic without damage or deterioration of sealer system.

B. Color Selection: Provide colors indicated and if not, to match adjacent material or paint color; provide custom colors where required; colors to be selected by Engineer.

C. Perform work in accordance with sealant manufacturers' requirements for preparation of surfaces and material installation instructions.

D. Contractor shall require sealant manufacturer to review joint conditions and details, and shall submit to the Engineer written certification from the sealant manufacturer that joints are of the proper size and design, that the materials and backing will properly perform to provide permanent watertight, airtight or vaportight seals (as applicable), and that materials supplied meet specified performance requirements.
   1. Certification shall include copies of manufacturer's test regarding adhesion and staining of adjacent.

E. Perform acoustical sealant application work in accordance with ASTM C919.

F. Maintain one copy of each referenced document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum five years documented experience.

1.6 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mockup of sealant joints in conjunction with window, wall and other mockups specified in other sections.

C. Construct mockup with specified sealant types and with other components noted.
   1. Determine preparation and priming requirements based on manufacturer's recommendations; take action necessary for correction of failure of sealant tests on mock-up.
   2. Verify sealants, primers and other components don't stain adjacent materials.

D. Locate where directed by the Engineer.

E. Remove mockup when directed by the Engineer.

1.7 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Products requirements.

B. Maintain temperature and humidity recommended by sealant manufacturer during and after installation.

1.8 COORDINATION

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

B. Coordinate Work with sections referencing this section.

PART 2 PRODUCTS

2.1 JOINT SEALERS

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

B. General:
1. Provide a complete system of cleaners, primers, fillers, tapes, backer rods and tapes and sealants in accordance with the manufacturer's requirements and the standards specified herein.
2. Color of Sealants:
   a. For Concealed Joints: Provide the manufacturer's standard color which has the best overall performance quantities for the application shown.
   b. For Exposed Joints: Provide custom colors as selected by the Engineer from the manufacturer's standard colors or other special custom colors.

C. 1-Part Polyurethane Sealants: Polyurethane based 1-part elastomeric sealant, in accordance and complying with Fed. Spec. TT-S-00230C, Type II Class A, with elongation and compression of not less than 25 %; ASTM C920, Type S, Class 25, Grade NS.
1. Location: Interior joints subject to movement.
2. Acceptable Manufacturers and Product:
   a. Sika Chemical Corporation: Sikaflex-1a.
   b. Sonneborn Building Products: Sonolastic NP-1.
   c. Tremco: Dymonic.

D. 2-Part Polyurethane Sealant: Polyurethane based 2-part elastomeric sealant, in accordance and complying with Fed. Spec. TT-S-00227, Type II, Class A, with elongation and compression of not less than 25 %; ASTM C920, Type M, Class 25, Grade NS.
1. Location: Exterior joints within masonry and concrete.
2. Acceptable Manufacturers and Product:
   a. Tremco: Dymeric.
   b. Sonneborn Building Products: Sonolastic NP II.

E. 2-Part Polyurethane Sealant for Horizontal Applications: Self leveling polyurethane based 2-part elastomeric sealant, complying with Fed. Spec. TT-S-00227E, Type I, Class A, with shore A hardness of not less than 30 and elongation and compression of not less than 25 %; ASTM C920, Type M, Class 25, Grade P.
   1. Location: Joints subject to pedestrian or vehicle traffic.
   2. Acceptable Manufacturers and Product:
      a. Tremco: THC900
      b. Sonneborn Building Products: Sonolastic Paving Joint Sealant.

F. Medium Modulus Silicone Rubber Sealant: Silicone rubber based 1-part neutral cure elastomeric sealant with plus 50 percent to minus 50 percent movement complying with ASTM C920 and Fed. Spec. TT-S-001543, Class A, and recommended by manufacturer for joints.
   1. Location: Exterior joints subject to movement, NOT in contact with external insulation finishing system (EIFS).
   2. Acceptable Manufacturers and Product:
      a. Dow Corning Corporation: 795 Building Sealant.
      b. Sonneborn, ChemRex Inc.: Sonolastic Omniseal or OmniPlus.
      c. Tremco Construction Division: Spectrum 2.

G. Medium Modulus Silicone Rubber Sealant to Reduce Bleeding and Mildew Growth: Silicone rubber based 1-part neutral cure elastomeric sealant with plus 50 percent to minus 50 percent movement specially designed for exterior application to reduce bleeding and mildew growth complying with ASTM C920.
   1. Location: Exterior joints in metal panels and exterior ceramic tile.
   2. Acceptable Manufacturers and Product:
      a. Dow Corning Corporation: 756 Building Sealant - HP.

H. Ultra Low-Modulus Silicone Rubber Sealant: Silicone rubber based 1-part neutral cure elastomeric sealant with plus 100 percent to minus 50 percent movement complying with ASTM C920 and Fed. Spec. TT-S-001543, Class A.
   1. Location: Joints in contact with external insulation finishing system (EIFS).
   2. Acceptable Manufacturers and Product:
      a. Dow Corning Corporation: 790 Building Sealant.

I. High Modulus Silicone Rubber Sealant: 1-part nonacid-curing silicone.
   1. Location: Joints related to structural glazing.
   2. Acceptable Manufacturers and Product:
      a. Dow Corning Corporation: Silicone 799.
      b. General Electric: Ultraglaze SSG 4000.

J. Mildew-Resistant Silicone Rubber Sealant: Silicone rubber based 1-part mildew resistance sealant with integral fungicide complying with Fed. Spec. TT-S-001543, Class A. Specifically recommended by manufacturer for interior joints in wet areas around plumbing fixtures and ceramic tile.
   1. Location: Joints in ceramic tile walls and floors, around equipment, and around plumbing fixtures.
   2. Acceptable Manufacturers and Product:
      a. General Electric: Sanitary 1700 Sealant.
      b. Dow Corning Corporation: Silicone 786 mildew resistant.

K. Acrylic Sealants: General purpose, paintable acrylic-emulsion sealant with plus 7.5 percent to minus 7.5 percent movement complying with ASTM C834.
   1. Location: Interior joints NOT subject to movement.
   2. Acceptable Manufacturers and Product:
      a. Tremco: Acrylic Latex 834.
      b. Sonneborn Building Products: Sonolac.

L. 2-Part Polysulfide Sealant: Polysulfide based 2-part elastomeric sealant with plus 25 percent to minus 25 percent movement, complying with Fed. Spec. TT-S-00227, type II, class A, non-sag synthetic rubber formulated form “Thiokol LP” polymer and recommended by manufacturer for continuous submersion in chlorinated water.
   1. Location: Joints submerged in treated water, swimming pools and whirlpools.
   2. Acceptable Manufacturers and Product:
      a. Pecora Corporation: Synthacalk GC-5.
      b. Sonneborn Building Products.

M. Foam Gasket Seal: Precompressed, impregnated open-cell foam sealant incorporating permanently elastic open cell polyurethane foam, manufacturer’s standard impregnating agent, and pressure sensitive backing.
   1. Acceptable Manufacturers and Product:
      a. Emseal Corporation: Emseal Greyflex.
      b. Illbruck Inc.: Will-Seal 150.
      c. York Manufacturing, Inc.: York-Seal 100.

N. Foam Gasket Seal for Submerged Application: Precompressed, impregnated open-cell foam sealant incorporating permanently elastic open cell polyurethane foam, manufacturer’s impregnating agent at higher levels than standard product, and pressure sensitive backing.
   1. Specially designed for use in submerge application.
   2. Acceptable Manufacturers and Product:
      a. Emseal Corporation: Emseal.
      b. Illbruck Inc.: Will-Seal 200.
      c. York Manufacturing, Inc.: York-Seal 200.

O. Splice Adhesive for Foam Gasket Seal: 1-part urethane wet sealant as recommended by gasket seal manufacturer.

2.2 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Backing: Round foam rod compatible with sealant; ASTM D1056, sponge or expanded rubber; or ASTM D1667, closed cell PVC; oversized 30 to 50 % larger than joint width.
   1. Type: As recommended by manufacturer.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify substrate surfaces and joint openings are ready to receive work.

C. Verify joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

A. Remove loose materials and foreign matter impairing adhesion of sealant.

B. Clean and prime joints.

C. Perform preparation in accordance with ASTM C1193.

D. Protect elements surrounding Work of this section from damage or disfiguration.

3.3 INSTALLATION

A. Perform installation in accordance with ASTM C1193.

B. Perform acoustical sealant application work in accordance with ASTM C919.

C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.

D. Install bond breaker where joint backing is not used.

E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.

F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

G. Tool joints as detailed.

H. Precompressed Foam Sealant: Do not stretch; avoid joints except at corners, ends, and intersections; install with face 3 to 6 mm below adjoining surface.

I. Compression Gaskets: Avoid joints except at ends, corners, and intersections; seal joints with adhesive; install with face 3 to 6 mm below adjoining surface.

3.4 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Clean adjacent soiled surfaces.

3.5 PROTECTION OF INSTALLED CONSTRUCTION

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

B. Protect sealants until cured.

3.6 SCHEDULES

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

END OF SECTION

SECTION 08 01 10

OPERATION AND MAINTENANCE OF DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes restoration of existing metal and wood doors and frames. Work to match in-kind existing details.

B. Related Sections:
1. Section 08 01 11.91 - Metal Door Restoration.
2. Section 08 01 14.91 - Wood Door Restoration.

PART 2 PRODUCTS

2.1 MATERIALS FOR METAL AND WOOD DOOR RESTORATION

A. Materials for metal door restoration shall be as specified in Section 08 01 11.91.

B. Materials for wood door restoration shall be as specified in Section 08 01 14.91.

PART 3 EXECUTION

3.1 RESTORATION OF METAL AND WOOD DOORS AND FRAMES

A. Restore metal door as specified in Section 08 01 11.91.

B. Restore wood door as specified in Section 08 01 14.91.

END OF SECTION

SECTION 08 01 11.91

METAL DOOR RESTORATION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the restoration of existing metal doors and frame, and trim replacement. Work to match in-kind existing details.
   1. Removal of paint system on steel surfaces shall be executed by an approved paint applicator.
   2. Damaged metal profiles and frames shall be repaired or replaced with new metal profiles and frames to match in-kind existing.
   3. Damaged glazing shall be replaced with new glass to match in-kind existing.

B. Related Sections:
   1. Section 08 11 13 - Hollow Metal Doors and Frames.
   2. Section 08 80 00 - Glazing.
   3. Section 09 90 00 - Painting and Coatings.

1.2 SUBMITTALS

A. Samples:
   1. Four samples, each 12" long, for each type of metal profile;
   2. Four samples, each 12" x 12", for each type of glass and glazing materials;
   3. Replacement materials for weatherstripping replacement;
   4. Replacement hardware and accessories;
   5. Testing results as requested.

B. Glazing Compound:
   1. Manufacturer’s product literature;
   2. Compatibility certificate.

C. Caulking:
   1. Manufacturer’s product literature;
   2. Color samples for Employer’s color selection.

D. Paint Samples for Steel Doors:
   1. Manufacturer’s product literature for both primer and finish paint;
   2. Four samples, each 6" x 6" for each finish paint. Color to match existing.

E. Chemical Cleaner:
   1. Manufacturer’s product literature;
   2. Testing result from field test: Conduct testing in accordance with manufacturer’s recommendations.

F. Weather Stripping:
   1. Manufacturer’s product literature;
   2. Weather stripping samples to verify compatibility with existing door operation and detail.

G. Shop Drawings:
   1. At a minimum, provide drawings including elevations, sections, and details necessary to describe all damage to existing doors and frames and to describe methods of repair.
   2. Plans and details of abatement protection.

H. Restoration Plan: Develop a plan of restoration encompassing all stages of work. Include as a minimum:
   1. Written description of all damage and methods and techniques of repair.
   2. Environmental factors affecting the work, and techniques and methods proposed to ensure construction within appropriate environmental conditions.
   3. Proposed phasing and timing of the work including coordination with progress of adjacent restoration work.
   4. Methods of protection for surrounding construction.

I. Mockup:
   1. Restore complete one door for each material type, to demonstrate aesthetic effects and set quality standards for material & execution. Review completed mock-up for approval by Employer. Correct all conditions noted during review process. Re-check until approved, at no additional cost to Employer.
   2. Do not begin remaining restoration work until mock-up is approved.

1.3 QUALITY ASSURANCE

A. The Work of this Section shall be conducted by a firm with not less than ten years of successful experience in similar door restoration work.

1.4 DEFINITION

A. In-Kind: Replacement material to match minimum existing original material in detail, specifications and design in every way to the satisfaction of the Engineer.

1.5 PROJECT CONDITIONS

A. Install all finish work plumb, level, true, and straight, with no distortions. Anchor finished work securely to supports and substrates, using concealed fasteners and blind nailing where possible.
   1. Work of this Section shall be performed on a door-to-door basis.
   2. Use fine finishing nails for exposed nailing, except as indicated, countersunk and filled flush with finish surface.

B. Salvage all undamaged glass and hardware.

C. Remove and replace rotten, damaged and/or deteriorating door material.

D. Remove paint finishes on steel surfaces. Apply primer and final finish only after testing treated steel surfaces for alkalinity and moisture content compatible to paint manufacturer’s written limitation(s). Submit a written copy of test results.

1.6 PRE-INSTALLATION MEETING

A. Conduct a pre-installation meeting at the Project site one week prior to restoration.

PART 2 PRODUCTS

2.1 DOOR MATERIALS

A. Materials for missing or any damaged part or component of the door shall minimum match in-kind existing specifications, and shall be as specified in Section 08 11 13.

B. Replacement of existing metal door shall minimum match in-kind existing specifications, and shall be as specified in Section 08 11 13.

2.2 GLASS AND GLAZING COMPOUND

A. Replace all damaged and broken glass with glazing compound by new glass system to match minimum existing specifications and as specified in Section 08 80 00.

B. Undamaged glass system shall not be replaced unless otherwise shown on Drawings.

2.3 SCREENS

A. Minimum to match in-kind existing specifications.

B. Use mortise and tenon for end-to-end joints to screen frames.

2.4 FASTENERS AND ANCHORAGES

A. Provide nail, screws and anchoring devices of type, size, material and finish suitable for intended use and required to provide secure attachment, concealed where required and to match minimum existing specifications.

B. Hot-dip galvanized for work exposed to exterior and high humidity to ASTM A153.

2.5 STANDING AND RUNNING TRIM

A. Install with minimum number of joints possible, using full-length pieces from maximum length of lumber available.

B. Cope at returns, and miter at corners to produce tight fitting joints.

2.6 PAINTING TO STEEL SURFACES

A. Use materials compatible with existing installations and as per Section 09 90 00.

2.7 MISCELLANEOUS MATERIALS

A. Glass Cleaners, Primers, Sealers, Filling Compounds, Hardware, Glazing Points and Weather Stripping:
   1. Provide all additional materials as necessary for the work.
   2. Field coordinate extent of work with all conditions indicated.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.

C. Report conditions capable of affecting proper application.

D. Measure moisture content of surfaces using electronic moisture meter. Do not apply painting to steel surfaces unless moisture content of surfaces is below 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Surface Appurtenances: Remove or mask hardware, ironmongery and glass prior to preparing surfaces or finishing.

B. Seal door top and bottom edge surfaces with clear sealer or tinted primer.

3.3 DOOR RESTORATION

A. Remove door sash and screen (if any).

B. Glass:
1. Remove damaged or broken glass from doors. Replace broken glass with new to match minimum existing specifications.
2. Remove undamaged glass from doors where needed.
3. Salvage to re-use undamaged glass.

C. Hardware:
1. Replace damaged or missing hardware with new hardware to match minimum existing specifications. Field-verify extent of hardware replacement at each door location indicated.
2. Remove undamaged hardware from doors where needed.
3. Salvage to re-use undamaged hardware.

D. Replace missing and broken metal profiles and frames.

E. Prepare and Paint Steel Surfaces: Repair paint as specified in Section 09 90 00 and in accordance with the following:
1. Prepare Steel Surfaces:
    a. Surfaces shall be dry and have a humidity value that meets the manufacturer’s recommendations.
    b. Surfaces to be clean; free from oil, grease, wax, silicon, coating, etc.
    c. Carefully remove any dust created during sanding and wipe away any residues to manufacturer’s recommendations.
    d. Test alkalinity and moisture content of steel.

2. Paint Application to Steel Surfaces:
   a. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
   b. Sand surfaces lightly between coats to achieve required finish.
   c. Prime surfaces with oil based primer, brush on.
   d. Paint surfaces with oil based paint, two coats, brush on. Paint shall cover glazing compound to seal.
   e. Temperature for Paint Application: +5ºC to +30ºC.
   f. Paint Coverage: 80 to 100 ml/m²/coat.

F. Clean to remove paint drips, spills and dirt.

G. Re-install glass and hardware.

H. Rehang door sash.

I. Clean and lubricate existing hinges and operating (movable) parts.

J. Adjust door for smooth and balanced movement.

3.4 CURE, PROTECTION AND CLEANING

A. Cure glazing sealants and compounds in compliance with manufacturer's written instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

B. Protect glass from chemical cleaning.

C. Protect glass from breakage immediately upon installation by use of crossed streamers attached to framing and held away from glass. Do not apply markers to surfaces of glass.

D. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during construction period, including natural causes, accidents and vandalism.

E. Maintain glass in a reasonably clean condition during construction so that it will not be damaged by corrosive action and will not contribute (by wash-off) to deterioration of glazing materials and other Work.

F. Wash and polish glass on both faces, interior and exterior, not more than four (4) days prior to the date of Substantial Completion. Comply with glass manufacturer's recommendations for final cleaning.

G. Touch-up paint and/or stain finish steel surfaces as required.

H. Clean, dust and leave adjacent Work area of the door in a clean and neat manner.

END OF SECTION

SECTION 08 01 14.91

WOOD DOOR RESTORATION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the restoration of existing wood doors and frame, and trim replacement. Work to match in-kind existing details.
   1. Removal and disposal of paint on wood surfaces shall be executed by an approved paint applicator.

B. Related Sections:
   1. Section 08 14 16 - Flush Wood Doors.
   2. Section 09 90 00 - Painting and Coatings.

1.2 SUBMITTALS

A. Samples:
   1. Four samples for each type of replaced hardware and accessories;
   2. Testing results as requested.

B. Paint Samples:
   1. Manufacturer’s product literature for both primer and finish paint;
   2. Four samples, each 6" x 6" for each finish paint. Color to match existing.

C. Shop Drawings: At a minimum, provide drawings including elevations, sections, and details necessary to describe all damage to existing doors and frames and to describe methods of repair.

D. Restoration Plan: Develop a plan of restoration encompassing all stages of work. Include as a minimum:
   1. Written description of all damage and methods and techniques of repair.
   2. Environmental factors affecting the work, and techniques and methods proposed to ensure construction within appropriate environmental conditions.
   3. Methods of protection for surrounding construction.

E. Mockup:
   1. Restore complete one door to demonstrate aesthetic effects and set quality standards for material and execution. Review completed mock-up for approval by Employer. Correct all conditions noted during review process. Re-check until approved, at no additional cost to Employer.
   2. Do not begin remaining restoration work until mock-up is approved.

1.3 QUALITY ASSURANCE

A. The Work of this Section shall be conducted by a firm with not less than ten years of successful experience in similar restoration work.

1.4 DEFINITION

A. In-Kind: Replacement material to match minimum existing original material in detail, specifications and design in every way to the satisfaction of the Engineer.

1.5 PROJECT CONDITIONS

A. Install all finish work plumb, level, true, and straight, with no distortions. Anchor finished work securely to supports and substrates, using concealed fasteners and blind nailing where possible.
   1. Work of this Section shall be performed on a door-to- door basis.
   2. Use fine finishing nails for exposed nailing, except as indicated, countersunk and filled flush with finish surface.

B. Salvage all undamaged hardware.

C. Remove and replace rotten, damaged and/or deteriorating door material.

D. Remove paint finishes. Apply primer and final finish only after testing treated wood surfaces for alkalinity and moisture content compatible to paint manufacturer's written limitation(s). Submit a written copy of test results.

1.6 PRE-INSTALLATION MEETING

A. Conduct a pre-installation meeting at the Project site one week prior to restoration work.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

A. Wood materials for missing or any damaged part or component of the door shall minimum match in-kind existing specifications, and shall be as per Section 08 14 16.

B. Replacement of existing wood door shall minimum match in-kind existing specifications, and shall be as specified in Section 08 14 16.

2.2 FASTENERS AND ANCHORAGES

A. Provide nail, screws and anchoring devices of type, size, material, and finish suitable for intended use and required to provide secure attachment, concealed where possible and to match minimum existing specifications.

B. Hot-dip galvanized for work exposed to exterior and high humidity to ASTM A153.

2.3 STANDING AND RUNNING TRIM

A. Install with minimum number of joints possible, using full-length pieces from maximum length of material available.

B. Cope at returns, and miter at corners to produce tight fitting joints.

2.4 WOOD PAINTING

A. Use materials compatible with existing installations and as per Section 09 90 00.

2.5 MISCELLANEOUS MATERIALS

A. Primers, Sealers, Filling Compounds, Hardware and Weather Stripping:
   1. Provide all additional materials as necessary for the work.
   2. Field coordinate extent of work with all conditions indicated.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.

C. Report conditions capable of affecting proper application.

D. Measure moisture content of wood surfaces using electronic moisture meter. Do not apply painting to wood surfaces unless moisture content of surfaces is below 15 percent, measured in accordance with ASTM D4442.

3.2 PREPARATION

A. Surface Appurtenances: Remove or mask hardware and ironmongery prior to preparing surfaces or finishing.

B. Seal wood door top and bottom edge surfaces with clear sealer or tinted primer to suit application.

3.3 DOOR RESTORATION

A. Remove door leaf.

B. Hardware:
   1. Replace damaged or missing hardware with new hardware to match in-kind minimum existing specifications. Field-verify extent of hardware replacement at each door location indicated.
   2. Remove undamaged hardware from doors where needed.
   3. Salvage to re-use undamaged hardware.

C. Replace missing and broken pieces.

D. Prepare and Paint Wood Surfaces: Repair paint as specified in Section 09 90 00 and in accordance with the following:
   1. Prepare Wood Surfaces:
      a. Wood surfaces shall be dry and have a humidity value that meets the manufacturer's recommendations.
      b. Sand wood surfaces. Clean and free from oil, grease, wax, silicon, coating, etc.
      c. Carefully remove any dust created during sanding and wipe away any residues to manufacturer's recommendations.
      d. Test alkalinity and moisture content of wood.
   2. Paint Application to Wood Surfaces:
      a. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
      b. Sand wood surfaces lightly between coats to achieve required finish.
      c. Prime wood surfaces with oil based primer, brush on.
      d. Paint wood surfaces with oil based paint, two coats, brush on. Paint shall cover glazing compound to seal.
      e. Temperature for Paint Application: +5ºC to +30ºC.
      f. Paint Coverage: 80 to 100 ml/m²/coat.

E. Clean to remove paint drips, spills and dirt.

F. Re-install hardware.

G. Rehang door leaf.

H. Clean and lubricate existing hinges and operating (movable) parts.

I. Adjust door for smooth and balanced movement.

3.4 CURE, PROTECTION AND CLEANING

A. Cure and protect compounds in compliance with manufacturer's written instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability.

B. Touch-up paint and/or stain finish surfaces as required.

C. Clean, dust and leave adjacent Work area of the door in a clean and neat manner.

END OF SECTION

SECTION 08 11 13

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes non-rated and fire rated steel doors, panels and louvers; with frames.

B. Related Sections:
1. Section 08 71 00 - Door Hardware.
2. Section 09 90 00 - Painting and Coating: Field painting of doors and frames.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI 80 - Standard for Fire Doors and Other Opening Protective.
2. ANSI A156.115 - Hardware Preparation in Steel Doors and Steel Frames.
3. ANSI A156.7 - Hinge Template Dimensions.
4. ANSI A250.3 - Test Procedure & Acceptance Criteria for Factory Applied Finish Coating for Steel Doors and Frames.
5. ANSI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frames Anchors.
6. ANSI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
7. ANSI A250.8 - Specifications for Standard Steel Doors and Frames.
8. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel.
9. ANSI A250.11 - Recommended Erection Instructions for Steel Frames.
10. ANSI 257 - Standard on Fire Test for window and Glass Block Assemblies.

B. ASTM International:
1. ASTM A568 / A568M - Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
3. ASTM A879 / A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
4. ASTM A924 - Specification for General Requirements for Steel Sheet, Metallic Coated by the Hot Dip Process.
5. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
6. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
7. ASTM C143/C143M - Test Method for Slump of Hydraulic-Cement Concrete.
8. ASTM C1363 - Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.

9. ASTM E90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
10. ASTM E413 - Standard Classification for Rating Sound Insulation.

C. Hollow Metal Manufacturers Association:
1. HMMA 801 - Glossary of Terms for Hollow Metal Doors and Frames.
2. HMMA 802 - Manufacturing of Metal Doors and Frames.
3. HMMA 803 - Steel Tables.
4. HMMA 810 - Hollow Metal Doors.
5. HMMA 810 TN01 - Defining Undercuts.
6. HMMA 820 - Hollow Metal Frames.
7. HMMA 820 TN01 - Grouting Hollow Metal Frames.
8. HMMA 820 TN03 - Guidelines for Glazing of Hollow Metal Transom, Sidelight and Windows.
9. HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames.
10. HMMA 831 - Hardware locations for Hollow Metal Doors and Frames.
11. HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames.
12. HMMA 840 TN01 - Painting Hollow Metal Products.
13. HMMA 866 - Guide Specifications for Stainless Steel Hollow Metal Doors and Frames.

D. National Fire Protection Association:
1. NFPA 80 - Standard for Fire Doors, Fire Windows.
2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

E. Steel Door Institute:
1. SDI 100 - Specifications for Standard Steel Doors and Frames.
2. SDI 108 - Recommended Selection & Usage Guide for Standard Steel Doors.
3. SDI 110 - Standard Steel Doors and Frames for Modular Masonry Construction.
4. SDI 111 - Recommended Details for Standard Details Steel Doors, Frames, Accessories and Related Components.
5. SDI 117 - Manufacturing Tolerances for standard Steel doors and Frames.
6. SDI 118 - Basic Fire Door, Fire Door Frame, Transom/Sidelight Frame and Window Frame Requirements.
7. SDI 122 - Installation and Troubleshooting Guide for Standard Doors and Frames.
8. SDI 124 - Maintenance of Standard Steel Doors and Frames.

F. Underwriters Laboratories Inc.:
1. ANSI/UL 9 - Fire Test of Window Assemblies.
2. UL 10B - Fire Tests of Door Assemblies.
3. ANSI/UL10C - Standard for Positive Pressure Fire Tests of Door Assemblies

G. Uniform Building Code:
1. UBC Standard 7-2 - Fire Tests of Door Assemblies.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate for each type the following:
1. Door and frame elevations.

2. Details of doors including vertical and horizontal visible interlocked edge details, metal thicknesses, internal reinforcement, closure method, and cut-outs for glazing, louvers and finishes.
3. Frame details including dimensioned profiles and metal thicknesses.
4. Details of sound-control UL listed and labeled seals.
5. Locations of reinforcement and preparations for hardware.
6. Details of each different wall opening condition.
7. Details of anchorages, joints, field splices, and connections.
8. Details of conduit and preparations for power, signal, and control systems.

C. Product Data: For each type of metal door, submit door and frame configurations, location of cut-outs for hardware reinforcement, construction details, material descriptions, core descriptions, fire-resistance rating and finishes.

D. Samples: Submit two samples of door face metal, 450 x 450 mm in size, illustrating shop finish colors and surface texture, and demonstrating compliance with requirements for quality of materials and construction of the following:
1. Doors: Show vertical-edge, top and bottom construction; core construction; and hinge and other applied hardware reinforcement.
2. Frames: Show profile, corner joint, visible seam edges, wall anchors, silencers and UL listed sound seals for sound-control doors.
3. Glazing: Include separate section showing glazing if applicable.

E. Manufacturer's Installation Instructions: Submit special installation instructions.

F. Manufacturer's Certificate: Certify Products meet or exceed specified requirements. Certificates to be signed by Intertek or UL accredited testing agency certifying that the manufacturer complies with the requirement of this section. Intertek or UL accredited testing agency standard labels should be attached on doors.

G. Schedule: Provide a schedule of hollow metal works prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

H. Product Test Reports: Based on evaluation of comprehensive tests performed by Intertek or UL accredited testing agency, for each type of door and frame assembly.

I. Site Quality Control Reports.

J. Method Statement.

K. Guarantee: Include names and addresses of the project, the Employer, the Engineer, and other specified information and as directed by the Engineer.

L. Operation and Maintenance Manuals: Submit maintenance procedure of the manufacturer including procedures and frequency for cleaning and repairing works.

1.4 PERFORMANCE REQUIREMENTS

A. Ensure that the work, including door architectural hardware meets the references as stated in this section and the ANSI standards of Architectural Hardware.

B. Fire-Rated Metal Doors - General: Metal doors, when installed and tested, shall pass UL10C, and can be rated as fire resistant metal doors for the specified duration. Assemblies complying with NFPA80 standard for fire protection rating indicated based on testing at positive pressure. Fire resistant metal doors must have been tested and shall carry the identifying label of Intertek or UL accredited testing agency confirming its fire resistance rating. Door skins with not less than 1.2 mm thickness indicated, fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise stated. Linear Interlock (visible seam) on door edge is permissible. Putty is not allowed.

C. Fire Resisting Doors and Assemblies: All fire-resisting doors, shutters, grilles, screens, panels and the like, together with associated component assemblies shall have been tested and must carry the identifying label of Intertek or UL accredited testing agency, confirming their fire resistance rating. The Contractor shall demonstrate that Intertek or UL accredited testing agency will conduct random factory inspection follow-ups to confirm that the submitted doors are identical to the tested specimens.

D. Where UL listed profile glazing doors are specified, comply with UL10C requirement and criteria. All UL listed profile glazing doors to be powder coated.

1.5 MAIN CRITERIA

A. Fire Labels: All fire labels to be issued by Intertek or UL accredited testing agency:
1. The label produced shall bear a serial number, the name of the Intertek or UL accredited testing agency and the date and number of the license.
2. The qualified Intertek or UL accredited testing agency shall certify the consistency of the door assembly production as per the tested specimen.

B. Fire Resisting Door Components: All components of fire resisting doors and assemblies, including but not limited to, door leaves, frames, architectural hardware, and glazing, shall have the same rating, and shall carry identifying labels of Intertek or UL accredited testing agency, confirming their individual fire resistance rating and transmitted temperature.
1. Door leaves and frames shall be labeled, and from same manufacturer.
2. Door hardware shall be listed and labeled.
3. Latched as tested.
4. Fire doors is associated with door closing devices. Where allowed by NFPA 80 closing devices can be removed.
5. Oversize fire-rated door assemblies: For units exceeding sizes of tested assemblies, manufacturer to provide labels that oversize doors comply with standard construction requirements for tested and labeled fire-rated doors.

C. Fire Resisting Door Enclosures: The space between the top of the fire resisting door assembly and the structural soffit above shall be closed by a wall, or an appropriate panel with a fire rating equal to or exceeding that of the door.

D. Weather Stripping: Provide weather seals to all external doors.

E. Metal Frames General: Provide frames not less than 1.5 mm thickness indicated, fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise stated. Frames to be with visible seam edges. Knock-down frames are accepted.

F. Sound Rated Doors: Provide sound-control door assemblies that have been fabricated and tested as sound-retardant units, and that are identical to assemblies tested according to ASTM E90 and

have a weighted sound reduction index (Rw) or Sound Transmission Class (STC), calculated according to ASTM E413, less than 45 dB unless otherwise shown on drawings. Acoustic doors hardware shall include perimeter/smoke seals, automatic drop down seals and threshold. Where smoke sealant doors are specified, the doors shall be provided with additional seals and threshold to meet the acoustic STC requirement of the door assemblies.

1.6 DESIGN CRITERIA

A. Door architectural hardware shall be as shown on drawings and/or final approved hardware sets. The door assembly manufacturer shall ensure that the door architectural hardware does not negate the certification of the door.

B. All doors assembly shall be checked at all levels with regard to security and the relevant security symbols.

C. The Contractor in liaison with the hardware supplier shall ensure that all necessary seals, fasteners, accessories and ancillary items are supplied as required to achieve the requirement of the specification.

D. All labels shall be permanently marked on each door or frame as per the recommendation of Intertek or UL accredited testing agency.

E. Ensure that all doors are clearly marked on the hinge edge with their door number.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing work of this section with minimum ten years documented experience, and that is approved, authorized or licensed by the product manufacturer to install his product, and that is eligible to receive manufacturer's guarantee.

1.8 QUALITY ASSURANCE

A. Perform Work in accordance with the drawings, to the manufacturer’s instructions and to the satisfaction of the Engineer.

B. Source Limitations: Obtain hollow metal work including UL listed sound-control doors from single source, from single manufacturer.

C. Perform Work in accordance with ANSI A250.8.

D. Fire Rated Door & Panel Construction: Conform to NFPA 252, UL 10B & UBC 7-2.

E. Fire Rated Door Construction: Rate of rise of 361ºC across door thickness for stairs.

F. Installed Door and Panel Assembly: Conform to NFPA 80 for fire rated class as indicated on Drawings.

G. Quality Benchmark Installation: An area determined by the Engineer of each element of the work fully installed, completed and accepted by the Engineer and comply with the standards of SDI, NFPA and HMMA.

H. Preconstruction Testing/Reports:
1. Provide certification to demonstrate that doors and frames have been previously tested to meet the standard UL10C.
2. Test certificates shall not relieve the Contractor of his responsibilities regarding performance and service life requirement of the doors and frames.
3. Fire Rated Doors and Frames:
a. Label fire doors and frames in accordance with Underwriters Laboratories standard UL10C.
b. Construct and install doors and frames to comply with NFPA 80.
c. Manufacture Underwriters' Laboratories labeled doors and frames under the UL Follow Up Service (FUS) and in strict compliance to UL procedures and provide the degree of fire protection.
d. Affix a physical label or approved marking to each fire door or fire door frame, at an authorized facility as evidence of compliance with procedures of Intertek or UL accredited testing agency. Label embossment is not permitted.

I. Maintain one copy of each document on site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. General Requirements: Product requirements for transporting, handling, storing, and protecting products.

B. Handle, store and protect products in accordance with the manufacturers printed instructions or ANSI A250.11 and HMMA 840.

C. Accept doors and frames on site in manufacturer's packaging. Inspect for damage.

D. Break seal on site to permit ventilation.

E. Store doors vertically in a dry area, under a proper vented cover. Place on 4 inch (102mm) high wood sills to prevent rust or damage. Provide ¼ inch (6mm) space between doors to promote air circulation.

F. Store frames in an upright position with heads uppermost under cover. Place on 4-inch (102mm) high wood or steel sills to prevent rust and damage. Store frames, five units maximum in a stack, with 2 inch (51mm) space between frames to promote air circulation.

G. Do not use non-vented plastic or canvas shelters and the like to prevent rust or damage.

H. Should wrappers become wet, remove immediately.

1.10 COORDINATION

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

B. Coordinate Work with door opening construction, frame and hardware installation.

C. Coordinate installation to accommodate door hardware electric wire connections.

1.11 WARRANTY

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

B. Include coverage for repairing and/or replacing components of steel doors and frames that fail in materials and/or workmanship within the specified period; and for installation and finishing that may be required due to repair and/or replacement of defective doors.

C. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, breakage, and the like.
2. Faulty operation of doors.
3. Deterioration of metals, finishes, warping beyond specified installation tolerances, and defective and other materials beyond normal weathering and normal use.

D. Provide five-year warranty from date of Substantial Completion, unless otherwise indicated, for all doors and frames.

1.12 MAINTENANCE SERVICE

A. General Requirements: Execution requirements for maintenance service.

B. Maintenance to Certificate of Completion: Beginning at Substantial Completion and during the Defects Liability Period, all doors and frames shall be maintained and guaranteed until the issue of Certificate of Completion. Provide full maintenance by skilled employees of door manufacturer and installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, cleaning and adjusting as required for proper door smooth operation, as specified and to the satisfaction of the Engineer.

PART 2 PRODUCTS

2.1 MANUFACTURER

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

2.2 STEEL DOORS AND FRAMES

A. Hollow Metal Doors and Hollow Metal Frames: Door and frame assembly shall include all door hardware and associated accessories to complete the installation.

B. General: Construct metal doors and frames to the following designs and thickness:
1. Doors: Coating thickness 274.3 g/m² hot dipped galvanized steel sheets, minimum thickness 1.2mm, physical performance level B; full flush as per SDI standards.
2. Frames: Coating thickness 274.3 g/m² hot dipped galvanized steel sheets, minimum thickness 1.5 mm.

C. Core Construction: Manufacturer’s standard, that has been successfully tested by Intertek or UL accredited testing agency.

D. Face Edges for Single Acting or Double Acting Doors: Visible seam edges. Putty is not allowed.

E. Doors Total Thickness: As indicated on the drawings or as per fire test reports.

F. Top and Bottom Channels: Same thickness as doors leaves or as per fire test reports.

G. Doors Silencers: To be provided as per doors manufacturer's standard.

H. Clearance or free gaps for fire resistant doors to be as per the fire test report permissible and NFPA 80.

I. Tolerance for fire resistant doors to be as per door manufacturer standard, NFPA 252 and SDI.

J. Frames Width: As shown on the drawings.

K. Frames and Doors Finishes: Manufacturer's standard factory-applied paint finish, and as specified in this Section.

L. All frames to be filled with mortar or infill or hollow as per manufacturer's test report. Knock-down frames are accepted.

M. Frames Finishes and Gloss: As shown on the drawings or as selected by the Engineer.

N. Jamb Anchors: Provide 1 No. of the following types to suit site conditions for the door assembly and adjacent wall construction:
1. Masonry Type: As indicated on the drawings by the door manufacturer. Frames to have a depth to exceed the wall thickness. Maximum frame depth to be 250 mm.
2. Stud-Wall Type: As indicated on the drawings by the door manufacturer. Frames to have a depth to exceed the wall thickness. Maximum frame depth to be 250 mm.
3. Compression Type for Drywall Slip-On Frames: As indicated on the drawings by the door manufacturer: Frames to have a depth to exceed the wall thickness. Maximum frame depth to be 250 mm.
4. Post-Installed Expansion-Type for In-Place Concrete or Masonry: As indicated on the drawings by the door manufacturer. Frames to have a depth to exceed the wall thickness. Maximum frame depth to be 250 mm.

O. Hardware Reinforcements: Hinges reinforcement of 5 mm thickness galvanized, lock reinforcement with 3 mm thickness galvanized, flush bolt reinforcement (for double leaves) with 3 mm thickness galvanized, door closing reinforcement with 1.5 mm thickness galvanized, hinges (4.5 inches) to be mortised (flush with frames and edge of the door) 5 knuckles butt hinges in stainless steel type SUS304, locks and flush bolt to be mortised in the door leaves, locks to be made in stainless steel type SUS304, all other architectural hardware to be in stainless steel type SUS304.

P. Vertical Edge Seams: Provide doors with continuous vertical mechanical inter-locking joints at lock and hinge edges. Putty is not allowed.

Q. Lead-Lined Frames: Steel frames for lead-lined doors and lead glass, lined with lead sheet of the same thickness as the door, overlapping the wall shielding by minimum 15 mm, as specified in Section 13 49 00.

2.3 ACCESSORIES

A. Louvers: Manufacturer's standard louver for non-fire-rated doors and fire-rated louvers for fire-rated door.

B. Hardware Blocks and Reinforcement: Provide concealed zinc-coated reinforcement for hinges, closer, fire exit hardware and flush bolt as indicated on shop drawings and fire test report. Fix all hardware reinforcement by using welding machines and/or cold-welding machines.

C. Grout Guards: Formed from same material as frames, not less than 1.2 mm thick.

D. Removable Stops: Rolled steel, channel shape, butted or mitered corners; prepared for countersink style tamper proof screws.

2.4 FABRICATION

A. Site Measurement: Verify actual dimensions of openings by site measurement before fabrication.

B. Tolerance: In accordance to the doors manufacturer's standard, NFPA 252 and SDI.

C. Minimum overall thickness of door panels is 45 mm unless otherwise stated.

D. Fabricate zinc-coated metal sheets to be rigid and free of defects, warp or buckle.

E. Before and after making permanent connection in frames & other structural elements, which are assembled before delivery to site, the fit shall be checked for accuracy.

F. To ensure proper assembly at site, clearly identify work that cannot be permanently factory assembled before shipment.

G. Fabricate components carefully and accurately to ensure compliance with the design intend as indicated on drawings and approved shop drawings, and as indicated on the fire rated doors reports.

H. All metal leaves and frames should be provided by the same manufacturer.

I. Astragals: As indicated on drawings. Provide full length steel astragal for pairs, attached to secure side of opening, projecting not less than 20mm, unless hardware specified allows both doors, swinging in same direction, to be active.

J. Architectural hardware supplier to provide sample of each type to doors manufacturer before doors fabrication.

K. Jamb anchors location as per the doors approved shop drawings.

L. Wire Chases: Fabricate wireways within doors or transom panels for installation and connection of electrical devices.

M. Glazing Stops: Flush type steel with removable stops on 1 side of glass. Install fixed stops on locked side of interior doors and outside of exterior doors. Fabricate to accommodate glass thickness.

2.5 FINISHES

A. Galvanized Steel: To ASTM A653/A653M Z120, Z180 and/or Z275.

B. Primer for Painted Steel: ANSI A250.10 rust inhibitive type.

C. Factory Finish: Clean, pretreat, and apply manufacturer's standard one-coat, baked-on finish consisting of thermosetting topcoat, complying with SDI A250.3.

D. Color and Gloss: As selected by Engineer from manufacturer's full range.

2.6 SOURCE QUALITY CONTROL

A. Doors manufacturer to have established quality control system specified in this Section.

PART 3 EXECUTION

3.1 EXAMINATION

A. General Requirements: Administrative requirements for verification of existing conditions before starting work.

B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

C. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

D. Verify that headers are level with finished floor.

E. Door Frames: Verify that wall thickness does not exceed standard tolerance allowed.

F. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

G. Verify opening sizes and tolerances are acceptable.

H. Notify the Engineer of unsatisfactory conditions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Only Materials meeting the specifications requirement and stored under appropriate conditions shall be used for installation

C. Prior to installation, adjust hollow metal frames for squareness, alignment, twist and plumbness

D. Drill and tap doors and frames to receive non-templated, mortised and surface-mounted door hardware.

3.3 INSTALLATION - GENERAL

A. Install hollow metal doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with the drawings and manufacturer's written instructions.

3.4 INSTALLATION - FRAMES

A. Set frames accurately in position, plumbed and aligned until permanent anchors are set. After wall construction is completed, remove temporary braces, leaving surfaces smooth and undamaged.

B. At fire-protection-rated openings, install frames according to UL10C.

C. Doors Requiring Silencers: Install door silencers in frames before grouting.

D. Check plumbness, squareness and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

E. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

F. Floor Anchors: As per door manufacturer’s recommendations.

G. Concrete Walls: As per door manufacturer’s recommendations. Take precautions to ensure that frames are not deformed or damaged by grout forces.

H. In-Place Concrete or Masonry Construction: Secure frames in place with post-installed expansion anchors. Countersunk anchors, and fill and make smooth, flush, and invisible on exposed faces.

I. Ceiling Struts:
1. Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb.
2. Bend top of struts to provide flush contact for securing to supporting construction.

J. Provide adjustable wedged or bolted anchorage to frame jamb members.

K. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist and plumb to tolerances recommended by manufacturer.

3.5 INSTALLATION - DOORS

A. Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

B. Non-Fire-Rated Standard Steel Doors: As recommended by metal door manufacturer.

C. Fire-Rated Doors: Install doors with clearances according to UL10C.

D. Sound-Control Seals: Where seals have been pre-fit and pre-installed in the factory and subsequently removed for shipping, reinstall seals and adjust according to manufacturer's written instructions.

E. Works should be securely fastened and sealed in strict accordance with the manufacturer’s recommendations, not compromising the performance & certification of the door assemblies.

F. Recess exposed fastenings and use plastic instead of wood, touch up with the finish to match the adjacent surface.

G. Cutting, trimming or machining of finished surfaces are not permitted.

H. Coordinate installation with door hardware installation specified in Section 08 71 00.

I. Doors shall be fitted with the specified hardware, hung and immediately before final completion of work, additional adjustments shall be made so that doors operate in perfect order.

J. Location of hardware on doors and frames shall be in accordance with applicable standard of the National Association of Architectural Metal Manufacturers (NAAMM) and the Door Hardware Institute (DHI).

K. Hardware shall be assorted and stored in space assigned and shall be kept under lock and key. The safety and preservation of delivered items shall be the responsibility of the Contractor.

L. Doors shall be installed with the following clearances unless otherwise stated:
1. Jambs: 3.75 mm each side; 7.5mm total.
2. Head: 3.75 mm.
3. Meeting Edges, Pairs of Doors: 3.75 mm.
4. Bottom: 9.5 mm, where no threshold or carpet occurs.
5. Bottom: At threshold or carpet, 3.75mm above carpet or threshold.
6. Place fire-rated doors with clearances as specified in NFPA No. 80 Standard.

M. Install finishing hardware in accordance with manufacturer’s written instructions. Do not modify finishing hardware. Set, fit, adjust and clean hardware according to manufacturer’s written instruction. After installation of hardware, check opening units for correct fit, and for uniformity of space around perimeter of units or between units. Ensure smoothly operating opening units free from binding.

N. After installation and at the project closeout, all templates, instruction sheets and installation details shall be turned over to the Engineer.

O. Do not use shims without the Engineer’s approval.

P. Wrapping or other factory-applied protection furnished with finish hardware shall be left on such hardware until final acceptance by the Engineer, at which time protection shall be removed and work left in proper condition.

Q. Exposed surfaces shall be free of any tool marks, rust, or blemishes, and any damage to exposed surfaces shall be repaired or replaced at the Contractor’s expense and to the satisfaction of the Engineer.

R. Fasteners furnished with the hardware shall be used to secure the hardware in place for each type of substrate. Through-bolts shall in no case be permitted for the fastening of any hardware unless otherwise approved by the Engineer. Hardware shall be properly adjusted and checked out to ensure the hinges, locks, latches, bolts, holders and closers are in proper operational condition. After hardware has been checked, key shall be tagged, identified and delivered to the Employer. Any errors in cutting and fitting, keying or any damage to adjoining work shall be repaired at no extra cost to the Employer. Drill and countersink units which are not factory prepared for anchorage.

S. Cut and fit threshold and floor covers to profile of door frames, with mitered corners and hairline joints. Join units with concealed welds or concealed mechanical joints. Cut smooth openings for spindles, bolts and similar items, if any.

T. Keys used shall be construction keys which are to be tagged with fiber discs as approved, clearly labeled with identifying inscriptions and then neatly arranged in a temporary cabinet. Construction keys shall be returned to the Employer.

U. Rejection:
1. Hollow metal work which, in the opinion of the Engineer, is defective, shall be removed and replaced with new at no additional cost to the Employer.
2. Rejection will additionally be considered for items including hardware cutouts of improper size or location or which prevent proper installation of doors, hardware or work of other trades.

3.6 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Diagonal Distortion: 1.5mm measured with straight edge, corner to corner.

3.7 ADJUSTING AND CLEANING

A. General Requirements: Execution requirements for adjusting.

B. Adjust door for smooth and balanced door movement.

C. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Lubricate moving parts with type lubrication recommended by manufacturer. Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made. Final adjustment of hardware is to be done after heating and ventilating has been balanced.

D. Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

E. Upon completion, remove debris and unused materials from the site, and dispose of safely.

F. Remove grout and other bonding material from hollow metal work immediately after installation.

G. Clean the works of dirt and splashes.

H. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

I. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.

J. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

3.8 SCHEDULES

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

END OF SECTION

SECTION 08 14 16

FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fire rated and non-rated wood doors and frames.

B. Section includes lead-lined wood doors for radiation-shielded rooms.

C. Related Sections:
1. Section 06 20 00 - Finish Carpentry.
2. Section 08 71 00 - Door Hardware.
3. Section 08 80 00 - Glazing.
4. Section 09 90 00 - Painting and Coating: Site finishing of wood doors.
5. Section 13 49 00 - Radiation Protection.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI/NFPA 80 - Standard for Fire Doors and Other Opening Protective.
2. ANSI A135.4 - Basic Hardboard.
3. ANSI/BHMA A156.7 - Hinge Template Dimensions.
4. ANSI A208.1-09 - Particleboard.
5. ANSI A208.2-09 - Medium Density Fiberboard for Interiors Applications.

B. ASTM International:
1. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
2. ASTM D3359 - Standard Test Methods for Measuring Adhesion by Tape Test.
3. ASTM D4060 - Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
4. ASTM E90 - Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
5. ASTM E413 - Standard Classification for Rating Sound Insulation.

C. Architectural Woodwork Institute:
1. AWI - Quality Standards Illustrated.

D. Hardwood Plywood and Veneer Association:
1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.

E. National Electrical Manufacturers Association:
1. NEMA LD 3 - High Pressure Decorative Laminates.

F. National Fire Protection Association:
1. NFPA 80 - Standard for Fire Doors, Fire Windows.
2. NFPA 101 - Life Safety Code.

3. NFPA 105 - Standard for the installation of Smoke Door Assemblies and Other Opening Protectives.
4. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.
5. NFPA 5000 - Building Construction and Safety Code.

G. Underwriters Laboratories Inc.:
1. UL 9 - Fire Test of Window Assemblies.
2. UL 10B - Fire Tests of Door Assemblies.
3. UL10C - Standard for Positive Pressure Fire Tests of Door Assemblies.
4. UL - Building Materials Directory.

H. Uniform Building Code:
1. UBC Standard 7-2 - Fire Tests of Door Assemblies.

I. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

J. Window and Door Manufacturers Association (WDMA):
1. WDMA I.S.1A-11 - Industry Standard for Architectural Wood Flush Doors.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, and factory finishing criteria, identify cutouts for glazing and louvers.

C. Product Data: Submit information on door core materials and construction, and on veneer species, type and characteristics.

D. Samples:
1. Submit two samples of door construction, size as directed by the Engineer, cut from top and/or bottom corner of door.
2. Submit two samples of door veneer cut and grain pattern, size as directed by the Engineer, cut horizontally across the entire width of the door, showing veneer slices, match pattern and joint.
3. Submit two samples of door veneer, size as directed by the Engineer, illustrating wood grain, stain color, and sheen, and/or plastic laminate pattern and color.

E. Manufacturer's Installation Instructions: Submit special installation instructions.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with AWI Quality Standard Section 1300, Premium, Custom and/or Economy Grade.

B. Finish doors in accordance with AWI Quality Standard Section 1500.

C. Fire Door and Panel Construction: Conform to NFPA 252, and/or to UL 10B (for wood doors with steel frame) or UL 10C (for wood doors with wood frame), and/or to UBC Standard 7-2.

D. Fire Rated Door Construction: Rate of rise of 361 ºC across door thickness for stair doors.

E. Installed Fire Rated Door and Transom Panel Assembly: Conform to NFPA 80 for fire rated class as indicated.

F. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing work of this section with minimum five years documented experience.

1.6 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Package, deliver and store doors in accordance with AWI Section 1300.

1.7 COORDINATION

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

B. Coordinate Work with door opening construction, door frame and door hardware installation.

1.8 WARRANTY

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

B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

C. Provide five year warranty for interior and exterior doors.

PART 2 PRODUCTS

2.1 FLUSH WOOD DOORS

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

2.2 MATERIALS

A. Particle Board Core: Single thickness slab of 3 ply particle board complying with ANSI A208.1, Grade 1-L-1, average density not less than between 448-512 kg/m3, hot pressed with synthetic resin glue. Linear expansion shall not exceed 0.03% in either direction when tested in accordance with ASTM D1037, Sections 76 through 79. Faces of core slab shall be of 0.254mm thick flakes, with resin content a minimum of 50% higher than core resin content. Face layer density shall be a minimum of 25% higher than core density.

B. Plastic Laminate: 1mm thick; color as selected from manufacturer’s standard patterns.

1. Acceptable manufacturers:
a. Fromica Corporation or equal approved.

C. Mineral Core: Incombustible mineral composition free of asbestos fiber.

D. Top and Bottom Edge Bands: Thoroughly kiln dried hardwood, free from defects which will be visible when finished as specified herein.

E. Blocking: Manufacturers standard for purpose intended.

F. Side Edge Bands: Thoroughly kiln dried hardwood, free from defects which will be visible when finished as specified herein.
1. Wood for side edge bands shall match face veneers for natural finish doors.

G. Crossbands: Minimum 1.6 mm thick after sanding, properly dried hardwood.

H. Face Veneer for Natural Finish: Standard thickness, thoroughly dried conforming to CS35, Premium Grade. Match faces of doors in pairs. Face veneer shall be tapeless spliced with grain running vertically, belt and polish sanded, of the following species:
1. As described in the relevant sections of Division 6: Wood and Plastics.

I. Face Veneer For Interior Painted Finish: Standard thickness sound grade hardwood veneer conforming to CS35, overlaid with medium density cellulose fiber sheets impregnated with phenolic resin.

J. Type I Adhesive: CS35, Type I (fully waterproof bond).

K. Type II Adhesive: CS35, Type II (water-resistant bond).

L. Solid Core, Non-Rated: AWI Section 1300, Type PC - Particleboard.

M. Solid Core, Fire Rated: AWI Section 1300, Type FD 1-1/2, FD 1, FD 3/4, FD 1/2 and/or FD 1/3.

N. Solid Core, Special Function: AWI Section 1300.

O. Hollow Core: AWI Section 1300, Type SHC - Standard and/or IHC - Institutional.

P. Exterior Veneer Facing: AWI Premium, Custom and/or Economy quality wood, with matched grain and transoms. Pair match multiple door leaves in single opening.
1. Wood: As indicated on drawings.

Q. Interior Veneer Facing: AWI Premium, Custom and/or Economy quality wood, with matched grain and transoms. Pair match multiple door leaves in single opening.
1. Wood: As indicated on drawings.

R. Plastic Laminate Facing (Interior): NEMA LD-3, General and/or Special Purpose, Fire Rated Type, 1.3 mm thick, finish, color and pattern, as indicated on drawings.

S. Cross Banding Behind Laminate Finish: as per manufacturer’s standard construction.

2.3 PRODUCTS

A. Internal Wood Doors and Frames:
1. Door Leaf: 44mm thick [6+32+6], fabricated in 6mm thick MDF panel with approved wood veneer on both sides, and 32mm thick hollow core, reinforced with solid wood for lock and handle; and edge leaf frame in solid wood; lacquer polyurethane finish;
2. Door Frame: Fabricated in 1.25mm thick steel sheets, and finished with approved three-coat protective paint system after grit blasting and shop priming.

B. Wood Veneer: AWI Grade 1, premium 0.5mm thick before sanding.
1. Hardwood Veneer: HPVA Grade AA, unless otherwise indicated. Suitable for transparent finish.
2. Veneer match per leaf: Bookmatched, unless otherwise indicated.
3. Veneer match for pairs of doors: Pair or set matched.
4. Stain color: Custom to match Architect’s sample.
5. Finish: Pre-finished in compliance with AWI 1500-G-7, catalyzed polyurethane or catalyzed varnish finish with a satin sheen, meeting or exceeding performance characteristics of AWI System TR-6.

C. Opaque Facing (MDO): ANSI A 135.4 Type S2S, composition face, 3mm thick, for paint finish.

D. Facing and Crossband Adhesive: Type I, waterproof.

E. Transoms: Match door construction, veneers, rating and finish.

F. Vision Frames:
1. Exterior doors: Aluminum flashing under wood lipped frames at opening sill.
2. Non-rated doors: Flush wood frames, hardwood to match facing.
3. Fire rated doors: Provide manufacturer’s tested metal clip or comparable system with wood stop appearance.
4. Fire-rated doors: UL approved slimline metal trim.

G. Fabricate fire-rated doors in compliance with UL or WHI requirements.

H. Laminate 5-ply door facing, cross banding and assembled core in a hot press.

I. Factory sand assembled door leaf.

J. Fire-rated Door Stiles: Manufacturer’s tested reinforced stiles at doors with fire ratings greater than 60 minutes.
1. Bond stiles and rails to core. Sand for uniform thickness.

K. Fire Rated Pair of Doors; greater than 60 minutes: Provide full length steel astragal attached to secure side of opening, projecting not less than 19mm, unless hardware specified allows both doors to be active. Coordinate with Section 08 71 00.

L. Fire Rated Pair of Doors; greater than 60 minute: if an astragal is required, to comply with fire rated labeling requirements for pairs of fire rated doors, provide door manufacturer’s standard tested astragal.
1. Shop apply astragals.
2. shop apply matching veneer wrap to conceal metal astragal at wood faced doors.

M. Fire Rated Pair of Doors; 60 minutes: Door manufacturer's standard tested edge type.

N. Meeting Edge at Non-rated Pairs: Fabricate edge type between pairs of non-fire doors with non bevel, unless otherwise indicated.

O. Meeting Edge at Transoms: Fabricate with rabbeted edge on door and transom, unless otherwise indicated.

P. At exterior doors, provide aluminum flashings at top and bottom rails, and at sill of glazed opening full thickness of door.

Q. Cut and configure exterior door edges to receive (surface or recessed) weather stripping devices.

R. Factory finish doors in conformance with AWI Quality Standards Section 1500.
1. Apply finish to wood veneer face plys and wood edges.
2. AWI Section 1500, satin-medium rubbed, System 3 transparent, conversion varnish alkyd-urea, premium quality.

2.4 ACCESSORIES

A. Wood Louvers:
1. Material and Finish: As indicated on drawings.
2. Louver Blade: Flush, chevron or stock louver.
3. Louver Free Area: As indicated on drawings.

B. Metal Louvers:
1. Material and Finish: Roll formed steel, galvanized or prime painted; or aluminum or extruded aluminum, pre-painted finish; color as selected.
2. Louver Blade: Inverted V, Y or slat blade; fire rated with fusible link design to UL or FM requirements.
3. Louver Free Area: As indicated on drawings.
4. Frame: As indicated on drawings.

C. Lead-Lined Doors:
1. Construction: Solid core wood door with continuous lead sheet to ASTM B749 laminated within the core, of thickness scheduled (2 mm, 6 mm or 15 mm) and extending to all four edges.
2. Edges: Lead lining wrapped or lapped at edges so that no gap exists when the door is closed; lead-lined astragal for pairs.
3. Hardware: Heavy-duty hinges and closers rated for the door weight; cutouts for hardware backed with lead of the same thickness.
4. Vision Panels: Lead glass of lead equivalence not less than that of the door, set in lead-lined stops.
5. Labeling: Permanent label on hinge edge stating lead thickness.

D. Glazing Stops: Wood to match door facing, or wood with metal clips for rated doors.

2.5 FABRICATION

A. Fabricate non-rated doors in accordance with AWI Quality Standards requirements.

B. Fabricate fire rated doors in accordance with AWI Quality Standards and to UL or Intertek Testing Services (Warnock Hersey Listed) requirements. Attach fire rating label and temperature rise label to door.

C. Astragals for Fire Rated Double Doors: Steel and/or Treated wood, T shaped, overlapping and recessed at face edge and/or at mid-door thickness, specifically for double doors.

D. Sound Rating for Single Door Leaf and Frame Assembly: ASTM E413, STC 35.

E. Furnish lock blocks at lock edge and top of door for closer for hardware reinforcement.

F. Vertical Exposed Edge of Stiles: Of same species as veneer facing.

G. Fit door edge trim to edge of stiles after applying veneer facing.

H. Bond edge banding to cores.

I. At exterior doors, furnish aluminum flashing at top and bottom rail and sill of glazed openings for full thickness and width of door.

J. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Furnish solid blocking for through bolted hardware.

K. Factory fit doors for frame opening dimensions identified on shop drawings.

L. Cut and configure exterior door edge to receive recessed weather stripping devices.

M. Provide edge clearances in accordance with AWI 1300.

2.6 SHOP FINISHING

A. Factory finish doors in accordance with approved sample.

B. Seal door top edge with color and/or clear sealer to match door facing.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

A. Install fire rated and non-rated doors in accordance with AWI Quality Standard, NFPA 80, and to requirements for fire rating label by UL or Intertek Testing Services (Warnock Hersey Listed).

B. Trim non-rated door width by cutting equally on both jamb edges.

C. Trim door height by cutting bottom edges to maximum of 19 mm.
1. Trim fire door height at bottom edge only, in accordance with fire rating requirements.

D. Machine cut doors for hardware installation.

E. Coordinate installation of doors with installation of door hardware specified in Section 08 71 00.

F. Install lead-lined doors in lead-lined frames to maintain continuity of shielding with the wall lining, as specified in Section 13 49 00.

G. Install door louvers plumb and level.

H. Coordinate installation of glass and glazing specified in Section 08 80 00.

I. Site finish doors in accordance with Section 09 90 00.

3.3 INSTALLATION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Conform to AWI requirements for fit and clearance tolerances.

C. Conform to AWI Section 1300 requirements for maximum diagonal distortion.

D. Maximum Vertical Distortion (Bow): 3 mm measured with straight edge or taut string, top to bottom, over imaginary 915 x 2,130 mm surface area.

E. Maximum Width Distortion (Cup): 3 mm measured with straight edge or taut string, edge to edge, over imaginary 915 x 2,130 mm surface area.

3.4 ADJUSTING

A. General Requirements: Execution requirements for testing, adjusting and balancing.

B. Adjust door for smooth and balanced door movement.

C. Adjust closer for full closure.

3.5 SCHEDULES

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

END OF SECTION

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fire rated and non-rated access doors and panels with frames.
   1. Provide for access to controls, valves, traps, dampers, cleanouts, and similar items requiring operation behind inaccessible finished surfaces.
   2. Coordinate exact locations with various trades to assure proper placement.
   3. Provide fire-rated door assemblies in fire-rated wall assemblies.

B. Related Sections:
   1. Section 03 10 00 - Concrete Forming and Accessories.
   2. Section 08 11 13 - Hollow Metal Doors and Frames.
   3. Section 08 51 13 - Aluminum Windows.
   4. Section 08 14 16 - Flush Wood Doors.
   5. Section 09 90 00 - Painting and Coating.
   6. Division 23 - Heating, Ventilating and Air Conditioning: Duct Accessories.

1.2 REFERENCES

A. National Fire Protection Association:
   1. NFPA 80 - Standard for Fire Doors, Fire Windows.

B. Underwriters Laboratories Inc.:
   1. UL - Building Materials Directory.
   2. UL10C- Standard for Positive Pressure Fire Tests of Door Assemblies.

C. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

1.3 DESIGN REQUIREMENTS

A. Floor access to support live load of 4.7 kPa with deflection not to exceed $1/180$ of span.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate exact position of access door units.

C. Product Data: Submit literature indicating sizes, types, finishes, hardware, scheduled locations, fire resistance listings, and details of adjoining Work.

D. Samples: Submit two 300x300 mm in size illustrating frame configuration & anchors.

E. Manufacturer's Installation Instructions: Submit installation requirements and rough-in dimensions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified with minimum ten years documented experience.

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

1.6 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Units that comply with NFPA 80 and tested to UL10C and are labeled and listed by UL or Warnock Hersey/Intertek only.

B. Provide label from UL or Warnock Hersey/Intertek only.

1.7 COORDINATION

A. General Requirements: Administrative requirements for coordination.

B. Coordinate Work with work requiring controls, valves, traps, dampers, cleanouts, and similar items requiring operation being located behind finished surfaces.

1.8 WARRANTY

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

B. Include coverage for repairing and/or replacing components of doors and frames that fail in materials or workmanship within the specified period.

C. Failures include, but are not limited to, the following:
1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of doors.
3. Deterioration of materials, finishes and other materials beyond normal weathering and normal use.

D. Provide five-year warranty from date of Substantial Completion, unless otherwise indicated, for all access doors and panels.

PART 2 PRODUCTS

2.1 MANUFACTURER

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

2.2 COMPONENTS

A. Metal Access Doors and Panels: Refer to Section 08 11 13.

B. Wood Access Doors and Panels: Refer to Section 08 14 16.

2.3 FABRICATION

A. Fabricate units of continuous welded construction; weld, fill, and grind joints to assure flush and square unit.

B. Wall and Ceiling Access Door and Panel Hardware:
   1. Hinge: Standard continuous or concealed spring pin type, 175º steel hinges.
   2. Lock: Self-latching lock.

C. Floor Hatch Hardware:
   1. Hinge: 175º stainless steel type 316 hinges with removable pin.
   2. Lock: Self-latching lock or cylinder lock with latch, two keys for each unit.

D. Size Variations: Obtain acceptance of manufacturer's standard size units which vary slightly from sizes shown or scheduled.

2.4 SHOP FINISHING

A. Base Metal Protection: Galvanized, hot dipped finish.

B. Finish: Painted for steel & galvanized steel, and type 316 #4 finish for stainless steel.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify rough openings for access doors and panels are correctly sized and located.

3.2 INSTALLATION

A. Comply with manufacturer's instructions for installation. Coordinate installation with work of other trades.

B. Set frames accurately in position and securely attach to supports with face panels plumb in relation to adjacent finish surfaces; and horizontal surfaces level.
   1. Set concealed frame-type units flush with adjacent finished surfaces.

C. Position unit to provide convenient access to concealed work requiring access.

D. Install fire rated units in accordance with NFPA 80 and requirements for fire listing.

3.3 ADJUSTING

A. General Requirements: Execution requirements for testing, adjusting and balancing.

B. Adjust hardware and panels after installation for proper operation.

C. Adjust access doors and panels for smooth and balanced operation.

3.4 SCHEDULES

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

END OF SECTION

SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes extruded aluminum windows with fixed and operating sash, factory glazed panels, operating hardware and insect screens.

B. Related Sections:
1. Section 05 50 00 - Metal Fabrication.
2. Section 07 26 00 - Vapor Retarders.
3. Section 07 27 00 - Air Barriers.
4. Section 07 92 00 - Joint Sealants.
5. Section 08 80 00 - Glazing.

1.2 REFERENCES

A. Aluminum Association:
1. AA DAF-45 - Designation System for Aluminum Finishes.

B. American Architectural Manufacturers Association:
1. AAMA 101 - Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
2. AAMA 501.4 - Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Inter Story Drifts.
3. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
4. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
5. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
6. AAMA MCWM-1 - Metal Curtain Wall manual.

C. American National Standards Institute:
1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety.

D. American Society of Civil Engineers:
1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

E. ASTM International:
1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
3. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

4. ASTM D1784 - Standard Specification for Rigid Poly Vinyl Chloride (PVC) Compounds and Chlorinated Poly Vinyl Chloride (CPVC) Compounds.
5. ASTM D3656 - Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.
6. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.
7. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
8. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
9. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential.
10. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.
11. ASTM F588 - Standard Test Methods for Resistance of Window Assemblies to Forced Entry Excluding Glazing.

F. Glass Association of North America:
1. GANA - Glazing Manual.

G. National Fenestration Rating Council Incorporated:
1. NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

H. SSPC: The Society for Protective Coatings:
1. SSPC Paint 20 - Zinc-Rich Primers (Type I - Inorganic and Type II - Organic).
2. SSPC Paint 25 - Red Iron Oxide, Zinc Oxide, Raw Linseed Oil, and Alkyd Primer.

1.3 SYSTEM DESCRIPTION

A. Doors and windows system shall provide the acceptable level of air tightness and water tightness against wind driven rain.

B. Windows: Tubular or single thickness aluminum sections, factory fabricated, factory finished, factory glazed vision glass, related flashings, anchorage and attachment devices.

C. Configuration: Conform to AAMA 101, designations for windows required for Project.

D. Glazing: Interior and exterior.

E. Forced Entry Resistance: Conform to ASTM F588.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Design Drawings and Calculations: Show that system is able to support applied loads.

C. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related Work; and installation requirements.

D. Product Data: Submit component dimensions, anchorage and fasteners, glass, internal drainage, and typical details.

E. Samples: Submit two samples 600 x 600 mm in size, illustrating window frame section mullion section, screen and frame, factory finished aluminum surfaces, glass units, glazing materials. Submit two samples of operating hardware.

F. Manufacturer's Certificates: Certify Product performance ratings by independent third party such as AAMA, CAWM, or NFRC as meeting specified requirements.

G. Test Reports: Indicate substantiating engineering data, test results of previous tests by independent laboratory which purport to meet performance criteria, and other supportive data.

1.5 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mockups, size 1200 x 1200 mm high for window and 1200 x 2400 mm high for door, including all hardware and attachment accessories.

C. Locate where directed by the Engineer.

D. Remove mockup when directed by the Engineer.

E. Test mock-ups according to relevant standards.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with the following:
   1. Aluminum Windows: Fabricate window assemblies in accordance with AAMA 101 for types of windows required.
   2. Insulated Glass: Fabricate insulated glass units to GANA Glazing Manual.
   3. Safety Glass: Conform to ANSI Z97.1 and applicable codes.
   4. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing commercial and institutional aluminum windows with minimum ten years documented experience.

B. Installer: Company specializing in installation of commercial and institutional aluminum windows with minimum five years documented experience.

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 DELIVERY, STORAGE, AND PROTECTION

A. General Requirements: Product requirements for product storage and handling.

B. Handle Work of this section in accordance with AAMA MCWM-1 - Curtain Wall Manual #10.

C. Protect factory finished aluminum surfaces with wrapping and/or strippable coating. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1.10 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Do not install glazing materials when ambient temperature is less than 10ºC.

C. Maintain this minimum temperature during and after installation of glazing materials.

1.11 WARRANTY

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

B. Furnish ten-year manufacturer warranty for system.

C. Warranty: Include coverage for degradation of color finish and seal failure.

PART 2 PRODUCTS

2.1 ALUMINUM DOORS AND WINDOWS

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

2.2 COMPONENTS

A. Extruded Aluminum: ASTM B221M; 6063 alloy, T5 temper.

B. Sheet Aluminum: ASTM B209M; 5005 alloy, H15 or H34 temper.

C. Steel Sections: Profiled to suit mullion sections.

D. Thermally broken aluminum frame where explicitly shown on drawings.

E. Glass: Conforming to requirements of Section 08 80 00.

F. Hardware:
1. Operator: Geared rotary handle fitted to projecting sash arms with limit stops.
2. Projecting Sash Arms: Cadmium or zinc plated steel, friction pivot joints with nylon bearings, removable pivot clips for cleaning.
3. Pulls: Manufacturer's standard.
4. Sash lock: Lever handle with cam lock.
5. Bottom Rollers: Stainless steel type 316, adjustable.

G. Sills: Extruded aluminum; sloped for positive wash; fit under sash leg 12 mm beyond wall face; one-piece full width of opening jamb angles to terminate sill end.

H. Operable Sash Weather Stripping: Wool pile, nylon pile or resilient plastic; permanently resilient, profiled to effect weather seal.

I. Rolling Shutters (Where Indicated): Electrically operated unless otherwise stated; with aluminum tube to cover the gap between the frame and the rolling shutter rail.

2.3 ACCESSORIES

A. Fasteners and Anchors: Stainless steel type 316.

B. Visual Glass Dividers: Formed aluminum, fitted against interior of glazed surface, secured with spring loaded steel pins into plastic sockets.

C. Visual Glass Muntins: Formed aluminum, applied to interior and/or exterior glass surface.

D. Bituminous Paint: Fibered asphaltic type.

E. Limit Stops: Resilient rubber.

2.4 FABRICATION

A. Wherever possible, the doors/windows should be prefabricated, transported to site and installed without scaffolding. This allows superior quality control during fabrication and quick installation.

B. The panels will be transported to site and craned to the appropriate floor.

C. All occupational health and safety issues should be adequately addressed for the installation.

D. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

E. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

F. Prepare components to receive anchor devices. Fabricate anchors.

G. Arrange fasteners and attachments to ensure concealment from view.

H. Prepare components with internal reinforcement for operating hardware.

I. Furnish internal reinforcement in mullions with galvanized steel members to maintain rigidity.

J. Permit internal drainage weep holes and channels to migrate moisture to exterior. Furnish internal drainage of glazing spaces to exterior through weep holes.

K. Assemble insect screen frame, miter and reinforce frame corners. Fit mesh taut into frame and secure. Fit frame with four spring loaded steel pin retainers.

L. Double and/or single weatherstrip operable units.

M. Factory glaze window units. Install glass panels in accordance with Section 08 80 00.

2.5 SHOP FINISHING

A. Finish Coatings: Conform to AAMA 2603, AAMA 2604 or 2605 and/or AAMA 611.

B. Exterior and Interior Aluminum Surfaces: Advanced Durability Polyester Powder Coating System. Color: As selected. Minimum cover Thickness 60 microns. Percent Gloss: As selected.

C. If anodized finishes are adopted, Color Anodized Aluminum Surfaces: AA-M12C22A44 non-specular as fabricated mechanical finish, medium matte chemical finish and Architectural Class I, 0.018mm anodized coating; Color as shown on drawings or as selected by the Engineer.

D. Locks, Operators, and Exposed Hardware: Enameled to match window finish and/or color as directed by the Engineer.

E. Pull Handles: Prefinished wood with aluminum brackets, and/or Anodized aluminum. Color to match frames.

F. Screens: Black, White, and/or Gray color.

G. Apply coat of bituminous paint on concealed aluminum surfaces in contact with cementitious or dissimilar materials.

H. Shop and Touch-Up Primer for Steel Components: SSPC Paint 25 red oxide.

I. Touch-Up Primer for Galvanized Steel Surfaces: SSPC Paint 20 zinc rich.

J. Concealed Steel Items: Galvanized in accordance with ASTM A123/A123M to thickness Grade 85, 610 g/sq m.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify openings and adjoining air and vapor seal materials are ready to receive Work.

3.2 INSTALLATION

A. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.

B. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent Work.

C. Install sill and sill end angles.

D. Install thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

E. Coordinate attachment and seal of perimeter air barrier and vapor retarder materials with Section 07 26 00 and Section 07 27 00.

F. Install operating hardware.

G. Install rolling shutters where indicated, and install an aluminum tube to cover the gap between the frame and the rolling shutter rail.

3.3 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation from Level or Plumb: 1.5 mm/m non-cumulative, or 3 mm/3m, whichever is less.

3.4 FIELD QUALITY CONTROL

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

B. Inspection to monitor quality of installation and glazing.

C. Test to AAMA 502, ASTM E1105, and AAMA 501.

D. Perform field water test in compliance with ASTM E 1105, on completed portions of Aluminum Doors and Windows.

E. Perform one test each at 10%, 50% and 80% of Doors and Windows completion, with repeat tests when failures occur.

F. If testing results any leakage, eliminate causes of leaks and retest until no leaks occur.

3.5 ADJUSTING

A. General Requirements: Execution requirements for testing, adjusting and balancing.

B. Adjust hardware for smooth operation and secure weathertight closure.

3.6 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Remove protective material from factory finished aluminum surfaces.

C. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.

D. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

3.7 SCHEDULES

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

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Hardware for metal doors.
2. Hardware for wood doors.

B. Related Sections:
1. Section 08 11 13 - Hollow Metal Doors and Frames.
2. Section 08 14 16 - Flush Wood Doors.
3. Section 08 31 00 - Access Doors and Panels.
4. Division 26 - Electrical (Power supply to electric hardware devices).

C. General Requirements:
1. Door hardware and furniture shall be of approved types, suitable for the location and the intended function of the doors, in accordance with the Product Information and relevant Standards.
2. Submit Product Information, and Control Samples when directed.
3. Verify correct handing, internal external application, compliance to fire rating requirements, if applicable, and suitability of Hardware with the door type and door/frame construction, floor levels, door swinging and sliding limits for all hardware items before commencing.
4. Include fixings, striker plates, shims and escutcheons for a complete installation, whether indicated or not.
5. Unless otherwise indicated, door hardware shall enable escape from the inside of the room or area contained by the door hardware.
6. Door furniture shall be suitable for use with the lock or latch to which it is installed. Include key-ways, key-hole plates, turn-buttons, cut-outs, roses, plates and escutcheons required by the lock or latch type, for a complete installation, whether indicated or not.
7. Unless the door furniture is indicated separately for each side of the door, supply furniture as a paired set for both side of the door. Furniture fixings on the outside face of doors shall be concealed by fixing through the door from inside or by other appropriate methods.
8. Unless otherwise indicated, door hardware shall be manufactured from cast, forged or machined brass with electroplated finish or stainless steel, including corrosion-resistant components, in accordance with the relevant standards.

D. Related Trades:
1. Coordinate the work of this trade with the base-structure, services and adjacent work.
2. Coordinate with all types of doors, entrances and access panels, with all electrical services for power and control wiring for electric, electro-magnetic and electronic strikes, locks, detectors, controllers and similar devices, and with all security services used in the project.

1.2 REFERENCES

A. American National Standards Institute:
   1. ANSI A156.1 - Butts and Hinges.
   2. ANSI A156.2 - Bored and Preassembled Locks and Latches.
   3. ANSI A156.3 - Exit Devices.
   4. ANSI A156.4 - Door Controls - Closures.
   5. ANSI A156.5 - Auxiliary Locks and Associated Products.
   6. ANSI A156.6 - Architectural Door Trim.
   7. ANSI A156.7 - Template Hinge Dimensions.
   8. ANSI A156.8 - Door Controls - Overhead Holders.
   9. ANSI A156.12 - Interconnected Locks and Latches.
   10. ANSI A156.13 - Mortise Locks and Latches.
   11. ANSI A156.14 - Sliding and Folding Door Hardware.
   12. ANSI A156.15 - Closer Holder Release Devices.
   13. ANSI A156.16 - Auxiliary Hardware.
   14. ANSI A156.18 - Materials and Finishes
   15. ANSI A156.19 - Power Assist and Low Energy Power Operated Doors.
   16. ANSI A156.23 - Electromagnetic Locks.
   17. ANSI A156.24 - Delayed Egress Locks.
   18. ANSI A156 - Complete Set of 24 BHMA (A156 Series) with Binder.

B. Builders Hardware Manufacturers Association:
   1. BHMA Directory of Certified Products.

C. National Fire Protection Association:
   1. NFPA 80 - Standard for Fire Doors, Fire Windows.
   2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

D. Underwriters Laboratories Inc.:
   1. UL 10B - Fire Tests of Door Assemblies.
   2. UL 305 - Panic Hardware.
   3. UL - Building Materials Directory.

E. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Fire Rated Openings: Provide hardware listed by UL or Intertek Testing Services (Warnock Hersey Listed), or other testing laboratory approved by relevant authorities.
   1. Hardware: Tested in accordance with NFPA 252.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: For each type of product indicated, include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

C. Detailed Hardware Schedule: The Contractor shall provide a Detailed Hardware Schedule which shall prepared in full coordination with the door manufacturer and installer, and shall detail fabrication, assembly, installation procedures and diagrams of door hardware. Any hardware schedule furnished to the Contractor shall be for guidance.
   1. Prepare and supply 6 copies of a completely detailed hardware schedule. The schedule shall list all the doors by number, size, hand and degree of opening.
   2. Indicate the handling of each door and the degree of swing. In case of pairs of doors, indicate the active door. Schedule to indicate the material, finish, dimensions and details of fastenings for each hardware.
   3. The schedule shall indicate the manufacturer’s name and the article numbers.
   4. Provide with hardware schedule, template information and original catalogue cuts of all the hardware scheduled.
   5. Include the following information:
      a. Identification number, location, hand, fire rating, size, and material of each door and frame.
      b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
      c. Complete designations, including name, manufacturer, type, size, quantity, and finish of each door hardware product.
      d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
      e. Fastenings and other pertinent information.
      f. Explanation of abbreviations and symbols.

D. Master Electronic Credentials Schedule: To be prepared by hardware supplier and under the supervision of the Engineer, detailing Owner's electronic credentials schedule for all doors that have electronic access. Training to be provided by the hardware supplier to Owner’s staff and Engineer.

E. Shop Drawings:
   1. Indicate locations and mounting heights of each type of hardware, schedules, catalog cuts, electrical characteristics and connection requirements, and fixing details.
   2. Submit manufacturer's parts lists and templates.
   3. Submit details of electrified hardware indicating the following:
      a. Wiring Diagrams: For power, signal and control wiring, and including the following:
         1) Details of interface of electrified door hardware with the safety and security systems.
         2) Schematic diagram of systems that interface with electrified door hardware.
         3) Point-to-point wiring.
         4) Risers.
         5) Doors controlled by electrified door hardware.
      b. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

F. Samples: Submit the following full-size unit samples before, or concurrent with submission of door hardware schedule.
   1. Submit two samples for each hardware type (hinges, spring hinges, electrified hinges, door closers, locks and latches, electrified locks, push-pull handles, fire exit hardware and outside trim, electrified outside trim, electrified latch retraction kit for fire exit hardware, bolts, selectors and carry bar, lever handles, trim and knobs, cylinders and keys, closers, electromagnetic locks, electrified locks with latch retraction, access control systems, offline, and all other miscellaneous hardware), illustrating style, color and finish, with the appropriate fasteners.
   2. Full-size samples will be returned to the Contractor. Units that are acceptable and remain undamaged through submittal, review and field comparison process, might, after final check of operation, be incorporated into the Work, within limitations of keying requirements and subject to the approval of the Engineer.

G. Key Schedules: Submit key schedules for review with the Employer.

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

I. Submit affidavits to verify that hardware in each case has been installed in the correct location and that it is operating correctly.

J. Manufacturer’s Product Certificates: Certify that the electrified door hardware is approved for use on types and sizes of the certified and tested fire-rated doors to UL10C.

K. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by accredited bodies.

L. Operation and Maintenance Manuals: Submit maintenance procedure of the manufacturer. Include final architectural ironmongery and keying schedule.

M. Guarantee: Include names and addresses of the project, the Employer, the Engineer, and other specified information as directed by the Engineer.

1.5 CLOSEOUT SUBMITTALS

A. General Requirements: Execution requirements for closeout procedures.

B. Project Record Documents: Record actual locations of installed cylinders.

C. Operation and Maintenance Data: Submit data on operating hardware, components, lubrication requirements, and inspection procedures related to preventative maintenance.

D. Keys: Deliver with identifying tags to Employer by security shipment, direct from hardware supplier.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI A156 series, NFPA 80 and UL 305.

B. Furnish hardware marked and listed in BHMA Directory of Certified Products.

C. Source Limitations: Obtain door hardware from single manufacturer. Provide mechanical door hardware and electrified door hardware from same manufacturer, unless otherwise indicated.

D. Fire-Rated Door Assemblies: Provide door hardware rated for use in fire-rated door assemblies, complying with the standard UL10C that are tested by Intertek or UL, and for fire-protection ratings indicated, based on testing at positive pressure according to UL10C.

E. Means of Egress Doors: For doors designed with fire exit hardware, the devices shall be designed and fabricated to operate by body pressure alone, and shall require no knowledge of their operation. For doors designed to be on fire escape routes and are fire rated, dogging is not permitted unless the fire test shows that fire doors have been tested without latch and a door closer has been used to maintain the door in closing position.

F. Electronic Credentials Schedule: Coordinate all door hardware with the security systems of the project. Electronic credentials schedule shall include, but not limited to, the following:
   1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
   2. Preliminary electronic credentials diagram.
   3. Requirements for electronic credentials key control system.
   4. Requirements for access control.
   5. Address for delivery of electronic credentials.

G. Pre-Installation Conference: Conduct conference at project site.
   1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress, and avoid delays.
   2. Inspect and discuss preparatory work performed by other trades.
   3. Inspect and discuss electrical roughing-in for electrified door hardware.
   4. Review sequence of operation for each type of electrified door hardware.
   5. Review required testing, inspecting, and certifying procedures.

H. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Hardware Supplier: Company specializing in supplying commercial and institutional door hardware with minimum ten years documented experience. The supplier of hardware shall be regularly involved in the sale and distribution of all Hardware related to the project. The hardware supplier shall have a door hardware specialist.

C. Hardware Consultant: Employ a qualified Architectural Hardware Consultant to supervise the issues related to doors and hardware. The hardware consultant shall be responsible for hardware submittals, samples submission, to review hardware sets in conjunction with drawings, specifications, statuary rules, international standards such as Life Safety code and Disability Act. The hardware consultant shall also look after material deliveries to site, making sure right material is delivered, marked & packed.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for purpose specified and indicated.

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.

C. Include persons involved with installation of doors, frames and hardware.

1.9 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates and necessary fasteners with each item or package.

C. Deliver proprietary packaged products in the manufacturer’s original packages and containers with labels intact and legible, including installation instructions, templates and detailed delivery dockets. Packaging of hardware shall be in:
   1. Complete individual sets for each door.
   2. Separate dust and moisture proof packages.
   3. Clearly labeled to show intended locations.
   4. Complete with required fixings.

D. Record door hardware delivered to Project site, provide secure lock-up.

1.10 COORDINATION

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

B. Coordinate Work with other directly affected sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
   1. Provide templates or actual hardware as required to ensure proper preparation of doors and frames.

C. Coordinate layout and installation of door hardware with all other construction trades. Confirm that adequate provisions are made for locating and installing door hardware.

D. Coordinate installation of door hardware, keying and access control with project safety and security systems.

E. Coordinate layout and installation of electrified door hardware with connections to power supplies, and safety and security systems.

F. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions, and coordinate installation of door hardware to suit opening conditions, and to provide proper door operation.

G. Sequence installation to accommodate required utility connections.

H. Coordinate Employer's keying requirements during course of Work.

1.11 WARRANTY

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

B. Furnish five-year manufacturer warranty for all hardware from date of Substantial Completion, unless otherwise indicated.

C. The warranty shall include particular reference to failure of, or due to, the following:
1. Correct selection for required location performance.
2. Correct functioning of moving parts.
3. Structural adequacy.
4. Chipping, fading, excessive wear or delamination or other deterioration of finishes.
5. Fixing and connectors including stripped threads and damaged heads.
6. Integrity of seals.
7. Sagging, slackness or looseness of knobs and handles due to wear, relaxation of springs, stripped threads, or any other cause.

D. The warranty shall include an undertaking that spare parts and replacement items will be available for sale off-the-shelf, or with a lead time not exceeding four weeks from date of order, for a period not less than the warranty period.

E. Warranty to be accompanied by a current retail price list properly identified and dated

F. The warranty shall include an undertaking with respect to price control for the following items:
1. Replacement keys.
2. Replacement cylinders.

1.12 MAINTENANCE MATERIALS

A. General Requirements: Execution requirements for maintenance materials.

B. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
1. Furnish special wrenches and tools applicable for each different and for each special hardware component.
2. Furnish all maintenance tools and accessories supplied by the hardware manufacturer.

C. Provide maintenance data, parts, lists and manufacturer's instructions for installation and maintenance for each hardware including door closer, lock case, exit devices, etc.

D. Provide three copies of catalogues for all hardware used for incorporation into maintenance manual. Only original catalogue shall be used.

1.13 MAINTENANCE SERVICE

A. General Requirements: Execution requirements for maintenance service.

B. Maintenance to Certificate of Completion: Beginning at Substantial Completion and during the Defects Liability Period, provide full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door hardware smooth operation. Provide parts and supplies that are the same as those used in the manufacture and installation of original products.

1.14 EXTRA MATERIALS

A. General Requirements: Execution requirements for spare parts and maintenance products.

B. Furnish five extra key lock cylinders for each master keyed group.

PART 2 PRODUCTS

2.1 HARDWARE MANUFACTURERS

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

2.2 HARDWARE COMPONENTS

A. General Hardware Requirements: Where not specifically indicated, comply with applicable ANSI A156 standard for type of hardware required. Furnish each type of hardware with accessories as required for applications indicated and for complete, finished, operational doors.
   1. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
   2. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.
   3. Fasteners: Furnish as recommended by hardware manufacturer and as required to secure hardware. Finish to match hardware item being fastened.
   4. Fire Ratings: Provide hardware with UL or Intertek Testing Services (Warnock Hersey Listed) listings for type of application involved.
   5. Electrical Devices: Make provisions and coordinate requirements for electrical devices and connections for hardware.

B. Hinges: To EN1935 class 13; 40 hours salt test; 3 mm thick minimum; stainless steel 316; 5-knuckle; with pin, removable at interior, non-rising pin housed in ball bearing.
   1. Width: Sufficient to clear trim projection when door swings 180º.
   2. Number: Furnish minimum three hinges for each door leaf up to 2200mm high, and four hinges for each door leaf not exceeding 3050mm high.
   3. Size and Weight: 114 mm high heavy weight for door leaf up to 44mm thick and up to 1200mm wide, and 125 mm high extra heavy weight ball or iolite bearing hinges for door leaf exceeding 44mm thick or 1200mm wide.

C. Pivots: ANSI A156.1 and A156.4, center or offset full mortise pivots.
   1. Size: As recommended by pivot manufacturer for size and weight of door.

D. Locksets: Furnish locksets compatible with specified cylinders. Typical 70 mm backset. Furnish standard strikes with extended lips to protect trim from being marred by latch bolt, verify type of cutouts provided in metal frames.
   1. Mortise Locksets: ANSI A156.13, Series 1000, Grade 1.
   2. Bored (Cylindrical) Locksets: ANSI A156.2, Series 4000, Grade 1.
   3. Preassembled (Unit) Locksets: ANSI A156.12, Series 2000, Grade 1.
   4. Interconnected Locksets: ANSI A156.12, Series 5000, Grade 1.
   5. Auxiliary Locksets: ANSI A156.5, Grade 1, mortise dead locks, bored dead locks, rim locks or narrow stile locks.

E. Latch Sets: Match locksets.
   1. Mortise Latch Sets: ANSI A156.13, Series 1000, Grade 1, 2 or 3.
   2. Bored (Cylindrical) Latch Sets: ANSI A156.2, Series 4000, Grade 1, 2 or 3.

F. Exit Devices: ANSI A156.3, Grade 1; concealed vertical rod type or rim type; with push pad or cross bar; with extended lips to protect trim from being marred by latch bolt; verify type of cutouts provided in metal frames, with dust-proof floor strikes.
   1. Types: Suitable for doors requiring exit devices.
   2. Coordinators: Furnish overhead concealed in frame type at pairs of doors.

G. Cylinders: To DIN V18254 and ANSI A156.5, Grade 1, 5, 6 or 7, pin type removable cylinders, or interchangeable core type cylinders; Euro profile, length to suit door thickness; single, double or with turn where indicated; non copiable, protected with anti-drill option from outside; nickel-plated finish or to suit finish of handle.
   1. Locks and cylinders shall be keyed as per Engineer’s instruction.
   2. Keys: Nickel silver finish. Provide three keys per lock.

H. Lock: To BS 5872.
   1. Sash Lock: 76mm lock case, 57mm backset centers to suit Euro profile cylinder, stainless steel type 316, for end plate and strike plate, brass latch and deadbolt, deadbolt with hardened steel rollers.
   2. Deadlock: Same as sash lock without latch.
   3. Latch lock: Same as sash lock without deadlatch.
   4. Bathroom Lock: Special cylinder with thumbturn lock system with normal deadbolt to suit 8 or 5mm indicator and turn spindle.
   5. Nightlatch: Same as sash lock, cylinder to withdraw latch.

I. Electric Strikes and Locks: ANSI A156.5 mortised or rim mounted, semi rim mounted electric strikes, ANSI A156.23 electromagnetic locks, or ANSI A156.24 delayed egress locks.

J. Closers: ANSI A156.4 modern type with or without cover, stainless steel type 316 or to match door hardware on same face of door, surface mounted, overhead concealed, concealed in door, or concealed in floor center pivot or offset pivot closers; full rack and pinion type with steel spring and non-freezing hydraulic fluid.
   1. Adjustability: Furnish controls for regulating closing, latching, speeds, and back checking.
   2. Arms: Type to suit individual condition; parallel-arm closers at reverse bevel doors and where doors swing full 180 degrees.
   3. Location: Mount closers on inside of exterior doors, room side of interior doors typical; mount on pull side of other doors.
   4. Operating Pressure: Maximum operating pressure as follows:
      a. Interior Doors: Maximum 22 N.
      b. Exterior Doors: Maximum 38 N.
      c. Fire Rated Doors: As required for fire rating, maximum 65 N.

K. Door Controls and Overhead Holders: Furnish with accessories as required for complete operational installation.
   1. Manual Door Holders and Overhead Stops: ANSI A156.8, Grade 1 types as specified.
   2. Closer Holder Release Devices: ANSI A156.15 door mounted, jamb mounted, or concealed mounted closer holder release devices, or closers with single or multiple point hold open or free swinging release device designed to make swing doors close upon receiving electrical signal.
   3. Electro-Magnetic Door Holder: ANSI A156.15 wall or floor mounted type.
   4. Power Assist Door Operators: ANSI A156.19 power mechanism which reduces opening resistance of self-closing door.
   5. Low Energy Power Door Operators: ANSI A156.19 power mechanism which opens and closes door upon receipt of signal.
   6. Low Energy Power Open Door Operators: ANSI A156.19 power mechanism which opens self-closing door; door closing independent of power operator.

L. Sliding and Bi-Folding Door Hardware: ANSI A156.14; furnish complete hardware sets for operational installation.

M. Door Stop: ANSI A156.1, Grade 1; stainless steel type 316 material; cylindrical or dome type with rubber and with no visible screws; to be fixed at minimum ⅔ of door width from Hinge side. Furnish with accessories as required for applications indicated.

N. Handles: Stainless steel type 316 satin finish, hollow type with bolt through fixing screws, return to door type.

O. Pull handle: Stainless steel type 316; bolt through fixing type.

P. Push/Pulls, Manual and Automatic Bolts, Protection Plates, Gaskets, Thresholds and Trim: Provide with accessories as required for complete operational door installations
   1. Push/Pulls: ANSI A156.6; push plates minimum 1.27 mm thick. Furnish pulls with bolts to secure from opposite door face.
   2. Manual and Automatic Constant Latching Bolts: ANSI A156.16 Grade 1 top and bottom flush bolts, with dust-proof floor strike.
   3. Kickplates Mop Plate, Armor Plate and Door Edging: ANSI A156.6; height 25 mm less than door width; minimum 1.27mm thick stainless steel type 316.
   4. Weatherstripping: Continuous at top and sides of exterior doors.
   5. Fire Rated Gaskets: Continuous at top and sides of fire rated doors.
   6. Thresholds: Maximum 12 mm height.

2.3 ACCESSORIES

A. Lock Trim: Furnish levers as selected from manufacturer’s range of levers and roses.

B. Through Bolts: Do not permit through bolts and grommet nuts on door faces in occupied areas unless no alternative is possible. Do not permit through bolts on solid wood core doors.

C. Flush Bolt:
   1. All flush bolts for metal doors to be of type suitable for metal doors with rod length 305mm, size 25 x 172mm.
   2. All flush bolts for wood doors to be 19 x 200mm size, lever action type.

D. Key Cabinet:
   1. Cabinet Construction: Aluminum or sheet steel construction, baked enamel finish; color as selected; piano hinged door.
   2. Cabinet Size: Size to suit project keys plus 10 percent.
   3. Horizontal metal or plastic strips for key hook labeling with clear plastic strip cover over labels.

2.4 FINISHING

A. Finishing of Other Hardware Items: Furnish manufacturer’s standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

C. Verify doors and frames are ready to receive door hardware and dimensions are as indicated on shop drawings and as instructed by manufacturer.

D. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

E. Verify electric power is available to power operated devices and is of correct characteristics.

F. Notify the Engineer of unsatisfactory conditions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install Work as specified, in accordance with the drawings, to the manufacturer’s instructions, and to the satisfaction of the Engineer.

B. Mounting Heights of Hardware Item:
1. Mount door hardware units at heights indicated on Drawings unless otherwise indicated.
2. Coordinate mounting heights with door and frame manufacturers.
3. Comply with manufacturer’s recommendations, and applicable standards and codes where not otherwise stated.

C. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

D. Hinges: Install types and in quantities as specified, or as indicated in door hardware schedule, or as mentioned on fire door certificates.

E. Stops: Provide floor stops for doors unless wall or other type of stops are indicated on door hardware schedule. Do not mount floor stops where they will impede traffic.

3.3 FIELD QUALITY CONTROL

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

B. Primary hardware manufacturer’s representatives shall inspect installation and certify that hardware has been furnished and installed in accordance with manufacturer's instructions and as specified.

C. Submit certificates related to materials and systems used in the work as conformation of tests carried out.

D. Tests and inspection results shall be submitted to the Engineer.

3.4 ADJUSTING

A. General Requirements: Execution requirements for testing, adjusting and balancing.

B. Initial Adjustment: Adjust hardware for smooth operation. Check each operating item of door hardware and each door to ensure proper smooth operation and function of every unit. Replace units that cannot be adjusted or might be difficult to monitor.

3.5 CLEANING AND PROTECTION OF INSTALLED CONSTRUCTION

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

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper function and finish.

D. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration until time of Substantial Completion.

E. Do not permit adjacent work to damage hardware or hardware finish.

3.6 FINAL CLEANING AND ADJUSTING

A. General Requirements: Execution requirements for testing, adjusting and balancing.

B. Upon completion, remove debris and unused materials from the site and dispose of safely.

C. Clean the works of dirt and splashes.

D. Final Adjustment: Adjust the installation to ensure correct alignment of components and smooth operation of the doors.

3.7 SCHEDULES

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

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes glass for cupboards, doors, windows, glazed walls, curtain wall, external glass cladding and glazed balustrades.

B. Related Sections:
1. Section 07 26 00 - Vapor Retarders.
2. Section 07 27 00 - Air Barriers.
3. Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI Z97.1 - Safety Glazing Materials Used in Buildings Safety.

B. American Society of Civil Engineers:
1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

C. ASTM International:
1. ASTM C570 - Standard Specification for Oil and Resin-Base Caulking Compound for Building Construction.
2. ASTM C669 - Standard Specification for Glazing Compounds for Back Bedding and Face Glazing of Metal Sash.
3. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
4. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.
5. ASTM C1036 - Standard Specification for Flat Glass.
6. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
7. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass.
8. ASTM C1193 - Standard Guide for Use of Joint Sealants.
9. ASTM D4802 - Standard Specification for Poly (Methyl Methacrylate) Acrylic Plastic Sheet.
10. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
11. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
12. ASTM E546 - Standard Test Method for Frost Point of Sealed Insulating Glass Units.
13. ASTM E576 - Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position.
14. ASTM E773 - Standard Test Methods for Seal Durability of Sealed Insulating Glass Units.

15. ASTM E2190 - Standard Specification for Sealed Insulating Glass Units.
16. ASTM E1425 - Standard Practice for Determining the Acoustical Performance of Exterior Windows and Doors.

D. EN Standards:
1. EN 12207: Windows and Doors - Air Permeability - Classification.
2. EN 12208: Windows and Doors - Watertightness - Classification.
3. EN 12210: Windows and Doors - Resistance to Wind Load - Classification.

E. DIN Standards:
1. DIN 18516: Part4 – Heat Soaked Testing for Tempered Glass.

F. Glass Association of North America:
1. GANA - FGMA Sealant Manual.
2. GANA - Glazing Manual.
3. GANA - Laminated Glass Design Guide.

G. National Fire Protection Association:
1. NFPA 80 - Standard for Fire Doors, Fire Windows.

H. Underwriters Laboratories Inc.:
1. UL - Building Materials Directory.

1.3 PERFORMANCE REQUIREMENTS

A. Ensure that no glass or glazing combination develops stresses that may lead to damage of glass, glazing materials, components and/or framing systems.

B. Conduct a thermal stress analysis, undertake thermal calculations and make due allowance for any heat treated glass which may be required. Shading stresses that might occur from adjacent components and buildings including shading devices shall be taken into account.

C. For Impact Requirements: Conform to NF P01-013 and NF P01-012 standards.

D. AEV (Air, Water and Wind) performance tests should be provided for all exterior windows and doors.
1. Air Permeability (to EN 12207:1999-11): Class 4.
2. Watertightness (to EN 12208:1999-11).
3. Wind Resistance (to EN 12210:1999-11).

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Design Drawings and Calculations: Demonstrate that glass is able to support the applied loads.

C. Product Data:
1. Glass: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.

2. Glazing Sealants, Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.

D. Samples:
1. Glass: Submit three samples 600 x 600 mm in size, illustrating each glass and plastic units, color and design.
2. Glazing Materials: Submit 300 mm long bead of glazing sealant and gaskets, color as selected by the Engineer.

E. Certificates: Certify that products meet or exceed specified requirements.

F. Manufacturer's Certificate: Certify that sealed insulated, environmental, laminated and/or acoustical glass meets or exceeds specified requirements and the IGMA certification.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with GANA Glazing Manual, GANA Sealant Manual, and GANA Laminated Glass Design Guide for glazing installation methods.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.7 MOCKUP

A. General Requirements: Quality requirements for mock-up.

B. Construct mockup size as directed by the Engineer, including glass and air barrier and vapor retarder seal.

C. Locate where directed by the Engineer.

D. Remove mockup when directed by the Engineer.

E. Test mock-ups according to relevant standards.

1.8 PRE-INSTALLATION MEETING

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

B. Convene minimum one week before starting Work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Do not install glazing when ambient temperature is less than 10 ºC.

C. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.10 WARRANTY

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

B. Furnish ten-year warranty to include coverage for sealed glass units from seal failure, interpane dusting or misting, and replacement of same.

C. Furnish ten-year warranty to include coverage for delamination of laminated glass and replacement of same.

1.11 EXTRA MATERIALS

A. General Requirements: Execution requirements for spare parts and maintenance products.

B. Supply two of each glass size and each glass type.

PART 2 PRODUCTS

2.1 GLAZING

A. Glass, Glazing, Sealant, Gasket, Tapes Compounds and Glazing Accessories Manufacturers: Any internationally recognized manufacturers having an official technical agreement to conformity with standards for the products.

2.2 COMPONENTS

A. Safety Tempered and Laminated Glass Conform to ANSI Z97.1 and ASTM C1172.

B. PVB Interlayer: Manufacturer’s standard, minimum 0.76 mm thick.

C. Insulated Glass Units: Double pane to ASTM E2190 Class A and E773; with glass elastomer, glass to mastic, and special acoustic edge seal; multifunctional solar E sputter coating; purge interpane space with dry hermetic air.

D. All tempered glass to be heat soak tested.

E. Obtain the total quantity of each glass material from the same material manufacturer. In the case of coated glasses, or other processed glass products, the Sub-Contractor shall ensure that all products are processed from ‘raw’ glass material obtained from one manufacturer.

2.3 ACCESSORIES

A. Glazing Splines and Gaskets: ASTM C864 Option I, resilient neoprene, silicone, and/or polyvinyl chloride extruded shape to suit glazing channel retaining slot.

B. Setting Blocks: ASTM C864 Option I, Neoprene, EPDM, or Silicone, 80 to 90 Shore A durometer hardness, length of 25 mm for each square meter of glazing or minimum 100 mm x width of glazing rabbet space minus 1.5 mm x height to suit glazing method and pane weight and area.

C. Spacer Shims: ASTM C864 Option I, Neoprene or Silicone, 50 to 60 Shore A durometer hardness, minimum 75 mm long x one half the height of glazing stop x thickness to suit application.

D. Glazing Clips: Manufacturer's standard type.

E. Fire-Resistant Glazing Materials: Materials used to obtain required fire-resistant rating.

F. Smoke Removal Unit Targets: Adhesive targets affixed to glass to identify glass units destined for removal of smoke.

2.4 SOURCE QUALITY CONTROL AND TESTS

A. General Requirements: Quality requirements for testing and analysis.

B. Provide shop inspection and testing for safety insulated glass.

C. Test samples to ANSI Z97.1, ASTM E2190, ASTM E773, ASTM E546, and ASTM E576.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify openings for glazing are correctly sized and within acceptable tolerance.

C. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement; weeps are clear and ready to receive glazing.

3.2 PREPARATION

A. Clean contact surfaces with solvent and wipe dry.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant.

3.3 INSTALLATION

A. Perform installation in accordance with GANA Glazing Manual.
   1. Glazing Sealants: Comply with ASTM C1193.
   2. Fire Rated Openings: Comply with NFPA 80

B. Exterior Dry Method:
   1. Cut glazing spline to length; install on glazing pane. Seal corners by butting tape and sealing junctions with compatible butyl sealant.
   2. Place setting blocks at ¼ or ⅓ points with edge block no more than 150 mm from corners.
   3. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
   4. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
   5. Trim protruding tape edge.

3.4 FIELD QUALITY CONTROL

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

B. Monitor quality of glazing.

3.5 MANUFACTURER'S FIELD SERVICES

A. General Requirements: Quality requirements for manufacturers’ field services.

B. Glass and glazing product manufacturers to provide field surveillance of installation.

C. Monitor and report installation procedures, and unacceptable conditions.

3.6 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Remove glazing materials from finish surfaces.

C. Remove labels after Work is complete.

D. Clean glass and adjacent surfaces.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

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

B. After installation, mark pane with an 'X' by using removable plastic tape or paste. Don’t mark heat absorbing or reflective glass units.

END OF SECTION

SECTION 08 91 19

FIXED LOUVERS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fixed extruded aluminum louvers with insect screens and frames.

B. Related Sections:
1. Section 07 92 00 - Joint Sealants.
2. Division 23: Ductwork connections to louvers.

1.2 REFERENCES

A. ASTM International:
1. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

B. Air Movement and Control Association International (AMCA):
1. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating.

1.3 PERFORMANCE REQUIREMENTS

A. Free Area: Minimum 45 % unless otherwise indicated.

B. Water Penetration: Maximum 0.01 kg/m2 of free area at core velocity of 1.0 m/s when tested in accordance with AMCA 500-L.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate louver sizes, blade profiles, frames, anchorage and connections to ductwork.

C. Product Data: Submit free area, pressure drop and water penetration data.

D. Samples: Submit sample of louver finish.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the drawings, to the manufacturer's instructions and to the approval of the Engineer.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Any internationally recognized manufacturer having an official technical agreement to conformity with standards specified in this section.

2.2 COMPONENTS

A. Louvers: Fixed, drainable or storm-proof blade type, extruded aluminum alloy 6063-T5 to ASTM B221, blade and frame thickness minimum 1.6 mm.

B. Insect Screen: Aluminum or stainless steel mesh in removable aluminum frame on interior face.

C. Fasteners: Stainless steel.

D. Finish: Polyester powder coating, minimum 60 microns, color as selected by the Engineer.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install louvers plumb, level and true in prepared openings, securely anchored.

B. Seal perimeter with sealant specified in Section 07 92 00.

C. Coordinate connection of louvers to ductwork and plenums.

D. Isolate aluminum from dissimilar metals and from cementitious materials.

3.2 CLEANING

A. Clean exposed surfaces after installation; repair damaged finishes.

3.3 SCHEDULES

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

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes metal stud wall framing; metal channel ceiling framing; shaft wall system; gypsum board and joint treatment; acoustic insulation; and textured finish.

B. Section includes gypsum board and precast cement board wall cladding over lead lining of radiation-shielded rooms.

C. Related Sections:
1. Division 5 - Metals.
2. Division 6 - Wood, Plastics and Composites.
3. Section 07 21 13 - Board Insulation.
4. Section 08 31 00 - Access Doors and Panels.

1.2 REFERENCES

A. ASTM International:
1. ASTM C36 - Standard Specification for Gypsum Wallboard.
2. ASTM C79/C79M - Standard Specification for Gypsum Sheathing Board.
3. ASTM C442 - Standard Specification for Gypsum Backing Board and Coreboard.
4. ASTM C475 - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
5. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board.
6. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
7. ASTM C630/C630M - Standard Specification for Water-Resistant Gypsum Backing Board.
8. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members.
9. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
10. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
11. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
12. ASTM C931/C931M - Standard Specification for Exterior Gypsum Soffit Board.
13. ASTM C1002 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases.
14. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing.
15. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
16. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

B. Gypsum Association:
1. GA 214 - Recommended Levels of Gypsum Board Finish.
2. GA 216 - Application and Finishing of Gypsum Board.
3. GA 600 - Fire Resistance Design Manual Sound Control.

C. Underwriters Laboratories Inc.:
1. UL - Fire Resistance Directory.

D. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to applicable code for fire rated assemblies and as follows:
1. Fire Rated Partitions: Listed assembly by UL or WH or GA File.
2. Fire Rated Ceiling and Soffits: Listed assembly by UL or WH or GA File.
3. Fire Rated Structural Column Framing: Listed assembly by UL or WH or GA File.
4. Fire Rated Structural Beam Framing: Listed assembly by UL or WH or GA File.
5. Fire Rated Shaft Wall Requirements: in accordance with UL or WH listed assembly or GA File.

B. Acoustic Attenuation for Interior Partitions: STC in accordance with ASTM E90.

C. Shaft Wall: Perform to the following:
1. Air Pressure within Shaft: and maximum mid-span deflection as per applicable code.
2. Acoustic Attenuation: STC in accordance with ASTM E90.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.

C. Product Data: Submit data on metal framing, gypsum board, joint; decorative finish, and acoustic accessories.

D. Samples: Submit two samples of each type of gypsum board, size 300 x 300 mm, illustrating finish color and texture.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C840, ASTM C1280, GA-214, GA-216 and GA-600.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.7 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mock-up, size as directed by the Engineer, including interior wall and ceiling system illustrating surface finish.

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 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging. Store channels and studs to avoid damage.

C. Handle gypsum boards to prevent damage to edges, ends and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.10 PROJECT CONDITIONS

A. Monitor environmental conditions for application and finishing Gypsum Wallboard Systems to comply with Gypsum Waldboard Systems manufacturer’s recommendations.

B. For non-adhesive attachment of gypsum board to framing, maintain temperature no less than 4.4 degrees C. For adhesive attachment and finishing of gypsum board, maintain temperature no less than 10 degrees C for 48 hours prior to application and continuously thereafter until adhesive is dry.

C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

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

2.2 COMPONENTS

A. Framing Materials:
1. Studs and Tracks: ASTM C645; GA-216 and GA-600; galvanized sheet steel, thickness and shape as indicated on drawings.
2. Shaft Wall Studs and Accessories: As instructed by the manufacturer.
3. Furring, Framing, and Accessories: ASTM C645, GA-216 and GA-600.

4. Fasteners: ASTM C514, ASTM C1002, and GA-216.
5. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
6. Adhesive: ASTM C557, and GA-216.

B. Gypsum Board Materials:
1. Standard Gypsum Board: ASTM C36; 12 mm thick; ends square cut, tapered, beveled, square or round edges.
2. Fire Rated Gypsum Board: ASTM C36; fire resistive type, UL or WH rated; 12 mm thick; ends square cut, tapered, beveled, square or round edges.
3. Moisture Resistant Gypsum Board: ASTM C630/C630M; 12 mm thick; ends square cut, tapered, beveled, square, or round edges.
4. Exterior Gypsum Soffit Board: ASTM C931/C931M; standard or fire rated type, 12 mm thick; ends square cut, tapered, beveled, square, or round edges.
5. Gypsum Backing Board: ASTM C442; standard, fire rated or insulating type; 12 mm thick; square, round, V-grooved, or book tongue and grooved edges, ends square cut.
6. Length or Size: Maximum available length or size in place.
7. Batten Joints: Manufacturer's standard type.

C. Precast Cement Board Materials:
1. Cement Board: Glass-fiber-mesh reinforced cementitious board, ASTM C1325, 12 mm thick, for wall cladding from finished floor level up to 1.20 m and in wet areas.
2. Fasteners: Corrosion-resistant screws as recommended by the board manufacturer.
3. Joint Treatment: Alkali-resistant glass fiber mesh tape and cementitious or polymer-modified joint compound.

2.3 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, un-faced, thickness as instructed by the manufacturer.

B. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.

C. Corner Beads: Metal and/or Metal and paper combination.

D. Edge Trim: GA-216; Type LC, L, LK and/or U exposed reveal bead.

E. Joint Materials: ASTM C475; GA-216; reinforcing tape, joint compound, adhesive, and water.

F. Textured Finish Materials: As indicated on drawings.

G. Fasteners: ASTM C1002, Type S12 or W, and GA-216.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify site conditions are ready to receive work and opening dimensions are as indicated on shop drawings and as instructed by manufacturer.

3.2 EXISTING WORK

A. Extend existing installations of gypsum board using materials and methods as specified.

B. Repair and remodel existing gypsum board assemblies which remain or are to be altered.

3.3 INSTALLATION

A. Metal Stud Installation:
1. Install studs in accordance with ASTM C754, GA-216 and GA-600.
2. Metal Stud Spacing: 600 mm on center.
3. Extend stud framing to ceiling only. Attach ceiling runner securely to acoustic ceiling track or ceiling framing, in accordance with details indicated.
4. Refer to Drawings for indication of partitions extending stud framing through ceiling to structure above. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
5. Door Opening Framing: Install double studs at door frame jambs. Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.
6. Blocking: Nail wood blocking to studs, or Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, wood frame opening, toilet accessories, and/or hardware.

B. Wall Furring Installation:
1. Erect wall furring for direct attachment to concrete masonry and concrete walls.
2. Erect furring channels horizontally and/or vertically; space maximum 600 mm oc, not more than 100 mm from floor and ceiling lines. Secure in place on alternate channel flanges at maximum 600 mm on center.
3. Install thermal insulation in conjunction with Section 07 21 13 directly attached to concrete masonry and concrete walls.
4. Erect metal stud framing tight to concrete and/or concrete masonry walls, attached by adjustable furring brackets.

C. Furring for Fire Ratings: Install furring as required for fire resistance ratings indicated and to GA-600 requirements.

D. Shaft Wall Framing: To GA-600 requirements.

E. Ceiling Framing Installation:
1. Install in accordance with ASTM C754 and GA-216.
2. Coordinate location of hangers with other work.
3. Install ceiling framing independent of walls, columns, and above ceiling work.
4. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 600 mm past each end of openings.
5. Laterally brace entire suspension system.

F. Acoustic Accessories Installation:
1. Install resilient channels at maximum 600 mm on center. Locate joints over framing members.
2. Place acoustic insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions, and tight to items passing through partitions.

3. Install acoustic sealant within partitions or at gypsum board perimeter at:
a. Metal Framing: Two beads.
b. Base Layer.
c. Face Layer.
d. Seal penetrations of partitions by conduit, pipe, duct work, and rough-in boxes.

G. Gypsum Board Installation:
1. Install gypsum board in accordance with GA-216 and GA-600.
2. Erect single layer standard gypsum board in most economical direction, with ends and edges occurring over firm bearing.
3. Erect single layer fire rated gypsum board vertically, with edges and ends occurring over firm bearing.
4. Erect exterior gypsum soffit board in accordance with ASTM C931/C931M.
5. Use screws when fastening gypsum board to metal furring or framing.
6. Use nails or screws when fastening gypsum board to wood furring or framing. Staples may only be used when securing first layer of double layer applications.
7. Double Layer Applications: Secure second layer to first with fasteners or adhesive and sufficient support to hold in place. Use fire rated gypsum backing board for fire rated partitions and ceilings. Place second layer perpendicular or parallel to first layer as indicated on drawings. Offset joints of second layer from joints of first layer.
8. Erect exterior gypsum soffit board perpendicular to supports, with staggered end joints over supports.
9. Treat cut edges and holes in moisture resistant gypsum board and exterior gypsum soffit board with sealant.
10. Place control joints consistent with lines of building spaces as indicated on Drawings and/or as directed.
11. Place corner beads at external corners as indicated on Drawings. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials as indicated on Drawings.
12. Apply gypsum board to curved walls in accordance with GA-216.
13. Over Lead Lining: Install gypsum board and cement board cladding only after the lead lining has been inspected and approved; fix to the steel support structure; where fasteners penetrate lead lining, cover with lead discs as specified in Section 13 49 00.
14. Cement Board: Install with 3 mm gaps at joints, fastened at 200 mm centers, joints taped and filled to the board manufacturer's instructions; cement board from finished floor level up to 1.20 m and gypsum board above.

H. Joint Treatment:
1. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
2. Feather coats on to adjoining surfaces so that camber is maximum 0.8 mm.
3. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.

I. Texture Finish: Spray, Trowel, Roller and/or Brush apply finish texture coating.

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

3.4 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 3mm/3m.

3.5 SCHEDULES

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

END OF SECTION

SECTION 09 24 00

PORTLAND CEMENT PLASTERING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes Portland cement plaster system.

B. Related Sections:
1. Division 3 - Concrete.
2. Division 4 - Masonry.
3. Division 5 - Metals.
4. Division 8 - Openings.

1.2 REFERENCES

A. ASTM International:
1. ASTM C91 - Standard Specification for Masonry Cement.
2. ASTM C150 - Standard Specification for Portland Cement.
3. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
4. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
5. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
6. ASTM C847 - Standard Specification for Metal Lath.
7. ASTM C897 - Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters.
8. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster.
9. ASTM C932 - Standard Specification for Surface-Applied Bonding Agents for Exterior Plastering.
10. ASTM C933 - Standard Specification for Welded Wire Lath.
11. ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete.
12. ASTM C1002 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases.
13. ASTM C1032 - Standard Specification for Woven Wire Plaster Base.
14. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster.
15. ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete and Shotcrete.
16. ASTM C1328 - Standard Specification for Plastic (Stucco) Cement.
17. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

B. Federal Specification Unit:
1. FS UU-B-790 - Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant).

C. National Terrazzo and Mosaic Association:
   1. NTMA - Terrazzo Specifications Guide.

D. Portland Cement Association:
   1. PCA - Portland Cement Plaster (Stucco) Manual.

E. Underwriters Laboratories Inc.:
   1. UL - Fire Resistance Directory.

F. Intertek Testing Services (Warnock Hersey Listed):
   1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to ASTM E119 and applicable code for fire rated assemblies, and as follows:
   1. Fire Rated Partitions: Listed assembly by UL or WH.
   2. Fire Rated Ceilings Bulkheads and Interior Soffits: Listed assembly by UL or WH.
   3. Fire Rated Structural Column Framing: Listed assembly by UL or WH.
   4. Fire Rated Structural Beam Framing: Listed assembly by UL or WH.

B. Fabricate vertical elements to limit finish surface to 1:360 deflection under lateral point load of 445 N.

C. Fabricate horizontal elements to limit finish surface to 1:360 deflection under superimposed dead load and wind uplift loads.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data on plaster materials, characteristics and limitations of products specified.

C. Samples: Submit two samples, size as directed, illustrating finish color and texture.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with ASTM C926 and PCA Portland Cement Plaster (Stucco) Manual.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.7 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mock-up, size as directed by the Engineer, including exterior and interior wall and ceiling system illustrating surface finish.

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. Exterior Plaster: Do not apply plaster when ambient temperature is less than 4ºC.

C. Interior Plaster: Do not apply cement plaster unless minimum temperature of 10ºC has been and continues to be maintained in building for minimum 48 hours prior to plaster application, during application, and until cured.

PART 2 PRODUCTS

2.1 PORTLAND CEMENT PLASTER

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

2.2 COMPONENTS:

A. Plaster Materials:
1. Cement: ASTM C150, Type I Portland cement.
2. Aggregate: Natural sand, within the following sieve sizes and percentage retained limits:

Sieve Size	Percent Retained
4.75 mm	0
2.36 mm	0 to 5
1.18 mm	5 to 30
0.60 mm	30 to 65
0.30 mm	65 to 95
0.15 mm	90 to 100

3. Water: Clean, fresh, potable and free of mineral or organic matter capable of affecting plaster.
4. Bonding Agent: ASTM C932; type recommended for bonding plaster to concrete and concrete masonry surfaces.

5. Admixtures: Type as per manufacturer instructions.
6. Glass Fibers: 13 mm nominal length; meeting requirements of ASTM C1116.
7. Color Pigment: ASTM C979 mineral oxide or synthetic type, color as selected by the Engineer.
8. Sand for finish coats shall be clean, graded silica sand, 100% passing a 30 mesh screen.

B. Furring and Lathing:
1. Expanded Metal Lath: ASTM C847, galvanized, to suit application.
2. Woven Wire Plaster Base: ASTM C1032, having 25 mm openings.
3. Welded Wire Lath: ASTM C933.
4. Backing Material: FS UU-B-790 Grade D.
5. Casing and Corner Beads, and Base Screed: Formed sheet steel, depth governed by plaster thickness, maximum possible lengths, expanded metal or solid flanges, with square, bullnosed, or beveled edges; galvanized.
6. Corner Mesh: Formed sheet steel, minimum 0.5 mm thick, perforated or expanded flanges shaped to permit complete embedding in plaster, minimum 50 mm size; galvanized.
7. Strip Mesh: Expanded metal lath, minimum 0.5 mm thick, 50 mm wide x 600 mm long; galvanized.
8. Control and Expansion Joint Accessories: Formed sheet steel, accordion profile, 50 mm expanded metal or solid flanges each side, galvanized.
9. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized.
10. Fasteners: ASTM C1002, self-drilling, self-tapping screws.
11. Polyethylene Sheet: Clear, 0.15 mm thick.
12. Access Panels in Plaster on Metal Furring (If Any): Formed stainless steel type 316, one-hour fire rating.

C. Acoustic Accessories:
1. Resilient Channels: Formed steel, minimum 0.5 mm thick; face, profile and width as indicated on drawings, splicing permitted; galvanized.
2. Acoustic Insulation: ASTM C665, friction fit type, unfaced; Thickness as per manufacturer’s instructions.
3. Acoustic Sealant: Non-hardening, non-skinning, for use with plaster system.

2.3 MIXES

A. Except where hand-mixing of small batches is approved by the Engineer, mechanical mixers of an approved type shall be used for the mixing of plaster. Frozen, caked or lumped materials shall not be used.

B. Mechanical mixers, mixing boxes and tools shall be cleaned after mixing each batch and kept free of plaster from previous mixes. Plaster shall be thoroughly mixed with the proper amount of water uniform in colour and consistency. Retempering will not be permitted and all plaster which has begun to stiffen shall be discarded.

C. All tools, implements, vessels and surfaces shall at all time, be kept scrupulously clean and strict precautions shall be taken to avoid the plasterer or other materials becoming contaminated by pieces of partially set material which would tend to retard or accelerate the setting time.

D. Spartterdash Coat (Rasheh): 1 part Portland cement, 1 part of sand and 1 part of crushed powder sand, proportioned by volume.

E. Internal plaster shall be (1:3) composed of 475 kg of cement per m^3 of sand. Internal plaster shall be 15 mm thick for walls and ceilings.

F. External plaster shall be (1:3) composed of 475 kg of cement per m^3 of sand. External plaster shall be 20 mm thick.

G. Internal and external plasters shall be executed in one single coat work in addition to the spartterdash (Rasheh). If more than one coat is required, approved galvanized wire mesh reinforcement shall be used.

H. Mix and proportion cement plaster in accordance with approved methodology.

I. Add glass fibers to plaster at rate of 8.0 kg per cubic meter of plaster.

J. Add admixtures as instructed by the manufacturer.

K. Mix only as much plaster as can be used prior to initial set.

L. Add color pigments to finish coat.

M. Mix materials dry, to uniform color and consistency, before adding water.

N. Protect mixtures from freezing, frost, contamination, and excessive evaporation.

O. Do not retemper mixes after initial set has occurred.

2.4 READY MIX PLASTER

A. For External Applications: Fiber reinforced cementitious ready mix plaster as produced by "Sodamco" or similar approved.
   1. Appearance: Grey powder.
   2. Grain Size: 0.02 to 1.5 mm.
   3. Composition: Portland cement, selected sand, fibers and additives.
   4. Wet Mix Life: Less than 1 hour.
   5. Compressive Strength: 10 MPa.
   6. Mix: 50 kg bag with 9 to 10 liters of clean water.
   7. Coat Thickness: 20 mm.
   8. Consumption: Around 2.0 kg/m^2/1mm thickness.

B. For Internal Applications: Cementitious ready mix plaster as produced by "Sodamco" or similar approved.
   1. Appearance: Grey powder.
   2. Grain Size: 0.02 to 1.5 mm.
   3. Composition: Portland cement, selected sand and additives.
   4. Wet Mix Life: Less than 1 hour.
   5. Mix: 50 kg bag with 7 to 8 liters of clean water.
   6. Coat Thickness: 15 mm.
   7. Consumption: Around 1.7 kg/m^2/1mm thickness.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Masonry: Verify joints are cut flush and surface is ready to receive work of this section. Verify no bituminous or water repellent coatings exist on masonry surface.

C. Concrete: Verify surfaces are flat, honeycomb and are filled flush, and surfaces are ready to receive work of this section. Verify no bituminous, water repellent, or form release agents exist on concrete surface that are detrimental to plaster bond.

D. Metal Lath and Accessories: Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are in place.

E. Mechanical and Electrical: Verify services within surfaces to be plastered (walls, ceiling, etc.) have been tested and approved.

3.2 PREPARATION

A. Dampen masonry surfaces to reduce excessive suction.

B. Clean concrete surfaces of foreign matter. Clean surfaces using acid solutions, solvents, or detergents. Wash surfaces with clean water.

C. Roughen smooth concrete surfaces and apply bonding agent.

D. Galvanized wiremesh reinforcement shall be provided wherever blockwalls abut against concrete columns, beams or slabs, and plaster finish is required to continue over both blockwork and concrete surfaces. The galvanized wiremesh reinforcement shall consist of 20 cm wide strips and shall cover the whole length of the joint, horizontally as well as vertically and shall be securely nailed, plugged or stapled in place to both surfaces at intervals not exceeding 40 cm at both edges.

E. Plastering shall not be commenced until all mechanical and electrical services, conduits, pipes and fixtures have been installed complete and tested.

F. All walls shall be wetted immediately prior to applying the first spatterdash coat (Rasheh) to provide key for subsequent coats.

3.3 EXISTING WORK

A. Extend existing Portland cement plaster installations using materials and methods as specified.

B. Repair existing damaged Portland cement plaster which remains or to be remodeled.

3.4 INSTALLATION

A. Installation of Lathing Materials:
   1. Apply one or two layers of Grade D building paper over substrate; lap edges 50 mm minimum. Fasten in place.
   2. Install metal lath in accordance with ASTM C1063.

B. Installation of Accessories:
   1. Install accessories in accordance with ASTM C1063.
   2. Place corner bead at external wall corners; fasten at outer edges of lath only.
   3. Place strip mesh diagonally at corners of lathed openings. Secure rigidly in place.
   4. Place casing beads at terminations of plaster finish. Butt and align ends. Secure rigidly in place.
   5. Install door and glazed frames plumb and level in opening. Secure rigidly in place.
   6. Position to provide convenient access to concealed work requiring access.

C. Control and Expansion Joints:
   1. Install interior control and expansion joints as indicated on Drawings.
   2. Install exterior contraction joints after initial set, scribed as indicated on Drawings by cutting through 2/3 of cement plaster depth, neatly, in straight lines.
   3. For horizontal exterior surfaces, install control and expansion joints as indicated on Drawings.
   4. For vertical exterior surfaces install control and expansion joints as indicated on Drawings.
   5. Establish control and expansion joints with specified joint device.

D. Plastering:
   1. Plaster shall be thoroughly mixed with the proper amount of water until uniform in colour and consistency. Retempering will not be permitted and all plaster which has begun to stiffen shall be discarded.
   2. All plastering shall be executed in a neat workmanlike manner and corners shall be true, straight and plumb.
   3. All tools, implements, vessels and surfaces shall at all times be kept scrupulously clean and strict precautions shall be taken to avoid the plaster or other materials becoming contaminated by pieces of partially set materials which would tend to retard or accelerate the setting time.
   4. The temperature before, during and after application of plaster shall be uniformly maintained above 12°C. The heat shall be well distributed in all areas, and concentration or irregular heat on plaster surfaces shall be prevented.
   5. Ventilation shall be provided to properly dry the plaster during and subsequent to its application. Plaster shall be prevented from too-rapid drying.
   6. All ingredients entering the several mixes shall be proportioned and measured by means of calibrated boxes or containers of such nature that the quantities can be accurately checked at any time. Ingredients shall be thoroughly mixed and then cleaned from the mixer and tools after each mix.

7. Plaster shall be rodded and straight-edged to uniform thickness in true planes flush to the required surface and flush with outlet boxes, and similar details and steel-troweled smooth and level with sharp, straight arises and true angles. Plaster shall be free from laps, cracks, trowels marks, or other structural defects or surface imperfections.
8. Where plaster finish is flush with adjoining surface or where tooled joint is indicated on the drawings, the plaster shall be grooved back with smallest available edging tool, to control any cracking at these points.
9. At doors and frames and other openings, all plaster shall be keyed in, except that across head of openings and 12 inches down each side plaster shall be cut free of frame, or grounds with edge of trowel, after stiffening but before setting, to allow for expansion.
10. All pressed metal door frames in walls shall be grouted full with Portland cement fine concrete after being completely anchored in place and prior to application of plaster. Rake grout to allow plaster to enter jamb.
11. Apply the spatterdash coat (Rasheh) and allow to dry before rendering is commenced.
12. Moist cure each coat. Apply successive coat immediately following initial set of scratch coat.
13. After curing, dampen previous coat prior to applying finish coat.
14. Apply finish coat to indicated color and texture.
15. Plumb, square and level.
16. Avoid excessive working of surface. Delay troweling as long as possible to avoid drawing excess fines to surface.
17. Moist cure finish coat for minimum period of 48 hours.

E. Waterproof Plaster to External Surfaces:
1. All surfaces to be plastered shall be clean and free from dust, grease, loose or projecting mortar and all traces of salts and are to be thoroughly sprayed with water but all free water shall be allowed to disappear from the surface before the plaster is applied.
2. Efflorescence shall be brushed off and all dust and foreign matter removed. All waterproof plastering shall be in two coats and shall contain 475 kg of cement per one-meter cube of sand mixed with an approved waterproofing admixture compound and applied in accordance with manufacturer’s instructions and shall be applied and allowed to dry before rendering is commenced. All walls shall be wetted immediately prior to applying the first coat of rendering and this shall be allowed to thoroughly dry out before the next coat is applied.

3.5 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation from Flat Surface: 3 mm in 3 m, non-cumulative.

3.6 ADJUSTING

A. General Requirements: Execution requirements for testing, adjusting and balancing.

B. Remove damaged or defective plaster by cutting and replace with specified materials to match adjacent plaster.

C. Fog coat non-uniform or discolored plaster with finish coat materials spray applied to entire finish coat surface.

3.7 SCHEDULES

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

END OF SECTION

SECTION 09 30 00

TILING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes ceramic, ceramic mosaic, quarry, and paver, tile for floor and for wall applications; tile stair treads and risers using mortar bed and backing application method; cementitious backer board as tile substrate; thresholds at door openings; and tile accessories.

B. Related Sections:
1. Section 03 35 00 - Concrete Finishing.
2. Section 07 13 00 - Sheet Waterproofing.
3. Section 07 14 00 - Fluid Applied Waterproofing.
4. Section 07 92 00 - Joint Sealants.
5. Section 09 24 00 - Portland Cement Plaster.
6. Section 10 28 00 - Toilet, Bath and Laundry Accessories.
7. Division 22 - Plumbing: Plumbing Fixtures.

1.2 REFERENCES

A. American National Standards Institute:
1. ANSI A108.1 - Installation of Ceramic Tile, A collection.
2. ANSI A108.10 - Specifications for Installation of Grout in Tilework.
3. ANSI A108.1A - Specifications for Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar.
4. ANSI A108.1B - Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.
5. ANSI A108.1C - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar -or- Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar.
6. ANSI A108.4 - Specifications for Ceramic Tile Installed with Organic Adhesives or Water-Cleanable Tile Setting Epoxy Adhesive.
7. ANSI A108.5 - Specifications for Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
8. ANSI A108.6 - Specifications for Ceramic Tile Installed with Chemical-Resistant, Water-Cleanable Tile-Setting and -Grouting Epoxy.
9. ANSI A108.7 - Specifications for Electrically Conductive Ceramic Tile Installed with Conductive Dry-Set Portland Cement Mortar.
10. ANSI A108.8 - Specifications for Ceramic Tile Installed with Chemical-Resistant Furan Mortar and Grout.
11. ANSI A108.9 - Specifications for Ceramic Tile Installed with Modified Epoxy Emulsion Mortar/Grout.
12. ANSI A118.1 - Standard Specification for Dry-Set Portland Cement Mortar.

13. ANSI A118.3 - Chemical-Resistant, Water-Cleanable, Tile-Setting and - Grouting Epoxy and Water-Cleanable Tile-Setting Epoxy Adhesive.
14. ANSI A118.4 - Latex-Portland Cement Mortar.
15. ANSI A118.5 - Chemical-Resistant Furan Mortar and Grout.
16. ANSI A118.6 - Ceramic Tile Grouts.
17. ANSI A118.8 - Modified Epoxy Emulsion Mortar/Grout.
18. ANSI A118.9 - Test Methods and Specifications for Cementitious Backer Units.
19. ANSI A136.1 - Organic Adhesives for Installation of Ceramic Tile.
20. ANSI A137.1 - Ceramic Tile.

B. ASTM International:
1. ASTM C847 - Standard Specification for Metal Lath.

C. Tile Council of America:
1. TCA - Handbook for Ceramic Tile Installation.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.

C. Product Data: Submit instructions for using grouts and adhesives.

D. Samples: Submit for each type of tile and grout required, two samples on two plywood panels backing, 300 x 300 mm each, illustrating pattern, color variations, and grout type, color and joint size variations.

E. Samples: Submit two samples for each type of tile and grout required, 300 x 300 mm each, on two plywood panels backing, illustrating pattern, color variations, and grout type and joint size variations.

F. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. General Requirements: Execution requirements for closeout procedures.

B. Operation and Maintenance Data: Submit recommended cleaning methods, cleaning materials, stain removal methods, and polishes and waxes.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with TCA Handbook and ANSI A108 Series/A118 Series.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.7 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mock-up, 10 m^2, with backer board, cleavage membrane, waterproofing, finish grout, and specified accessories.

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 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Protect adhesives and grouts from freezing or overheating.

1.10 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Do not install adhesives and grouts in unventilated environment.

C. Maintain ambient and substrate temperature of 10 ºC during installation of mortar materials.

1.11 EXTRA MATERIALS

A. General Requirements: Execution requirements for spare parts and maintenance products.

B. Supply 10 sq m of each type, size, color and surface finish of tile specified.

PART 2 PRODUCTS

2.1 TILE

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

2.2 COMPONENTS

A. Ceramic and Mosaic Tile: ANSI A137.1, and conforming to the following:
1. Moisture Absorption: 0 to 0.5 percent.
2. Size: As indicated on drawings.
3. Shape: Square or rectangular, as indicated on drawings.
4. Edge: Square or cushioned, as indicated on drawings.
5. Surface Finish: Unglazed, matte glazed, mottle glazed, or slip resistant, as indicated on drawings.
6. Color: As selected.
7. Mounted Sheet Size: As indicated on drawings.
8. Ceramic Type and Thickness: Unless otherwise stated, solid ceramic (plein masse), 10 mm thick minimum.

B. Ceramic Wall Tile: ANSI A137.1, and conforming to the following:
1. Moisture Absorption: 0 to 0.5 percent.
2. Size: As indicated on drawings.
3. Shape: Square or rectangular, as indicated on drawings.
4. Edge: Square or cushioned, as indicated on drawings.
5. Surface Finish: Unglazed, matte or mottle glazed, as indicated on drawings.
6. Color: As selected.
7. Pattern: As indicated on drawings.
8. Ceramic Type and Thickness: Unless otherwise stated, solid ceramic (plein masse), 8 mm thick minimum.

C. Quarry Tile: ANSI A137.1, and conforming to the following:
1. Moisture Absorption: 0 to 0.5 percent.
2. Size: As indicated on drawings.
3. Shape: Square or rectangular, as indicated on drawings.
4. Edge: Square or cushioned, as indicated on drawings.
5. Surface Finish: Unglazed, matte glazed or non-slip, as indicated on drawings.
6. Color: As selected.

D. Paver Tile: ANSI A137.1, and conforming to the following:
1. Moisture Absorption: 0 to 0.5 percent.
2. Size: As indicated on drawings.
3. Shape: Square or rectangular, as indicated on drawings.
4. Edge: Square or cushioned, as indicated on drawings.
5. Surface Finish: Unglazed, matte glazed or non-slip, as indicated on drawings.
6. Color: As selected.

E. Skirting or Base: To match floor tile for moisture absorption, surface type and finish, thickness and color:
1. Length: Tile length: As indicated on drawings.

2. Height: As indicated on drawings.
3. Top Edge: Bull nosed, unless otherwise indicated.
4. Internal Corner: Coved, unless otherwise indicated.
5. External Corner: Bullnosed, unless otherwise indicated.
6. Moisture Absorption: 0 to 0.5 percent.
7. Surface Finish: Unglazed, matte or mottle glazed, as indicated on drawings.
8. Color: As selected.

F. Wainscot Cap: Match mosaic wall tile for moisture absorption, surface finish, and color, tile length and height as indicated on drawings, bull nosed top edge, unless otherwise indicated.

G. Stair Tread and Riser: Match quarry tile and paver tile for moisture absorption, surface finish, thickness and color:
1. Tread Length and Width: As indicated on drawings.
2. Riser Length and Height: As indicated on drawings.
3. Nosing: Radiused or bull nosed, as indicated on drawings.
4. Tread Surface: Non-slip or ribbed, as indicated on drawings.

H. Exposed Edges: All exposed edges should be cut in factory to ensure straight alignment.

2.3 ACCESSORIES

A. Ceramic Accessories: Glazed and unglazed finish, size as indicated on drawings; same color and texture as adjacent wall tile.

B. Adhesive Materials:
1. Organic Adhesive: ANSI A136.1, thin-set bond type.
2. Epoxy Adhesive: ANSI A118.3, thin-set bond type.
3. Tile Setting Adhesive: Elastomeric, waterproof, and liquid applied.

C. Mortar Materials:
1. Mortar Bed Materials: Portland cement, sand, latex additive and water.
2. Mortar Bond Coat Materials:
   a. Dry-Set Portland Cement type: ANSI A118.1.
   b. Latex-Portland Cement type: ANSI A118.4.
   c. Epoxy: ANSI A118.3.
   d. Furan: ANSI A118.5.

D. Grout Materials:
1. Standard Grout: Portland cement type, Sand-Portland Cement type, Latex-Portland cement type, or Silicone Rubber type as specified in ANSI A118.6.
   a. Color Admixture: Site mixed type as recommended by manufacturer.
   b. Color: As selected.
2. Epoxy Grout: ANSI A118.8, modified epoxy emulsion grout, color as selected.
3. Furan Grout: ANSI A118.5, furan resin type, color as selected.
4. Silicone Rubber Grout: Silicone sealant, moisture and mildew resistant type, complying with ANSI A118.6, color as selected; use for wet floors and walls.
5. Grout Color: To match tile unless otherwise stated.

E. Cleavage Membrane: 6.9 kg asphalt saturated felt or 0.1 mm thick polyethylene film.

F. Waterproofing under Floor Tiling: As per Section 07 13 00 or Section 07 14 00.

G. Membrane at Walls: 6.9 kg asphalt saturated felt or 0.1 mm thick polyethylene film.

H. Reinforcing Mesh: 50 x 50 mm size weave of 16/16 wire size; welded fabric, galvanized.

I. Metal Lath: ASTM C847, Flat diamond mesh, weight to suit application, galvanized.

J. Cementitious Backer Board: ANSI A118.9; High density, cementitious, glass fiber reinforced, 13 mm thick; 50 mm wide coated glass fiber tape for joints and corners.

K. Thresholds: Marble type, 20 mm thick unless otherwise stated, color and finish as indicated on drawings, size by full width of wall or frame opening, beveled both sides, radiused edges from bevel to vertical face.

L. Toilet and Bath Accessories: Refer to Section 10 28 00.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify surfaces are ready to receive work.

3.2 PREPARATION

A. Protect surrounding work from damage.

B. Vacuum clean surfaces and damp clean.

C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.

D. Install cementitious backer board. Tape joints and corners, cover with skim coat of dry-set mortar to feather edge.

E. Prepare substrate surfaces for adhesive installation.

3.3 EXISTING WORK

A. General Requirements: Execution requirements for maintenance service.

B. Prepare and remodel existing tile installations using materials and methods as specified.

C. Clean and repair existing tile which remains.

3.4 INSTALLATION

A. Install tile, skirting, thresholds, stair treads and risers, and grout as per applicable requirements of ANSI A108.1 thru A108.10, and TCA Handbook recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Place thresholds and edge strips at locations indicated and/or scheduled.

D. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor, base and wall joints.

E. Place tile with joints uniform in width, subject to variance in tolerance allowed in tile size. Make joints watertight, without voids, cracks, excess mortar, or excess grout.
   1. Ceramic and Ceramic Mosaic Tile: 1.6 and 3 mm.
   2. Quarry and Paver Tile: 6 and 10 mm.

F. Form internal angles square or coved and external angles bullnosed or square, unless otherwise indicated.

G. Install ceramic accessories rigidly in prepared openings.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep expansion and control joints free of adhesive or grout. Apply sealant to joints.

J. Allow tile to set for a minimum of 48 hours prior to grouting.

K. Grout tile joints. Use standard grout unless otherwise indicated.

L. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

M. Installation - Floors - Thin-Set Methods:
   1. Over exterior concrete substrates, install in accordance with TCA Handbook Method F102, with standard grout.
   2. Over interior concrete substrates, install in accordance with TCA Handbook Method F113, dry-set or latex-Portland cement bond coat or F116, organic adhesive, with standard grout, unless otherwise indicated.
      a. Where waterproofing membrane is indicated, install in accordance with TCA Handbook Method F122, with latex-Portland cement grout.
      b. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F131.
      c. Where furan bond coat and grout are indicated, install in accordance with TCA Handbook Method F133.
      d. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCA Handbook Method F115.
   3. Over wood substrates, install in accordance with TCA Handbook Method F142, with standard grout, unless otherwise indicated.
      a. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F143.

N. Installation - Floors - Mortar Bed Methods:
   1. Over exterior concrete substrates, install in accordance with TCA F101, bonded, with standard grout.
   2. Over interior concrete substrates, install in accordance with TCA Handbook Method F111, with cleavage membrane and/or F112, bonded, unless otherwise indicated.
      a. Where waterproofing membrane is indicated, with standard grout or no mention of grout type, install in accordance with TCA Handbook Method F121.
      b. Where epoxy bond coat and grout are indicated, install in accordance with TCA Handbook Method F132, bonded.
      c. Where conductive tile is indicated, install in accordance with TCA Handbook Method F125, bonded.
      d. Where epoxy or furan grout is indicated, but not epoxy or furan bond coat, install in accordance with TCA Handbook Method F114, with or without cleavage or waterproofing membrane.
   3. Over wood substrates, install in accordance with TCA Handbook method F141, with standard grout, unless otherwise indicated.
   4. Cleavage Membrane: Lap and seal watertight, edges and ends.
   5. Waterproofing: Install as per Section 07 13 00 or Section 07 14 00.
   6. Mortar Bed Thickness: 15 mm, unless otherwise indicated.

O. Installation - Showers and Bathtub Walls:
   1. At tiled shower receptors install in accordance with TCA Handbook Method B414, mortar bed floor, and W201, mortar bed over concrete or masonry walls or B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
   2. At bathtub walls install in accordance with TCA Handbook Method B411, mortar bed on studs with waterproofing membrane; B412, over cementitious backer units with waterproofing membrane; or W202, thin-set over masonry.
   3. Grout with silicone rubber grout.
   4. Seal joints between tile work and other work with sealant Type specified in Section 07 92 00.

P. Installation - Wall Tile:
   1. On exterior walls install in accordance with TCA Handbook Method W244, thin-set over cementitious backer units with waterproofing membrane, W201, mortar bed over concrete and masonry with waterproofing membrane, or W202, thin-set over concrete and masonry with latex-Portland cement grout.
   2. Over cementitious backer units install in accordance with TCA Handbook Method W244, using membrane at toilet rooms and kitchens; or W223, organic adhesive.
   3. Over gypsum wallboard or wood or metal studs install in accordance with TCA Handbook Method W243, thin-set with dry-set or latex-Portland cement bond coat, W223, thin-set with organic adhesive, unless otherwise indicated.
      a. Where mortar bed is indicated, install in accordance with TCA Handbook Method W222, one coat method.
      b. Where waterproofing membrane is indicated other than at showers and bathtub walls, install in accordance with TCA Handbook Method W222, one coat method.

4. Over interior concrete and masonry install in accordance with TCA Handbook Method W202, thin-set with dry-set or latex-Portland cement bond coat, or W211, bonded mortar bed without membrane.
5. Over wood studs without backer install in accordance with TCA Handbook Method W231, mortar bed, with membrane where indicated.
6. Over metal studs without backer install in accordance with TCA Handbook Method W241, mortar bed, with membrane where indicated.

3.5 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Clean tile and grout surfaces.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

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

B. Do not permit traffic over finished floor surface for 4 days after installation.

3.7 SCHEDULES

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

END OF SECTION

SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes suspended metal grid ceiling system and perimeter trim; tile or panel false ceilings; and supplementary acoustic insulation over system units.

B. Related Sections:
1. Section 06 20 00 - Finish Carpentry.
2. Section 07 92 00 - Joint Sealants.
3. Section 08 31 00 - Access Doors and Panels.
4. Section 09 21 16 - Gypsum Board Assemblies.
5. Section 09 54 23 - Linear Metal Ceiling.
6. Division 23 - Heating Ventilating and Air Conditioning: Air Outlets & Inlets.
7. Division 26 - Electrical: Interior and External Luminaires.

1.2 REFERENCES

A. ASTM International:
1. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
2. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
3. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
4. ASTM E580 - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
5. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.

B. Ceilings and Interior Systems Construction Association:
1. CISCA - Acoustical Ceilings: Use and Practice.

C. Underwriters Laboratories Inc.:
1. UL - Fire Resistance Directory.

D. Intertek Testing Services (Warnock Hersey Listed):
1. WH - Certification Listings.

1.3 PERFORMANCE REQUIREMENTS

A. Installed System: Conform to UL or WH for ceiling and floor, and ceiling and roof assembly.

B. Suspension System: Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of 1:360.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other work or ceiling finishes, interrelation of mechanical and electrical items related to the system. Indicate method of suspension where interference exists.

C. Product Data: Submit data on metal grid system components, and acoustic units.

D. Samples:
1. Submit two full size samples, illustrating material and finish of units.
2. Submit two samples each, 300 mm long, of suspension system main runner, cross runner, and perimeter molding.

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

1.5 QUALITY ASSURANCE

A. Conform to CISCA requirements.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

C. Provide seismic design of suspended ceiling under direct supervision of Professional Engineer experienced in design of this Work and approved by the Engineer.

1.7 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mock-up, 4000 x 4000 mm, including typical field and edge conditions.

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 uniform temperature of minimum 16ºC and maximum humidity of 40% prior to, during, and after acoustic unit installation.

1.10 SEQUENCING

A. Sequence Work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Install acoustic units after interior wet work is dry.

1.11 EXTRA MATERIALS

A. General Requirements: Execution requirements for spare parts and maintenance products.

B. Furnish one percent of total acoustic unit area of extra tiles or panels to Employer.

PART 2 PRODUCTS

2.1 SUSPENDED ACOUSTICAL CEILINGS

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

2.2 COMPONENTS

A. Gypsum Board False Ceiling: As specified in Section 09 21 16.

B. Aluminum Strips False Ceiling: As specified in Section 09 54 23.

C. Tile or Panel False Ceiling: ASTM E1264, conforming to the following:
1. Size: As indicated on drawings.
2. Thickness: unless otherwise stated, 15 mm.
3. Composition: Calcium silicate, mineral, gypsum with aluminum backing or as shown on the drawings.
4. Density: As selected.
5. Light Reflectance: As selected.
6. NRC Range: As selected.
7. STC Range: As selected.
8. Fire Hazard Classification: As selected.
9. Joint: Kerfed or Rabbeted, as selected.
10. Edge: Square or beveled, as selected.
11. Surface Color: As selected.
12. Surface Finish: Perforated, Non-directional fissured, or Directional fissured, as indicated on drawings.

D. PVC Panel False Ceiling:

1. Panels: Rigid PVC panels, lay-in or clip-in type, non-porous, washable and resistant to hospital cleaning and disinfecting agents, with antibacterial surface.
2. Size and Thickness: As indicated on drawings; minimum 8 mm.
3. Fire Performance: Class B-s3,d0 to EN 13501-1 or equivalent, or as required by authorities having jurisdiction.
4. Color: White, or as selected.
5. Grid and Accessories: Galvanized steel grid with PVC or powder-coated cover, as recommended by the panel manufacturer.

E. Grid:
1. Non-fire Rated Grid: ASTM C635, light, intermediate and/or heavy duty; exposed T, exposed T/one direction, concealed T and G, concealed H and T, paired access T, downward access removable T, concealed Z, concealed T, or metal panel T; components die cut and interlocking.
2. Fire Rated Grid: ASTM C635, light, intermediate and/or heavy duty, listed by UL for use, two directional concealed, exposed T and/or exposed T/one direction; components die cut and interlocking.
3. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
4. Exposed Grid Surface Width: 24 mm.
5. Grid Finish: color as selected.
6. Accessories: Stabilizer bars, clips, splices, perimeter moldings, and hold down clips, required for suspended grid system.
7. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.

2.3 ACCESSORIES

A. Acoustic Batt Insulation: ASTM C665, friction fit type, unfaced; 50 mm thick, size cut to fit acoustic system.

B. Gypsum Board: Fire rated or standard type; specified in Section 09 21 16.

C. Acoustic Sealant for Perimeter Moldings: Specified in Section 07 92 00.

D. Gasket for Perimeter Moldings: Closed cell rubber sponge tape.

E. Touch-up Paint: Type and color to match acoustic and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify layout of hangers will not interfere with other work.

3.2 EXISTING WORK

A. Extend existing acoustical ceiling installations using specified materials and methods.

B. Clean and repair existing acoustical ceilings which remain or are to be reinstalled.

3.3 INSTALLATION

A. Lay-In Grid Suspension System:

1. Install suspension system in accordance with ASTM C636 and as supplemented in this section.
2. Install system in accordance with ASTM E580.
3. Install system capable of supporting imposed loads to deflection up to 1/360.
4. Lay out system to balanced grid design with edge units no less than 50 percent of acoustic unit size. Arrange system with long dimension of tile parallel or perpendicular to long dimension of the space.
5. Install after major above ceiling work is complete. Coordinate location of hangers with other work.
6. Install hanger clips during steel deck erection. Install additional hangers and inserts as required.
7. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
8. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers and related carrying channels to span extra distance.
9. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 150 mm of each corner; or support components independently.
10. Do not eccentrically load system, or produce rotation of runners.
11. Perimeter Molding:

a. Install edge molding at intersection of ceiling and vertical surfaces into bed of acoustic sealant or with continuous gasket.
b. Use longest practical lengths.
c. Miter or Overlap and rivet corners.
d. Install at junctions with other interruptions.

12. Form expansion joints as detailed. Form to accommodate plus or minus 25 mm movement. Maintain visual closure.
13. Install light fixture boxes constructed of gypsum board, or acoustic panel above light fixtures in accordance with UL or WH assembly requirements and light fixture ventilation requirements.

B. Concealed Grid Suspension System:

1. Install suspension system to ASTM C636 and as supplemented in this section
2. Install system in accordance with ASTM E580.
3. Install system capable of supporting imposed loads to deflection of 1: 360.
4. Lay out system to balanced grid design with edge units no less than 50 percent of acoustic unit size.
5. Install after major above ceiling work is complete. Coordinate location of hangers with other work.
6. Install hanger clips during steel deck erection. Install additional hangers and inserts as required.
7. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
8. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers and related carrying channels to span extra distance.
9. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 150 mm of each corner; or support components independently.
10. Do not eccentrically load system, or produce rotation of runners.

11. Perimeter Molding:
a. Install concealed edge molding at intersection of ceiling and vertical surfaces into bed of acoustic sealant or with continuous gasket.
b. Use longest practical lengths.
c. Miter or Overlap and rivet corners.
d. Install concealed at junctions with other interruptions.
12. Form expansion joints as detailed. Form to accommodate plus or minus 25 mm movement. Maintain visual closure.

C. Acoustic Units:
1. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
2. Lay directional patterned units one way with pattern parallel to longest or shortest room axis, or in basket weave pattern. Fit border trim neatly against abutting surfaces.
3. Install units after above ceiling work is complete.
4. Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
5. Cutting Acoustic Units:
a. Cut to fit irregular grid and perimeter edge trim.
b. Cut square reveal or bevel edges to field cut units.
c. Double cut and field paint exposed edges of tegular units.
6. Where bullnose concrete block corners or round obstructions occur, install preformed closures to match perimeter molding.
7. Lay acoustic insulation for distance of 1200 mm on both sides of acoustic partitions and as indicated on Drawings.
8. Install hold-down clips to retain panels tight to grid system within 6 m of exterior door.

D. Install gypsum board false ceiling as specified in Section 09 21 16.

E. Install aluminum strips false ceiling as specified in Section 09 54 23.

3.4 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation from Flat and Level Surface: 3 mm in 3 m.

C. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 º.

END OF SECTION

SECTION 09 54 23

LINEAR METAL CEILING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes suspended, pre-finished false ceilings systems of formed steel or aluminum comprising metal grid and perimeter trim; with or without space closures; at interior and exterior locations; linear; formed metal ceiling and soffit panels; and supplementary acoustical and/or thermal insulation over system units.

B. Related Sections:
1. Section 05 50 00 - Metal Fabrication.
2. Section 08 31 00 - Access Doors and Panels.
3. Section 09 21 16 - Gypsum Board Assemblies.
4. Division 21 - Fire Suppression: Sprinkler heads, and fire alarm (Fire or smoke detectors), in ceiling system.
5. Division 23 - Heating Ventilating and Air Conditioning: Air outlets and inlets (Air diffusers or grilles) in ceiling system.
6. Division 26 - Electrical: Interior and external luminaires in ceiling system.
7. Division 27 - Communications: Equipment in ceiling system.

1.2 REFERENCES

A. ASTM International:
1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
2. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric).
4. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
5. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
6. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
7. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
8. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
9. ASTM E580 - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.

1.3 PERFORMANCE REQUIREMENTS

A. Exterior Soffit and Suspension System: Resist wind uplift in accordance with applicable code without damage.

B. Installed Ceiling and Suspension System:
1. Support dead loads, including light fixtures, accessories, without eccentric loading of supports.
2. Resist dead loads with maximum deflection of 1/360 of span.
3. Resist seismic loads required by applicable code.

C. Ceiling/Soffit:
1. Noise reduction coefficient (NRC) when tested in accordance with ASTM C423 with insulation installed: As selected.
2. Acoustic attenuation (STC) in accordance with ASTM E90: As selected.
3. Thermal resistance (RSI): As selected.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate ceiling system reflected plan, location of mechanical and electrical components, details of junction with dissimilar materials, and points of suspension.

C. Product Data: Submit data for component profiles, materials, perimeter and integral trim, and space closures. Performance characteristics.

D. Samples: Submit two samples 150 x 1200 mm in size illustrating color and finish of exposed to view components.

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

1.5 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc. and testing firm acceptable to authority having jurisdiction.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.7 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mock-up, 2000 x 3000 mm, including suspension system, finish panels, closures, fixtures, integral mechanical and electrical components, etc.

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 DELIVERY, STORAGE, AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Accept factory-finished products on site in manufacturer's unopened factory packaging only; reject opened packages.

C. Protect factory-finished products from damage to appearance by storing products in manufacturer's unopened factory packaging in dry storage area.

1.10 COORDINATION

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

B. Coordinate Work of this section with installation of mechanical and electrical components and items, and with other construction activities affected by Work of this section.

C. Supply hanger clips during steel deck erection. Supply additional hangers and inserts as required.

1.11 WARRANTY

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

B. Furnish five year manufacturer warranty; include coverage for corrosion resistance and discoloration of surface finish.

1.12 EXTRA MATERIALS

A. General Requirements: Execution requirements for spare parts and maintenance products.

B. Supply five percent in standard lengths of linear ceiling panels.

PART 2 PRODUCTS

2.1 LINEAR METAL CEILING SYSTEM

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

B. Furnish materials in accordance with the drawings and to Engineer's satisfaction.

2.2 COMPONENTS

A. Linear Panels:
   1. Steel sheet, ASTM A653/A653M, 0.6 mm thick, galvanized with Z275 zinc coating. Sight-exposed surface finish: Enamel, satin chrome, or polished chrome finish, as selected.
   2. Stainless steel sheet, ASTM A666, Type 316, 0.6 mm thick. Sight-exposed surface finish: Satin or Polished finish, as selected.
   3. Aluminum sheet, ASTM B209M, or Aluminum extrusions, ASTM B221M 0.8 mm thick. Sight-exposed surface finish: Enamel or Anodized finish, as selected.
   4. Characteristics:
      a. Profile: Channel or box shape, 50 x 150 mm forming 100 mm module.
      b. Edge: Square or Bullnosed.
      c. Length: Equal.

B. Edge Molding, Expansion Joints and Splices: Same material, thickness and finish as linear panels.

C. End Caps: Molded plastic or formed metal; same color and finish as sight-exposed surfaces of linear panels.

D. Space Closures: Recessed or flush, extruded vinyl, formed steel, or formed aluminum sections, color as selected; snap fit between exposed linear panels.

E. Accessories: Stabilizer bars, clips, hold down clips, and as required for suspended grid system; sight-exposed surfaces same color and finish as sight-exposed surfaces of linear panels.

F. Suspension Members: Formed steel or aluminum sections, with integral attachment points; galvanized finish; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

G. Suspension Wire: Steel, annealed, galvanized finish, size and type for application, seismic requirements, and ceiling system flatness requirement specified.

H. Subgirt Members: ASTM A653/A653M, galvanized with Z275 zinc coating, formed to resist imposed loads and to provide attachment for linear panels and accessories.

I. Access Panel: Furnish matching removable or hinged panel (as applicable) with frameless appearance, swinging downward, with spring latch; size as shown on drawings or as directed by the Engineer.

J. Air Distribution Devices and Others: Fully integrated with ceiling system, requiring no interruption of suspension components, adjustable from below ceiling, relocatable, and independently suspended.

K. Lighting Fixtures and Others: Fabricated to fit system, requiring no interruption of suspension components, in accordance with Division 26 - Electrical, and independently suspended.

L. Acoustic and Thermal Insulation: ASTM C665, preformed glass or mineral fiber batt or roll; friction fit, black on exposed side, conforming to the following:
1. Thermal Resistance (RSI): As selected.
2. Batt or Roll Size: As selected.
3. Facing: Unfaced or Faced on one side with foil, asphalt treated, black plastic, or mesh reinforced Kraft paper.

M. Touch-up Paint for Concealed Items: Zinc rich or Zinc oxide type.

2.3 FABRICATION

A. Shop cut linear panels to accommodate mechanical and electrical items.

B. Form internal and external corners of same material, thickness, finish and profile to match exposed linear panels; back brace internal corners.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify layout of hangers do not interfere with other work.

C. Verify required utilities are available, in proper location and ready for use.

D. Verify field measurements are as indicated on approved shop drawings.

3.2 INSTALLATION

A. Suspension Components: Install after above ceiling work is complete in accordance with ASTM C636 and ASTM E580.
1. Hang carrying members independent of walls, columns, ducts, light fixtures, pipe, and conduit; where carrying members are spliced, avoid visible displacement of face panels with adjacent panels.
2. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest adjacent hangers to span required distance.
3. Locate suspension system for linear panel layout as indicated on the Drawings.

B. Linear Panels: Stagger end joints minimum 300 mm or align end joints.
   1. Butt interior end joints tight or set exterior end joints with 2 mm gap for expansion and contraction.
   2. Provide expansion or control joints to accommodate plus or minus 25 mm movement and maintain visual closure.
   3. Install recessed space closures between linear panels at interior and exterior locations.
   4. Install edge moldings at intersections of ceiling, junctions with other finishes, and at vertical surfaces; use maximum piece lengths.
   5. Where bullnose masonry units occur, install radiused closures to fit edge molding.
   6. Install end caps at sight-exposed ends of linear panels.
   7. Field miter corners or install prefabricated corner sections.
   8. Exercise care when site cutting sight-exposed finished components to ensure surface finish is not defaced.

C. Insulation: Install above panel members; fit tight between grid members; place insulation facing side down.

D. Install Work in accordance with the drawings and to the satisfaction of the Engineer.

3.3 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation from Flat and Level Surface: 3 mm in 3 m.

C. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 º.

D. Maximum Variation from Dimensioned Position: 6 mm.

3.4 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Remove protective coating or film.

C. Clean polished and reflective surfaces.

D. Replace damaged or abraded components.

3.5 SCHEDULES

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

END OF SECTION

SECTION 09 62 63

CEMENT SAND SCREED FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. This section specifies architectural sand cement screed casted as floor finish, or substrate to other floor finishes.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete.
2. Section 03 35 00 - Concrete Finishing.
3. Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

A. American Concrete Institute (ACI):
1. ACI 308 - Standard Practice for Curing Concrete.
2. ACI 318 - Building Code Requirements for Reinforced Concrete.
3. ACI 347 - Recommended Practice for Concrete formwork.

B. American Standards for Testing and Materials (ASTM):
1. ASTM C33 - Standard Specifications for Concrete Aggregates.
2. ASTM C94 - Ready-Mixed Concrete.
3. ASTM C150 - Portland Cement.
4. ASTM C190 - Test Method for Tensile strength of Hydraulic Cement Mortars.
5. ASTM C256 - Test Method for Flexural strength of Hydraulic Cement Mortars.
6. ASTM C330 - Standard Specifications for Lightweight Aggregates for Structural Concrete.
7. ASTM C1439 - Test Method for Compressive strength of Hydraulic Cement Mortars.

C. BS EN Standards:
1. BS EN 206-1 - Concrete, specification, performance, production and conformity.
2. BS 8204 - Code of Practice for Screeds, Bases and In-Situ Floorings.
3. BS EN 13318 - Screed material and floor screeds, definitions.

D. Code of Practice:
1. CP 202 - Code of Practice for Tile Flooring and Slab Flooring.
2. CP 203 - Code of Practice for Sheet and Tile Flooring.
3. CP 204 - Code of Practice for In-Situ Floor Finishes.

E. DIN Standards:
1. DIN 18353 - Contract Procedures for Building Works - Part C: General Technical Specifications for Building Works - Floor Screed Works.
2. DIN 18560 - Floor Screeds in Building Construction.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data on screed hardener, sealer, curing compounds and slip resistant treatment, compatibilities, and limitations.

C. Design Data:
1. Submit mix design.
2. Submit separate mix designs when admixtures are required for the following:
   a. Hot and cold weather concrete work.
   b. Air entrained concrete work.
3. Identify mix ingredients and proportions, including admixtures.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with Referenced Standards.

B. Acquire cement and aggregate from same source for all work.

C. Use only 1 brand of cement and admixtures unless otherwise approved in writing by the Engineer.

D. Provide the Engineer with delivery ticket for each load of screed.

1.5 REGULATORY REQUIREMENTS

A. Comply with all requirements of applicable Standards and Codes.

PART 2 PRODUCTS

2.1 SAND CEMENT SCREED

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

2.2 MATERIALS

A. Cement: To ASTM C150, type I, Portland cement, unless noted otherwise.

B. Aggregate:
1. For Normal Weight Screed: To ASTM C33.
2. For Light Weight Screed: To ASTM C330.

C. Reinforcement: To ASTM A706 / A706M, deformed low-alloy steel bars, or to ASTM A615 / A615M, deformed steel bars; Grade 60, 420 MPa minimum yield grade; unfinished.

D. Water: Clear, clean, potable water complying with BS EN 1008.

2.3 CONCRETE MIX

A. Screed Type:
1. Screed as Substrate for Other Floor Finishes: Lean concrete screed of at least 24 MPa on cylinder (30 MPa on cube), with a minimum thickness of 50mm.
2. Screed as Floor Finish: Bonded lean concrete screed, crack free and shrink free with strength of at least 24 MPa on cylinder (30 MPa on cube), 100mm thick unless otherwise shown on drawings.
3. Light Weight Screed: 700 kg/m³ dry density; to be used where indicated on drawings and where directed by the Engineer.

2.4 REINFORCEMENT

A. For Screed Thickness 70 mm and Higher: 8 mm thick welded wire mesh, unless otherwise shown on drawings.

B. For Screed Thickness less than 70 mm: Polymer fiber 19 mm long, unless otherwise shown on drawings.

2.5 JOINT FILLERS

A. Refer to Section 03 30 00 and Section 07 92 00.

2.6 CURING MATERIALS

A. Curing material shall be fresh potable water complying with BS EN 1008.

PART 3 EXECUTION

3.1 MIXING

A. Plant Batched and Transit Mixed:
1. Batch at a central plant in compliance with ASTM C94.

B. Hand Mixed:
1. Hand mixing on site is not permitted.

3.2 SCREED PLACEMENT

A. Notify Engineer minimum 24 hours prior to placement.

B. Convey screed from a mixer to the forms as near final position as practical in a manner which will prevent segregation or loss of materials.

C. Place screed in bays of 3m to 4m wide.

D. Immediately after placing, thoroughly compact and level screed.

E. Do not drop screed freely from higher than 4 feet above the surface of being poured.

F. Power float screed surfaces which are indicated to be exposed and all surfaces which are directed by the Engineer:
   1. Consolidate surface with power driven floats as soon as topping can support equipment and operator.
   2. Re-straighten, cut down high spots, and fill low spots.
   3. Repeat float passes and re-straightening until surface is smooth and uniform in texture, and to the satisfaction of the Engineer.

G. Steel trowel screed surfaces then smooth by hand all other screed surfaces not indicated to be exposed and not indicated to be power floated.

3.3 CURING

A. Commence curing and protection of screed immediately after placing, as instructed by the Engineer. Curing shall be done by potable water only.

3.4 CONCRETE REPAIR

A. For any repair of sand cement screed, use products complying with BS EN 1504 (1-9) as applicable.

3.5 CLEANING AND PROTECTION

A. General Requirements: Execution requirements for final cleaning.

B. Clean and protect all surfaces on which sand cement screed was scheduled.

C. Do not permit traffic over unprotected floor surface.

3.6 TOLERANCES OF SCREED SURFACE FLATNESS

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation of Screed Surface Flatness: 3 mm in 3 m.

3.7 SCHEDULES

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

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes resilient sheet flooring; resilient tile flooring; resilient base; and resilient stair treads and risers.

B. Related Sections:
1. Section 09 62 63 - Cement Sand Screed Flooring: Power floated cement sand screed sub-floor surface.

1.2 REFERENCES

A. ASTM International:
1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
3. ASTM E662 - Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
4. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.
5. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing.
6. ASTM F1344 - Standard Specification for Rubber Floor Tile.
7. ASTM F1861 - Standard Specification for Resilient Wall Base.

B. Federal Specification Unit:
1. FS L-F-475 - Floor Covering Vinyl, Surface (Tile and Roll), with Backing.
2. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant.

C. National Fire Protection Association:
1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.

1.3 PERFORMANCE REQUIREMENTS

A. Conform to applicable code for fire performance ratings as follows:
1. Flooring, Critical Radiant Flux (CRF): Minimum 0.45 Watt per square centimeter, per ASTM E 648.
2. Flooring, Smoke Developed: Maximum 450, per ASTM E662.
3. Wall Base, Flame Spread: Maximum 75, per ASTM E84.
4. Wall Base, Smoke Developed: Maximum 450, per ASTM E84.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate seaming plan, custom patterns and inlay designs.

C. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

D. Samples:
1. Submit manufacturer's complete set of color samples for initial selection.
2. Submit two samples, 100 x 300 mm in size illustrating color and pattern for each resilient flooring product specified.

1.5 CLOSEOUT SUBMITTALS

A. General Requirements: Execution requirements for closeout procedures.

B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Protect roll materials from damage.

1.8 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Maintain temperature in storage area between +13ºC and +32ºC.

C. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 21ºC to achieve temperature stability. Thereafter, maintain conditions above 13ºC.

1.9 EXTRA MATERIALS

A. General Requirements: Execution requirements for spare parts and maintenance products.

B. Furnish 1 sq m of flooring, 2 m of base, and 5 percent of installed stair materials of each type and color specified.

PART 2 PRODUCTS

2.1 RESILIENT FLOORING

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

2.2 SHEET FLOORING

A. Homogeneous Vinyl Sheet: Meet performance requirements of FS L-F-475, type II, grade A, or ASTM F1303, type II, grade 1, class B, color/pattern thru total thickness:
   1. Total Thickness: 2.5 mm nominal.
   2. Sheet Width: 1830 mm minimum.
   3. Static Load Limit: 3100 kPa minimum.
   4. Heat welded, chemically bonded or butted seams.
   5. Integral coved base with cap strip.

B. Vinyl Sheet with Backing: Meet performance requirements of FS L-F-475 Type II Grade A, B, or C, or to ASTM F1303, Type II, Grade 1, color and pattern through surface wear thickness:
   1. Backing: Organic or inorganic.
   2. Vinyl Wear Thickness: 1.25 mm minimum.
   3. Total Thickness: 2.5 mm minimum.
   4. Sheet Width: 1830 mm minimum.
   5. Static Load Limit: 860 kPa minimum.
   6. Heat welded, chemically bonded or butted seams.
   7. Integral coved base with cap strip.

C. Rubber Sheet: 100 % rubber composition, color and pattern through total thickness:
   1. Total Thickness: 3.2 mm minimum.
   2. Sheet Width: 1825 mm minimum.
   3. Design: Flat, embossed, raised, diamond, square, or circle.

2.3 TILE FLOORING

A. Vinyl Composition Tile: To ASTM F1066:
   1. Size: 305 x 305 mm.
   2. Thickness: 3.2 mm.
   3. Pattern: Solid color, through pattern, surface pattern, or marbleized.

B. Vinyl Tile: To ASTM F1066:
   1. Size: 305 x 305 mm.
   2. Thickness: 2.5 mm.
   3. Pattern: Solid color or through pattern.

C. Rubber Tile: To ASTM F1066, or ASTM F1344, Class I, Type A or B:
   1. Size: 305 x 305 mm.
   2. Overall Thickness: 3.2 mm.
   3. Base Thickness: 1.25 mm.
   4. Design: Smooth, or molded; in disc, square, diamond, or "steel plate" pattern.
   5. Style: Solid color, or mottled.

2.4 RESILIENT BASE

A. Base: To ASTM F1861, rubber, or vinyl; top set coved, toeless or extended toe:
   1. Height: 80 mm.
   2. Thickness: 2.0 mm.
   3. Finish: Satin, matte, or gloss.
   4. Length: 1.2 m sections, or roll.
   5. Accessories: Premolded external corners, internal corners and end stops.

2.5 STAIR COVERING

A. Rubber Stair Treads: To FS RR-T-650, Composition A; full width and depth of stair tread in one piece; non-slip tread designs; tapered thickness; nosing not less than 41mm deep.
   1. Nominal Thickness: 4.75 mm.
   2. Nosing Style: Square, or round.
   3. Type: Smooth, designed, ribbed, grooved, or abrasive surface.
   4. Design Pattern: Squares, discs, or chevrons.
   5. Color Style: Solid, or marbleized.

B. Vinyl Stair Treads: To FS RR-T-650, Composition B; full width and depth of stair tread in one piece; non-slip tread designs; tapered thickness; nosing not less than 32mm deep.
   1. Nominal Thickness: 4.75 mm.
   2. Nosing Style: Square, or round.
   3. Type: Smooth, designed, ribbed, grooved, or abrasive surface.
   4. Design Pattern: Squares, discs, or chevrons.
   5. Color Style: Solid, or marbleized.

C. Stair Risers: Maintain height and length in one piece, matching treads in material and color:
   1. Thickness: 2.0 mm.

D. Stringers: Maintain height in one piece and in maximum available lengths, matching treads in material and color:
   1. Thickness: 2.0 mm.

E. Stair Nosings: 38 or 76 mm horizontal return, 28.5 or 38 mm vertical return, full width of stair tread in one piece:
   1. Material: Rubber, or vinyl.
   2. Nominal Thickness: 2.5 mm.
   3. Pattern: Smooth, raised, or abrasive insert strip.

2.6 ACCESSORIES

A. Subfloor Filler: Cementitious, or premix latex; type recommended by adhesive material manufacturer.

B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.

C. Moldings and Edge Strips: Same material as flooring, stainless steel, or aluminum; width as per drawings.

D. Sheet Flooring Vinyl Welding Rod: Solid vinyl bead produced by manufacturer of vinyl flooring for heat welding seams, in color matching or contrasting with field color (as selected).

E. Feature Strips: Of same material as flooring, width as per drawings.

F. Filler for Coved Base: Plastic or wood.

G. Sealer and Wax: Types recommended by flooring manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. General Requirements: Administrative requirements for coordination and project conditions, verification of existing conditions before starting Work.

B. Verify concrete floors are dry to maximum moisture content as recommended by manufacturer, and exhibit negative alkalinity, carbonization and dusting.

C. Verify floor and lower wall surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.

3.2 PREPARATION

A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat and hard surface.

B. Prohibit traffic until filler is cured.

C. Clean substrate.

D. Apply primer as required to prevent "bleed-thru" or interference with adhesion by substances cannot be removed.

3.3 EXISTING WORK

A. Extend existing resilient flooring installations using materials and methods compatible with existing installations, and to manufacturer’s recommendations.

3.4 INSTALLATION - GENERAL

A. Install Work as specified, in accordance with the drawings, to the manufacturer’s instructions and to the satisfaction of the Engineer.

3.5 INSTALLATION - SHEET FLOORING

A. Lay flooring with joints and seams parallel to longer room dimensions; produce minimum number of seams. Lay out seams to avoid widths less than ⅓ of roll width; match patterns carefully at seams.

B. Double cut sheet; provide heat welded seams, chemically bonded seams, or butt joints.

C. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.

D. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. Secure metal strips with stainless steel screws. Secure resilient strips by adhesive.

E. Install coved base as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated; cover top edge with metal cap strip if shown on drawings.

F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

G. Install flooring in recessed floor access covers. Maintain floor pattern.

H. At movable partitions, install flooring under partitions without interrupting pattern.

I. Install feature strips where indicated. Fit joints tightly.

3.6 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed.

B. Lay flooring with joints and seams producing symmetrical tile pattern.

C. Install tile to approved pattern. Allow minimum ½ full size tile width at room or area perimeter.

D. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

E. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.

F. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. Secure metal strips with stainless steel screws.

G. Install flooring in recessed floor access covers. Maintain floor pattern.

H. At movable partitions, install flooring under partitions without interrupting pattern.

I. Install feature strips where indicated. Fit joints tightly.

3.7 INSTALLATION - BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension between joints as shown on approved shop drawings.

B. Miter internal corners. At external corners, use premolded units or 'V' cut back of base strip to ⅔ of its thickness and fold. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

3.8 INSTALLATION - STAIR COVERINGS

A. Install stair nosing, stair treads, and stair risers in one piece for full width and depth of tread.

B. Install stringers configured tightly to stair profile.

C. Adhere over entire surface. Fit accurately and securely.

3.9 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Remove excess adhesive from floor, base and wall surfaces without damage.

C. Clean, seal and maintain resilient flooring products.

3.10 PROTECTION OF INSTALLED CONSTRUCTION

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

B. Prohibit traffic on resilient flooring for 48 hours after installation.

3.11 SCHEDULE

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

END OF SECTION

SECTION 09 66 00

TERRAZZO FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes cast-in-place or precast Terrazzo flooring, base and border, and stairs and landings; and divider strips and termination edging.

B. Related Sections:
1. Section 03 30 00 - Cast-in-Place Concrete.
2. Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

A. ASTM International:
1. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C150 - Standard Specification for Portland Cement.
4. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
5. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
6. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

B. National Terrazzo and Mosaic Association:
1. NTMA - Terrazzo Specifications Guide.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate divider strip layout, control joint and expansion joint layout, flooring material transitions, color, patterns, and details of adjacent components.

C. Product Data: Submit data for reinforcing, divider strips, control joint strips, non-slip inserts, and sealer.

D. Samples: Submit two samples, 150 x 150 mm in size illustrating color, chip size and variation, chip gradation, mortar color, and typical divider strip.

1.4 CLOSEOUT SUBMITTALS

A. General Requirements: Execution requirements for closeout procedures.

B. Operation and Maintenance Data: Submit procedures for stain removal, stripping, and sealing.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NTMA recommendations contained in "Terrazzo Information Guide."

B. Maintain one copy of document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

B. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

1.7 MOCKUP

A. General Requirements: Quality requirements for mockup.

B. Construct mockup, 1000 x 1000 mm, including terrazzo flooring, base, curb, border, and stair illustrating appearance of finished work especially at corner.

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. Do not install terrazzo when temperature is below 10 ºC or above 32 ºC.

C. Maintain temperature within specified range 24 hours before, during, and 72 hours after installation of terrazzo.

D. Provide ambient lighting level of 860 lx , measured at floor surface.

1.10 COORDINATION

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

B. Coordinate placement of terrazzo divider strips with location of mechanical and electrical access covers, floor mat frames, and other items built in to terrazzo.

PART 2 PRODUCTS

2.1 MATERIALS

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

2.2 COMPONENTS

A. Portland Cement: ASTM C150, Type 1 Normal; white color for topping mix; gray color for underbed; modified to NTMA higher compressive strength requirements; obtained from single source.

B. Color Pigments for Topping: Non-fading mineral type, alkali-resistant.

C. Terrazzo Sand: ASTM C33, fine aggregates, clean and free of deleterious material.

D. Cushion Sand: ASTM C33, clean and free of deleterious material.

E. Water: Potable.

F. Dimension of Tiles: Size and thickness as shown on drawings.

G. Surface Aggregate: Crushed marble, granite, and/or quartz, No. 0 - 1, or 1 - 2 size in accordance with NTMA chip size for standard gradation and uniform coloration.

2.3 ACCESSORIES

A. Underbed Reinforcing Mesh: ASTM A185; 50 x 50 x 1.4 mm, galvanized.

B. Divider Strips: 3 mm thick zinc, brass or plastic exposed top strip, zinc coated steel concealed bottom strip, with anchoring features.

C. Control Joint Strips: 3 mm nominal width zinc or brass exposed top strips, zinc coated steel concealed bottom strip, 6 mm wide neoprene filler strip between vertical strips, with anchoring features.

D. Strip Height: To suit thickness of terrazzo topping, with allowance for grinding.

E. Base Cap, Base Divider Strip, and Separator Strip: Match divider strips.

F. Foam Filler: Closed cell urethane foam, capable of compression to 50 percent of its thickness with full recovery.

G. Slip Sheet: ASTM D2103; 0.15 mm polyethylene sheet or Asphalt treated and reinforced paper.

H. Non-slip Inserts: Zinc, or Brass, 9 x 9 x 0.9 mm dove-tail shaped channels, with anchors; filled with silicon carbide or carborundum non-slip filler.

I. Curing Compound: ASTM C309, or ASTM C1315.

J. Cleaner: Liquid type, pH of 7 - 10.

K. Sealer: Colorless, non-yellowing, penetrating liquid type, pH of 7 -10; not detrimental to terrazzo components.

L. Wood Subfloor Joint Tape: Cloth type.

M. Subfloor Filler: Latex type.

2.4 MIXES

A. Underbed: One part Portland cement to 4 parts sand by volume. Add water to produce low slump mix.

B. Floor: Comply with mix requirements of NTMA, white or gray Portland cement, with exposed divider and accessory strips.

C. Base and Border: Comply with mix requirements of NTMA, white or gray Portland cement, with exposed divider and accessory strips.

D. Curb and Border: Comply with mix requirements of NTMA, white or gray Portland cement, with exposed divider and accessory strips.

E. Stair Treads and Risers, Landings, and Stringers: Comply with mix requirements of NTMA, white or gray Portland cement, with exposed divider and accessory strips.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify substrate surfaces are ready to receive Work.

C. Do not begin terrazzo work until concrete substrate has cured 28 days, minimum.

3.2 PREPARATION

A. Clean substrate of foreign matter.

B. Remove loose or flaking concrete and repair to form sound, solid substrate.

C. Remove surface water and thoroughly brush in neat cement slurry bond coat.

3.3 INSTALLATION

A. Monolithic Terrazzo:
   1. Saw cut existing floor slab to receive divider and control joint strips and inserts and fill with grout.
   2. Install strips straight and level to locations indicated.

3. Install non-slip inserts in floors and stair nosings where indicated.
4. Install recessed floor mat, floor access panel, and frames.
5. Slope strips to match floor surface slope to drains.
6. Install base border, and curb divider and control joint strips to match floor pattern.
7. Install terminating cap strip at top of base; attach securely to wall substrate.
8. Place terrazzo topping mix over slurry coated substrate to nominal thickness of 25 mm.

B. Bonded Terrazzo:
1. Place cementitious underbed over wet slurry bond coat, to nominal thickness of 31 mm. Broom finish top surface.
2. Divide underbed construction into panels of 40 sq m separated with 13 mm foam filler.
3. Place divider strips and control joints at locations indicated and insert in semi-plastic uncured under-bed. Install straight and level.
4. Slope strips to achieve floor surface slope to drains.
5. Install non-slip inserts in floors and stair nosings where indicated.
6. Install recess frames.
7. Install base border, and curb divider and control joint strips to match floor pattern.
8. Install terminating cap strip at top of base; attach securely to wall substrate.
9. Place terrazzo topping mix over prepared underbed to nominal thickness of 25 mm.

C. Sand Cushion Terrazzo:
1. Place sand cover over structural floor substrate to nominal thickness of 3 mm, and roll smooth.
2. Place slip sheet over sand bed surface, lapping edges and ends 50 and 150 mm.
3. Place cementitious underbed over slip sheet to nominal thickness of 44 mm. Broom finish top surface.
4. Place reinforcement in center third of underbed. Stop reinforcement at control joint and joint separations of underbed, holding back approximately 25 mm from joint. Lap reinforcement joints 150 mm minimum.
5. Locate control joints to form underbed panels as indicated on Drawings.
6. Place divider strips and control joints at locations indicated and insert in semi-plastic uncured underbed. Install straight and level.
7. Slope strips to achieve floor surface slope to drains.
8. Install non-slip inserts in floors and stair nosings where indicated.
9. Install recess frames.
10. Install base border, and curb divider and control strips to match floor pattern.
11. Install terminating cap strip to top of base; attach securely to wall substrate.
12. Place terrazzo topping mix over prepared underbed to nominal thickness of 25 mm.

D. Base, Border and Curbs:
1. Vertical Base Flush with Wall: 9 mm minimum topping on underbed bonded to wall substrate, with cove transition between horizontal and vertical surfaces. Form base to total minimum thickness of 9 mm.

2. Vertical Base Projecting from Wall: 9 mm minimum topping on underbed bonded to wall substrate, projecting 6 mm from finish wall surface, with cove transition between horizontal and vertical surfaces; shape base as detailed.
3. Border: Form with division strips, of size and terrazzo color as per Drawings.
4. Hospital Curb: Form to profile as indicated on Drawings with 9 mm topping minimum, on underbed; of terrazzo color as indicated on Drawings.

E. Stairs:
1. Terrazzo Stairs and Landings on Concrete: Minimum 16 mm topping on underbed bonded to treads and minimum 9 mm topping on underbed bonded to risers. Total minimum thickness of 38 mm for treads and 25 mm for risers.
2. Terrazzo Treads and Landings in Metal Pans: 16 mm terrazzo topping on reinforced underbed. Total minimum thickness of 50 mm.

F. Curing:
1. Begin curing procedures as soon as curing materials can be applied without damaging formed surfaces.
2. Use curing method in accordance with NTMA instructions.
3. Close area to construction traffic, allowing undisturbed curing.

G. Surface Finishing:
1. Brush apply terrazzo topping mix slurry to topping surface.
2. Finish terrazzo in accordance with NTMA instructions.
3. Produce terrazzo finish surface to match approved mock-up sample, with minimum 70 percent chip exposed.
4. Grind terrazzo surface with power disc machine; successively sequence using coarse to fine grit abrasive, using wet or dry method.
5. Apply grout mix matching matrix color to fill honeycomb exposed during grinding.
6. After grout has sufficiently cured, grind repaired areas using fine grit abrasive.
7. Hand grind base, cove, and curb.

3.4 ERECTION TOLERANCES

A. General Requirements: Quality requirements for tolerances.

B. Maximum Variation from Flat Surface: 3 mm in one m.

C. Maximum Variation from Level (Except Surfaces Sloping to Drain): 3 mm.

3.5 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Scrub and clean terrazzo surfaces with cleaner in accordance with NTMA instructions. Let dry.

C. Immediately after terrazzo has dried, apply sealer in accordance with NTMA instructions and let dry.

D. Seal and polish surfaces in accordance with NTMA instructions.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

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

B. Do not permit traffic over finished terrazzo surfaces.

3.7 SCHEDULES

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

END OF SECTION

SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes surface preparation and field application of paints and coatings.

B. Related Sections:
1. Division 5 - Metals: Shop primed metal items.
2. Division 6 - Wood, Plastics and Composites: Shop finished woodwork.
3. Division 7 - Thermal and Moisture Protection.
4. Division 8 - Openings: Shop finished doors and panels.
5. Section 20 05 53 - Identification for Mechanical Systems.
6. Section 26 05 07 - Painting and Anti Corrosion Treatments.
7. Section 26 05 53 - Identification for Electrical Systems.

1.2 REFERENCES

A. ASTM International:
1. ASTM D16 - Standard Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.

B. Painting and Decorating Contractors of America:
1. PDCA - Architectural Painting Specification Manual.

C. SSPC: The Society for Protective Coatings:
1. SSPC - Steel Structures Painting Manual.

1.3 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data on finishing products and special coating.

C. Samples:
1. Submit two paper chip samples each 300 x 300 mm, illustrating color range and textures available for each surface finishing product scheduled.
2. Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded.

D. Manufacturer's Installation Instructions: Submit special surface preparation procedures, and substrate conditions requiring special attention.

1.5 CLOSEOUT SUBMITTALS

A. General Requirements: Execution requirements for closeout procedures.

B. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

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

1.7 MOCKUP

A. General Requirements: Quality requirements for mock-up.

B. Construct mockup panel, size as directed by the Engineer, illustrating special coating color, texture, and finish.

C. Construct door and frame assembly illustrating painting, stain and varnish, coating color, texture, and finish.

D. Locate where directed by the Engineer.

E. 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 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

D. Storage of Paint Materials: Store at minimum ambient temperature of 7ºC and maximum ambient temperature of 32ºC in ventilated area, and as required by manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements.

B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

C. Do not apply exterior coatings during rain/snow, or when relative humidity or moisture content of surfaces exceeds those required by paint product manufacturer.

D. Minimum Application Temperatures for Latex Paints: 7ºC for interiors; 10ºC for exterior, unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish Finishes: 18ºC for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 860 lx measured mid-height at substrate surface.

1.11 SEQUENCING

A. General Requirements: Requirements for Work sequence.

B. Sequence application to the following:
1. Do not apply finish coats until paintable sealant is applied.
2. Back prime wood trim before installation of trim.

1.12 WARRANTY

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

B. Furnish ten-year manufacturer warranty for paints and coatings.

1.13 EXTRA MATERIALS

A. General Requirements: Execution requirements for spare parts and maintenance products.

B. Supply 4 liters of each color, type and surface texture; store where directed.

C. Label each container with color, type, texture and room locations in addition to manufacturer's label.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Paint, Transparent Finishes, Stain, Primer Sealers, Block Filler, and Field Catalyzed Coatings Manufacturers: Any internationally recognized manufacturers having an official technical agreement to conformity with standards for the products.

B. Furnish materials as specified, as shown on drawings and to Engineer's satisfaction.

2.2 COMPONENTS

A. Coatings: Ready mixed, except field catalyzed coatings. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; prepare

coatings for good flow and brushing properties, capable of drying or curing, and free of streaks or sags.

B. Use products of the same manufacturer for succeeding coats. Where primer is shop applied to steel, subsequent coats may be the product of another manufacturer provided the coatings are mutually compatible.

C. Colors, textures and degree of luster shall be as selected by the Engineer. Tint prime and undercoats approximately to the shade of the final coat but with sufficient variation to distinguish them from the preceding coat. Proprietary names used to designate colors or materials, are not intended to imply that products named are required, or to exclude equal products of other manufacturers.

D. Colors of finishes shall not necessarily be manufacturer's stock colors. All materials for finishing coats shall be factory mixed and shall be of a standard quality equal to that of the standard colors of the material specified.

E. Specular Gloss Range:

1. Ranges determined in accordance with ASTM D523:

Sheen	Geometry / Degree	Gloss / Range
Flat	85	Below 15
Eggshell	60	5 to 20
Semi-Gloss	60	30 to 65
Gloss	60	Over 65

2. In locations where ambient temperature and humidity conditions encourage the ready formation of mildew, use paints with additional mildew inhibitive agent incorporate during the manufacturing process, of type and in concentration recommended by the paint manufacturer to withstand such mildew formation.

F. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified.

G. Patching Materials: Latex filler.

H. Fastener Head Cover Materials: Latex filler.

I. Putty:

1. Putty shall comply with the following standards:
a. ASTM C321-83 and ASTM D2486-79
b. BS 2750, sound reduction.
c. BS 1191, 4551, 5270, 5492 and 6214 C and E.
d. NF T 30-606 and 30-608
e. US Federal TT C-555, textured coating.
2. Putty material shall be as manufactured by "alltek", “TouPret” or approved equal.
3. Putty shall be applied in four coats unless otherwise stated.

2.3 INTUMESCENT PAINT

A. Approved Manufacturer: FIREFREE Coatings - Inc., Sherwin-Williams, International Paint - LLC, or similar approved.

B. Types of Intumescent Coating Systems:

1. Thin-Film Intumescent Coatings: Solvent or water based, for internal use
2. Thick-Film Intumescent Coatings (Two component epoxy): epoxy based, for external and aggressive environment use.

C. Thickness of Intumescent Coating Systems (Primer, basecoat & sealer/decorative coat): As per manufacturer's recommendations to reach the required Fire Resistance Period/Fire Resistance Level.

D. Material Characteristics:
1. Surface Burning Characteristics: Class A (ASTM E-84)
2. Quality Control Requirements: FM approved and/or UL listed

2.4 HIGH-PERFORMANCE COATINGS COMPONENTS

A. General: Furnish complete multi-coat systems formulated and recommended by manufacturer for applications indicated, in thicknesses indicated; number of coats specified does not include primer or filler coat.
1. Lead content: None.
2. Chromium content, as zinc chromate or strontium chromate: None.
3. Maximum VOC content: As required by applicable regulations.
4. Colors: As selected from manufacturer's standard colors or as per Drawings.

B. Epoxy Coating: Polyamide, or polyester epoxy; complying with MIL C-22750; gloss, semi-gloss, or eggshell finish.
1. Percentage of solids by volume: To manufacturer's recommendations to suit project requirements.
2. Number of Coats and Dry Film Thickness per Coat: Two coats, 150 microns each, unless otherwise shown on drawings.
3. Comply with performance requirements of MIL C-22750

C. Epoxy Floor Coating: Two-part, polyamide or polyester epoxy, fuel oil resistant, non-skid finish.
1. Percentage of Solids by Volume: To manufacturer's recommendations to suit project requirements.
2. Number of Coats and Dry Film Thickness per Coat:
   a. For Parking and Traffic Circulation Areas: Three coats, 250 microns each, without aggregates.
   b. For Ramp: Three coats, 250 microns each, with aggregates.
   c. Others: Two coats, 200 microns each, without aggregates.
3. Comply with performance requirements of MIL C-22750.

D. Polyurethane Coating: Two-part, aliphatic moisture-curing polyurethane, gloss, semi-gloss, or eggshell finish.
1. Percentage of Solids by Volume: To manufacturer's recommendations to suit project requirements.
2. Number of Coats and Dry Film Thickness per Coat: Two coats, 150 microns each, unless otherwise shown on drawings.
3. Comply with performance requirements specified above for severe exposure.

E. Polyurethane Floor Coating: Two-part, aliphatic polyurethane, non-skid finish.

1. Percentage of Solids by Volume: To manufacturer's recommendations to suit project requirements.
2. Number of Coats and Dry Film Thickness per Coat: Unless otherwise stated:
   a. For Parking and Traffic Circulation Areas: Three coats, 250 microns each, without aggregates.
   b. For Ramp: Three coats, 250 microns each, with aggregates.
   c. Others: Two coats, 200 microns each, without aggregates.

3. Comply with performance requirements specified above for severe exposure.

F. Primers: As recommended by coating manufacturer for specific substrate with a minimum of 50 microns dry film thickness.

G. Shellac: Pure, white type.

2.5 ANTIBACTERIAL PAINT

A. Antibacterial Water-Based Paint: Water-based acrylic paint with silver-ion or equivalent antimicrobial additive, tested to ISO 22196 or JIS Z 2801 with minimum 99 % reduction of bacteria, low VOC, washable and resistant to hospital disinfectants, eggshell or semi-gloss finish.

B. Antibacterial Emulsion Paint: Water-based emulsion with antimicrobial additive meeting the same test requirements, matt or eggshell finish.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify surfaces and substrate conditions are ready to receive Work as instructed by product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report conditions capable of affecting proper application.

D. Test shop applied primer for compatibility with subsequent cover materials.

E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following values:
1. Plaster and Gypsum Boards: 12 percent.
2. Masonry, Concrete and Concrete Unit Masonry: 12 percent.
3. Wood: 15 percent, measured in accordance with ASTM D 4442.
4. Concrete Floors: 8 percent.

3.2 PREPARATION

A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

B. Surfaces: Correct defects and clean surfaces capable of affecting work of this section. Remove or repair existing coatings exhibiting surface defects.

C. Marks: Seal with shellac those which may bleed through surface finishes.

D. Impervious Surfaces: Remove mildew by scrubbing with solution of tetra-sodium or tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.

F. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials. Apply latex based, or compatible sealer or primer.

G. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.

H. Concrete Floors: Remove contaminations, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

I. Copper Surfaces Scheduled for Natural Oxidized Finish: Remove contamination by applying oxidizing solution of copper acetate and ammonium chloride in acetic acid. Rub on repeatedly for required effect. Once attained, rinse surfaces with clear water and allow to dry.

J. Copper Surfaces Scheduled for Paint Finish: Remove contamination by steam, high pressure water, or solvent washing. Clean and immediately apply vinyl etch primer.

K. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.

L. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

M. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with solution of sodium meta-silicate after thoroughly wetting with water. Allow for drying.
1. Exposed concrete surfaces shall be clean and without any holes, lips, angular ridges, unstable sandy or granular areas, and the like, all to the satisfaction of the Engineer (Holes shall be flush filled. Lips, aggressive ridges, projections, etc. shall be flushed by grinding).

N. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces. Wash and neutralize high alkali surfaces.

O. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand or power tool wire brushing or sandblasting; clean by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.

P. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Prime metal items including shop primed items.

Q. Interior Wood Items Scheduled to Receive Paint Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats.

R. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.

S. Exterior Wood Scheduled to Receive Paint Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior paintable caulking compound after prime coat has been applied.

T. Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.

U. Glue-Laminated Wood: Prior to finishing, wash surfaces with solvent, remove grease and dirt.

V. Wood Doors Scheduled for Painting: Seal wood door top and bottom edge surfaces with clear sealer or tinted primer.

W. Metal Doors Scheduled for Painting: Prime metal door top and bottom edge surfaces.

3.3 EXISTING WORK

A. Extend existing paint and coatings installations using materials and methods compatible with existing installations and as specified.

3.4 APPLICATION

A. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

B. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.

C. Sand wood and metal surfaces lightly between coats to achieve required finish.

D. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

E. Where clear finishes are required, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.

F. Prime concealed surfaces of interior and exterior woodwork with primer paint.

G. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.

H. Finishing Mechanical and Electrical Equipment:

I. Refer to Divisions 21, 22, 23 and 26 for schedule of color coding and identification banding of mechanical and electrical equipment, duct, piping, conduit, etc.

a. Paint shop primed equipment.

b. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.

c. Prime and paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are shop finished.

d. Paint interior surfaces of air ducts and convector and baseboard heating cabinets visible through grilles and louvers with one coat of flat black paint to visible surfaces. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

e. Paint exposed conduit and electrical equipment occurring in finished areas.

f. Paint both sides and edges of plywood backboards for electrical and telephone equipment before installing equipment.

g. Color code equipment, piping, conduit and exposed duct work in accordance with requirements indicated or color schedule. Color band and identify with flow arrows, names and numbering.

h. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

J. Install Work as specified, as shown on drawings, in accordance with manufacturer’s instructions, and to the satisfaction of the Engineer.

3.5 FIELD QUALITY CONTROL

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

B. Inspect and test questionable coated areas in accordance with applicable code.

3.6 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Collect waste materials daily; place waste materials that may constitute fire hazard in closed metal containers; and remove daily from site.

3.7 SCHEDULES - SHOP PRIMED ITEMS FOR SITE FINISHING

A. Shop primed items for site finishing are stated under Division 5.

3.8 SCHEDULES - EXTERIOR SURFACES

A. Wood - Painted (Opaque):
1. One coat of latex or alkyd primer sealer.
2. Two coats of alkyd or latex enamel, gloss or semi-gloss.

B. Wood - Transparent:
1. Two coats of stain.

C. Wood - Shingles and Shakes:
1. One coat of stain or clear sealer.
2. Two coats of clear sealer.

D. Glue-Laminated Wood and Wood Timber Members:
1. One coat of stain or sealer.
2. Two coats of varnish, gloss or semi-gloss.

E. Pavement Markings:
1. Two coats of thermoplastic reflectorized paint, yellow or white.

F. Concrete, Concrete Block, Restored Masonry and Cement Plaster:
1. One coat of primer sealer latex or alkyd.
2. Two coats of latex or alkyd, flat.

G. Gypsum Board and Cement Plaster Soffits:
1. One coat of primer sealer latex or alkyd.
2. Two coats of latex or alkyd, flat.

H. Structural Steelwork: Refer to individual specification sections of Division 5.

I. Architectural Steel - Unprimed:
1. One coat of latex or alkyd primer.
2. Two coats of alkyd or latex enamel, gloss or semi-gloss.

J. Architectural Steel - Shop Primed:
1. Touch-up with zinc chromate or zinc rich primer.
2. Two coats of alkyd or latex enamel, gloss or semi-gloss.

K. Architectural Steel - Galvanized:
1. One coat galvanized primer.
2. One mordant coat.
3. Two coats of alkyd or latex enamel, gloss or semi-gloss.

L. Aluminum - Mill Finish:
1. One coat etching primer.
2. Two coats of alkyd enamel, gloss.

M. Copper:
1. One coat etching primer.
2. Two coats of alkyd enamel, gloss.

3.9 SCHEDULES - INTERIOR SURFACES

A. Wood - Painted:
1. One coat of latex or alkyd prime sealer.
2. Two coats of alkyd or latex enamel, gloss, semi-gloss, eggshell or flat.

B. Wood - Intumescent Coating:
1. One coat of prime sealer.
2. Two coats of intumescent coating.

C. Wood - Transparent:
1. Filler coat (for open grained wood only).
2. Two coats of stain.
3. One coat sealer.
4. Two coats of varnish, gloss, satin or flat.

D. Cabinet Interior:
1. One coat of latex or alkyd prime sealer.
2. One coat of alkyd or latex enamel, semi-gloss or flat.

E. Glue-Laminated Wood and Wood Timber Members:
1. One coat of stain or sealer.
2. Two coats of varnish, gloss, satin or flat.

F. Concrete, Concrete Block, Restored Masonry and Cement Plaster:
1. One coat of primer sealer latex or alkyd.
2. Two coats of latex or alkyd, flat or semi-gloss.

G. Structural Steelwork: Refer to individual specification sections of Division 5.

H. Architectural Steel - Unprimed:
1. One coat of alkyd or latex primer.
2. Two coats of alkyd or latex enamel, gloss or semi-gloss.

I. Architectural Steel - Primed:
1. Touch-up with alkyd or latex primer.
2. Two coats of alkyd or latex enamel, gloss or semi-gloss.

J. Architectural Steel - Galvanized:
1. One coat galvanized primer.
2. One mordant coat.
3. Two coats of alkyd or latex enamel, gloss or semi-gloss.

K. Aluminum - Mill Finish:
1. One coat etching primer.
2. Two coats of alkyd enamel, gloss.

L. Concrete Floors:
1. One coat of alkali resistant or catalyzed epoxy primer.
2. Two coats of alkyd floor enamel or catalyzed epoxy enamel, gloss.

M. Gypsum Board and Plaster Walls and Ceiling:
1. One coat of primer sealer latex or alkyd.
2. Two coats of alkyd, latex or latex acrylic enamel or emulsion, gloss, semi-gloss, eggshell or flat.

N. Wall Surfaces Under Vinyl Wall Covering:
1. Two coats of alkyd primer sealer.

O. Fire Retardant Finish:
1. One coat of fire retardant primer.
2. Two coats of fire retardant finish, gloss.

3. Flame and smoke rating of 25/50.

P. Gypsum Board, Cement Board and Plaster Walls and Ceilings in Clinical Areas (PET-CT Unit):

1. One coat of water-based primer sealer.
2. Two coats of antibacterial water-based paint or antibacterial emulsion paint, as scheduled.

Q. Insulated Coverings - Canvas and Cotton:

1. One coat of alkyd primer sealer.
2. Two coats of alkyd enamel, gloss, semi-gloss, eggshell or flat.

3.10 SCHEDULES - COLORS

A. As indicated on drawings and/or as selected by the Engineer from manufacturer's range and samples.

END OF SECTION

SECTION 10 14 06

INTERIOR SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section includes interior signs.

B. Related Sections:
1. Section 05 50 00 - Metal Fabrication.
2. Section 09 90 00 - Paints and Coatings.
3. Division 21 - Fire Suppression: Mechanical Identification.
4. Division 22 - Plumbing: Mechanical Identification.
5. Division 26 - Electrical.

1.2 REFERENCES

A. As per approved manufacturer’s standards.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings: Indicate sign styles, lettering font, foreground and background colors, locations, overall dimensions of each sign.

C. Samples: Submit two signs, size as directed by the Engineer, illustrating type, style, letter font, and colors specified; method of attachment.

D. Manufacturer's Installation Instructions: Submit installation template and attachment devices.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum ten years documented experience.

1.5 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for product storage and handling.

B. Package signs, labeled in name groups.

C. Store adhesive attachment tape at ambient room temperatures.

1.6 ENVIRONMENTAL REQUIREMENTS

A. General Requirements: Product requirements for environmental conditions affecting products.

B. Do not install signs when ambient temperature is lower than recommended by manufacturer. Maintain this minimum temperature during installation of signs.

1.7 WARRANTY

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

B. Furnish five-year manufacturer warranty for each signage system.

PART 2 PRODUCTS

2.1 INTERIOR SIGNS

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

2.2 COMPONENTS

A. Engraved Signs: Laminated colored plastic; lettering engraved through face to expose core color:
1. Face Color: As selected by the Engineer.
2. Core Color: As selected by the Engineer.
3. Total Thickness: As shown on drawings.
4. Height: As shown on drawings.
5. Edges: Square, Beveled and/or Radiused, as shown on drawings.
6. Character Font: As shown on drawings.

B. Sand Blasted Signs: Acrylic high gloss plastic; letters sand blasted to dull sheen:
1. Color: As selected.
2. Total Thickness: As shown on drawings.
3. Height: As shown on drawings.
4. Edges: Square, Beveled and/or Radiused, as shown on drawings.
5. Character Font: As shown on drawings.

C. Silk Screened Signs: Letters height as shown on drawings silk screened onto plastic surface:
1. Sign Color: As selected.
2. Character Color: As selected.
3. Total Thickness: As shown on drawings.
4. Height: As shown on drawings.
5. Edges: Square, Beveled and/or Radiused, as shown on drawings.
6. Character Font: As shown on drawings.

D. Injection Molded Cast Signs: Acrylic plastic or Cast aluminum:
1. Sign Color: As selected.
2. Character Color: As selected.
3. Total Thickness: As shown on drawings.
4. Height: As shown on drawings.
5. Edges: Square, Beveled and/or Radiused, as shown on drawings.
6. Character Font: As shown on drawings.

E. Raised Letter Signs, Base Material: Clear and/or Solid color acrylic plastic:
   1. Total Thickness: As shown on drawings.
   2. Height: As shown on drawings.
   3. Edges: Square, Beveled and/or Radiused, as shown on drawings.
   4. Character Font: As shown on drawings.

F. Raised Character Size and Style: Acrylic plastic, character adhered to base material:
   1. Character Color: As selected.
   2. Character Thickness: As shown on drawings.
   3. Height: As shown on drawings.
   4. Edges: Square, Beveled and/or Radiused, as shown on drawings.
   5. Character Font: As shown on drawings.
   6. Character Case: Upper and lower case.

G. Individual Graphics, Material: Clear, or Solid color acrylic plastic:
   1. Thickness: As shown on drawings.
   2. Height: As shown on drawings.
   3. Edges: Square, Beveled and/or Radiused, as shown on drawings.
   4. Character Color: As shown on drawings.
   5. Character Font: As shown on drawings.
   6. Character Case: Upper and lower case.

H. Graphic Style: Handicapped type.

2.3 ACCESSORIES

A. Mounting Hardware: Chrome and/or Brass screws.

B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.1 EXAMINATION

A. General Requirements: Administrative requirements for verification of existing conditions before starting Work.

3.2 INSTALLATION

A. Install signs after doors and surfaces are finished in locations indicated on Drawings and/or as scheduled.

B. Position sign as shown on drawings.

3.3 SCHEDULES

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

B. The Emergency Exit Circulation:
   1. The Contractor shall comply with the British fire codes (for design, materials, etc.). Proposed Color Code: As selected.

2. Set-Up of Stairs Evacuation (Vertical Circulation):
   a. Indication of the floor + number of level, and indication on the way out direction (an exit sign with direction arrow): Fire resistant painted metal plate or coated vinyl cut mounted or suspended from ceiling.
   b. Secured lighting for the signs shall be requested.
3. Set-Up of Floors Evacuation (Horizontal Circulation):
   a. According to lighting condition inside each floor, the Contractor shall use flashing (light + sound) exit signs which shall be placed in each circulation alley with a regular spacing (approximately each 15 linear meters) and indicating the evacuation stair direction.
   b. This specific signage system shall not overlap with the regular circulation system indicating the access to the lifts of the building.
   c. The Contractor shall also indicate the eventual fire-fighting tools that shall be used (fire extinguisher, alarm phone, etc.).

C. Access to the Elevators:
1. The access to the elevators signage system shall include information and direction in each floor indicating the access to each building elevator. Proposed color code: As selected.
2. Design and Set-Up:
   a. Panels, suspended from ceiling, shall indicate direction to reach building elevators. According to lighting conditions, these panels shall need additional lighting approved by the Engineer.
   b. This specific signage system shall not overlap with the emergency exit circulation - floors evacuation indicating the evacuation stair direction.

END OF SECTION

SECTION 10 28 00

TOILET, BATH AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes vanity tops, mirrors and chrome plated accessories for toilets.

B. Related Sections:
1. Section 05 50 00 - Metal Fabrication.
2. Section 08 80 00 - Glazing.
3. Section 09 30 00 - Tiling.

1.2 REFERENCES

A. ASTM International:
1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
3. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
4. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
5. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
6. ASTM C1036 - Standard Specification for Flat Glass.

B. Federal Specification Unit:
1. FS A-A-3002 - Mirrors, Glass.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, attachment methods.

C. Samples: Submit two samples of each accessory, illustrating color and finish.

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

1.4 COORDINATION

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

B. Coordinate the Work with placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.5 WARRANTY

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

B. Furnish five-year manufacturer warranty for all mirrors and accessories.

PART 2 PRODUCTS

2.1 TOILET AND BATH ACCESSORIES

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

2.2 COMPONENTS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

B. Keys: Furnish keys for each accessory to Owner.

C. Stainless Steel Sheet: ASTM A666, Type 316.

D. Stainless Steel Tubing: ASTM A269, stainless steel type 316.

E. Galvanized Sheet Steel: ASTM A653, Z275 zinc coating.

F. Mirror Glass: As specified in Section 08 80 00.

G. Adhesive: Two component epoxy type and/or contact type, waterproof.

H. Fasteners, Screws, and Bolts: Hot dip galvanized.

I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

J. Primer: As instructed by the manufacturer.

2.3 MIRRORS AND CHROME PLATED ACCESSORIES

A. Mirrors: Frameless, or metal-framed consisting of 1.3 mm angle or channel shapes, with mitered and welded ground corners, and tamperproof hanging system; all as shown on the drawings.
   1. Minimum 6 mm thick clear glass, abrasion-resistant coated mirror.
   2. Size: As indicated on Drawings.
   3. Backing:

a. Full-mirror sized, minimum 0.8 mm galvanized steel sheet and non-absorptive filler material.
b. Plywood backing to BS 1455, WBP bonded, Grade 2, 16 mm thick.

4. Fixed Tilt Mirrors: Minimum 75 mm tilt from top to bottom.
5. Adjustable Tilt Mirrors: Stainless steel type 316 L piano hinge full width of base and elbow hinges at sides of mirror, for minimum tilt forward from top of 150 mm.
6. Shelves:
   a. Frameless for frameless mirrors; and metal-framed for metal-framed mirrors, gage and finish to match mirror frame, with turned down edges, welded to frame;
   b. 125 mm deep, full width of mirror, with concealed supports.

B. Chrome Plated Accessories:
1. Soap Holder: Wall or deck mounted on vanity and lavatory, stainless steel type 316.
2. Paper Towel Holder: Folded paper type, stainless steel type 316, with viewing slots on sides as refill indicator.
3. Toilet Paper Holder: Single roll, surface mounted bracket type, or folded tissue type, hinged at bottom; stainless steel type 316; designed to prevent theft of tissue roll.
4. WC Brush with Holder: Stainless steel type 316, wall mounted.
5. Robe Hook: Heavy-duty stainless steel type 316, single-prong or double-prong, rectangular-shaped bracket and backplate for concealed attachment, satin or bright polished finish.

C. Grab Bars: Stainless steel type 316, 32 and/or 38 mm outside diameter, minimum 1.3 mm wall thickness, non-slip grasping surface finish, concealed or exposed flange mounting; 38 mm clearance between wall and inside of grab bar.
1. Length and configuration: As indicated on Drawings and/or as schedule.

2.4 FACTORY FINISHING

A. Stainless Steel: No. 4 satin brushed and/or No.8 mirror polished finish, unless otherwise noted.

B. Chrome/Nickel Plating: ASTM B456, Type SC 2, satin and/or polished finish, unless otherwise noted.

C. Baked Enamel: Pretreat to clean condition, apply one coat primer and minimum two coats epoxy and/or electrostatic baked enamel.

D. Galvanizing for Items Other than Sheet: ASTM A123/A123M to 380 g/sq m. Galvanize ferrous metal and fastening devices.

E. Shop Primed Ferrous Metals: Pretreat and clean, spray apply one coat primer and bake.

F. Back paint components where contact is made with building finishes to prevent electrolysis.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify exact location of accessories for installation.

C. Verify field measurements are as indicated and as instructed by manufacturer.

D. See other related Sections for installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.2 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.3 EXISTING WORK

A. Clean and repair existing toilet accessories which remain or are to be reinstalled.

3.4 INSTALLATION

A. Install plumb and level, securely and rigidly anchored to substrate.

B. Mounting Heights and Locations: As indicated on Drawings.

C. Install work in accordance with the drawings and to the satisfaction of the Engineer.

END OF SECTION

SECTION 11 31 00

RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes residential appliances and their accessories, and necessary mechanical and electrical connections as indicated on the drawings and as specified herein for a complete operating system.

B. Related Sections:
1. Section 07 92 00 - Joint Sealants.
2. Division 22 - Plumbing: Services and connections to equipment.
3. Division 26 - Electrical: Wiring Connections to equipment.

1.2 REFERENCES

A. ASTM International:
1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
2. ASTM A666 - Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

B. National Electrical Manufacturers Association:
1. NEMA LD 3 - High Pressure Decorative Laminates.
2. NEMA MG 1 - Motors and Generators.

C. National Fire Protection Association:
1. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

D. Sheet Metal and Air Conditioning Contractors:
1. SMACNA - Kitchen Equipment Fabrication Guidelines.

E. Underwriters Laboratories Inc.:
1. UL - Electrical Appliance and Utilization Equipment Directory.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shop Drawings:
1. Indicate, in large scale detail, equipment showing model number, type of materials, finishes, hardware and fittings, plan, front elevation, cross-sections, and utility requirements as to types and sizes and locations.
2. Illustrate complicated parts of typical items in cut-away perspective.
3. For control systems, indicate service connections, characteristics and wiring diagrams.

C. Product Data: Submit data for each type of residential appliances indicating compliance with requirements, configuration, sizes, materials, finishes, locations, and utility connections and locations.

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

E. Manufacturer's Certificate: Certify Products meet or exceed UL and specified requirements.

1.4 CLOSEOUT SUBMITTALS

A. General Requirements: Execution requirements for closeout procedures.

B. Operation and Maintenance Data: Submit operating data and maintenance instructions for each item of residential appliances. Submit lubrication and periodic maintenance requirement schedules.

1.5 QUALITY ASSURANCE

A. Perform Work as follows:
1. Cooler and Freezer Units: Listed by UL standards.
2. Electrical Wiring and Components: Conform to UL standards.
3. Exhaust Hoods: Conform to NFPA 96, or SMACNA - Kitchen Equipment Fabrication Guidelines.
4. Fabricated Equipment: Conform to SMACNA - Kitchen Equipment Fabrication Guidelines.

B. Certification Labels: Provide residential appliances that comply with standards and bear certification labels as follows:
1. Energy Ratings: Provide energy guide labels with energy cost analysis (annual operating costs) and efficiency information as required by Federal Trade Commission. Provide Energy Star Rated appliances where available.
2. UL Standards: Provide residential appliances with UL labels.

C. Uniformity: Provide products of same manufacturer for each type of residential appliances required.

D. Provide residential appliances by a single manufacturer to the greatest extend possible for the entire project.

E. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

1.7 DELIVERY, STORAGE AND HANDLING

A. General Requirements: Product requirements for storage and handling.

B. Deliver products to project site in manufacturer's undamaged protective containers.

C. Store products clear of floor in manner to prevent damage.

D. Coordinate size of access and route to place of installation.

1.8 COORDINATION

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

B. Coordinate Work with location and placement of utilities. Coordinate characteristics of utilities with requirements of residential appliances where applicable.

C. Sequence installation to accommodate required utility connections where applicable.

1.9 WARRANTY

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

B. Furnish five-year manufacturer warranty for each type of residential appliances.

PART 2 PRODUCTS

2.1 RESIDENTIAL APPLIANCES AND EQUIPMENT

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

B. Furnish residential appliances and equipment as specified, as shown on drawings and to the satisfaction of the Engineer.

2.2 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Electrical characteristics and components shall be in accordance with Division 26.

2.3 ACCESSORIES

A. Provide all required accessories as required by each manufacturer in order to completely install each unit as shown on the drawings and to the satisfaction of the Engineer.

B. Coordinate electrical accessories required for complete installation.

C. Sealants between Built-in Equipment and Adjacent Components: Silicone, bacteria resistant, in accordance with Section 07 92 00.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify ventilation outlets and service connections are correct and in required location.

C. Verify electric power is available and of correct characteristics.

3.2 EXISTING EQUIPMENT TO BE REUSED (IF ANY)

A. Re-Used Equipment: Refer to schedule on Drawings for re-used equipment.

B. Disconnect, move, store, and re-install equipment.

C. Coordinate Work with Owner to minimize interruption to Owner’s normal operations.

D. Clean and re-furbish existing equipment to be re-used to original condition, and where required, remove existing equipment from site for repairs or alterations; handle carefully and return in "like new" condition.

3.3 INSTALLATION

A. General: Comply with manufacturer's instructions and recommendations.

B. Built-in Equipment: Securely anchor units to supporting cabinetry or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed. Install sealant to achieve clean joint with adjacent components.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

D. Utilities: Refer to Division 22 for plumbing requirements, and to and Division 26 for electrical requirements.

E. Provide additional supports or attachments required for installation.

3.4 MANUFACTURER’S FIELD SERVICES

A. General Requirements: Quality requirements for manufacturers’ field services.

B. At completion of work, demonstrate operation of each item of equipment and instruct Owner in operating procedures and maintenance.

C. Individual Performing Demonstration: Fully knowledgeable of operating and service aspects of equipment.

3.5 ADJUSTING

A. General Requirements: Execution requirements for testing, adjusting and balancing.

B. Adjust equipment and apparatus to ensure proper working order and conditions.

3.6 CLEANING

A. General Requirements: Execution requirements for final cleaning.

B. Remove packing material from equipment items and leave units in clean condition.

3.7 DEMONSTRATION AND TRAINING

A. General Requirements: Execution requirements for documentation submission.

B. Test equipment prior to demonstration. Demonstrate operation of each component.

3.8 SCHEDULES

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

END OF SECTION

SECTION 11 73 00

PATIENT CARE EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section includes supply, delivery, assembly, installation, testing, commissioning and handover of patient care beds, comprising:
1. Electric hospital beds for wards.
2. ICU electric beds for intensive care, cardiac care and trauma areas.

B. Mattresses are not included unless indicated in the Bill of Quantities.

C. Related Sections:
1. Division 26: Power outlets serving the beds.

1.2 REFERENCES

A. International Electrotechnical Commission (IEC):
1. IEC 60601-1 - Medical Electrical Equipment - General Requirements for Basic Safety and Essential Performance.
2. IEC 60601-1-2 - Medical Electrical Equipment - Electromagnetic Disturbances (EMC).
3. IEC 60601-2-52 - Particular Requirements for the Basic Safety and Essential Performance of Medical Beds.

B. ISO 13485 - Medical Devices - Quality Management Systems.

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Product Data: Manufacturer's catalogue data and technical data sheets for each bed type, with a point-by-point statement of compliance with this Section.

C. Certificates: IEC 60601-1, IEC 60601-1-2 and IEC 60601-2-52 test certificates, CE mark or US FDA clearance, and the manufacturer's ISO 13485 certificate.

D. Manufacturer's Authorization: Letter from the manufacturer authorizing the Contractor or its local agent to supply and service the beds in Lebanon.

E. Operation and Maintenance Data: User manuals, service manuals, spare parts lists and cleaning and disinfection instructions, in English.

1.4 QUALITY ASSURANCE

A. Beds shall be new, of current production, and of a model with proven use in hospitals.

B. All beds of the same type shall be of the same make and model.

1.5 WARRANTY AND SUPPORT

A. Warranty: Comprehensive warranty covering parts, labor, actuators and electronics from the date of clinical commissioning, of not less than two (2) years for electric hospital beds and not less than two (2) years, five (5) years preferred, for ICU electric beds.

B. Spare Parts and Service: Guaranteed availability of OEM spare parts for at least ten (10) years, supported by a certified local service agent with a maximum 24-hour on-site response time.

C. Training: Comprehensive on-site clinical training for nursing staff, including ICU nursing staff, and technical maintenance training for the hospital biomedical engineering department.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Any internationally recognized manufacturer having an official technical agreement to conformity with standards specified in this section.

2.2 ELECTRIC HOSPITAL BED

A. External Dimensions: Minimum 2150 mm to 2250 mm (length) x 1000 mm to 1050 mm (width).

B. Mattress Deck Area: Minimum 1950 mm (length) x 850 mm (width), to accommodate standard high-density therapeutic mattresses.

C. Safe Working Load (SWL): Minimum 250 kg, to safely support heavy-duty bariatric or complex critical care patients.

D. Frame Construction: High-strength structural steel, epoxy electrostatically powder-coated for heavy-duty corrosion resistance, with antimicrobial finish.

E. Mobility and Braking: Minimum 125 mm to 150 mm diameter dual/twin silent castors with integrated central-locking mechanism and directional steering brake, accessible from pedals at multiple corners.

F. Drive System: Heavy-duty, medically approved low-noise actuators (Linak or equivalent) in a 4-way or 5-way independent motor configuration.

G. Backrest Articulation: Smooth electric adjustment from 0° to minimum 70° or 75°, with an automated 30° pause to mitigate pressure injuries and facilitate lung recruitment.

H. Knee-Rest Articulation: Smooth electric adjustment from 0° to minimum 45°.

I. Height Travel (Hi-Lo Range): Vertical travel from an ultra-low floor clearance of 380 mm or less, for safe egress, up to an examination/nursing height of 750 mm or more.

J. Trendelenburg: Direct electric Trendelenburg and Reverse-Trendelenburg of 12° to 15° or more.

K. Dual Control Interfaces: Separate hand-held pendant for patient use, and integrated outer side-rail or panel controls for clinical staff.

L. Master Nurse Control Unit: At the foot-end panel, with individual function lockouts to restrict patient adjustments during clinical procedures.

M. One-Touch Presets: Instant mechanical or digital activation of Cardiac Chair, Flat Examination and Vascular positions.

N. Emergency CPR Release: Dual manual rapid-mechanical levers on both sides of the head section for immediate leveling, working independently from electrical power or motor operation.

O. Side Rails: Four-piece split, fold-down PP/ABS safety side rails with built-in angle indicators (goniometers) for head-of-bed angle monitoring.

P. Mains Input: Universal 100–240 V AC, 50/60 Hz, with medical-grade detachable power cord.

Q. Internal Output: Low-voltage 24 V DC internal control circuits, to eliminate micro-shock risks.

R. Ingress Protection: Minimum IPX4 (IPX6 preferred) for all actuators, control boxes and pendants.

S. Emergency Battery Backup: Built-in rechargeable lead-acid or lithium-ion battery providing full functional operation for a minimum of 50 complete duty cycles during power loss.

T. Compliance: Certified to IEC 60601-1 and IEC 60601-2-52.

U. Accessories:
1. Intravenous (IV) Poles: Heavy-duty, detachable, height-adjustable stainless steel 304 IV poles with 4 hooks, mountable at all four corners.
2. Drainage Bag Hooks: Dual-sided heavy-duty hooks permanently mounted underneath the frame rails.
3. Oxygen Cylinder Cage: Universal front-loading or under-bed mounting cage for medium-sized oxygen cylinders.
4. Head and Foot Boards: Tool-free, instantly detachable lightweight ABS or PP molded boards, for immediate head-end access during emergency intubation or CPR.

2.3 ICU ELECTRIC BED

A. General and Structural Requirements:
1. Intended Clinical Use: Fully motorized, heavy-duty critical care bed for high-acuity Intensive Care Units (ICU), cardiac care and trauma wards.
2. Safe Working Load (SWL): Minimum 250 kg (270 kg preferred), inclusive of patient, mattress and mounted ICU accessories.
3. Overall Dimensions: Length approximately 215 cm to 225 cm, extendable by integrated bed extension to at least 235 cm; width approximately 98 cm to 105 cm with side rails raised.
4. Mattress Platform: Minimum 200 cm x 86 cm (up to 208 cm x 90 cm), of radiolucent, removable, easy-to-disinfect HPL or molded composite panels.
5. Frame Construction: Heavy-duty steel frame with antimicrobial powder-coated finish, resistant to hospital-grade disinfectants and bodily fluids.
6. Under-Bed Clearance: Minimum 15 cm, for access by mobile patient hoists, C-arms and overbed tables.

B. Articulation and Positioning:
1. Height Adjustment: Electric, from approximately 39 cm (low position for fall prevention and mobilization) up to at least 78 cm (nursing height).
2. Backrest Inclination: Electric, from 0° to at least 70°, with auto-regression of minimum 10 cm to minimize abdominal compression and sacral shear.
3. Thigh and Knee Section: Electric, from 0° to at least 30°–40°, with mechanically or electrically adjustable calf/foot section (vascular position).
4. Trendelenburg / Reverse Trendelenburg: Smooth, rapid electric adjustment to at least ±15° to ±20°, with clear visual or digital angle indicators.
5. Lateral Tilt / Rotation Therapy: Integrated motorized lateral tilt up to ±15° to ±20°, to assist pulmonary hygiene, turning of heavy patients and pressure injury prevention.
6. One-Touch Positions: Dedicated single-button controls for Cardiac Chair, Examination height, Vascular, Mobilization height and Shock/Trendelenburg positions.

C. Clinical Monitoring and ICU Therapy Features:
1. Integrated Weighing System: Built-in Class III (or equivalent medical-grade) precision patient scale with automatic tare/zeroing, weight trend display, and ability to add or remove accessories without affecting patient weight readings.
2. Bed Exit Alarm: Multi-zone or multi-sensitivity integrated bed-exit detection with audible and visual alerts.
3. X-Ray and C-Arm Compatibility: Full-length or thoracic radiolucent backrest with integrated sliding X-ray cassette tray, allowing lateral and AP chest imaging without lifting the patient.
4. CPR Release System: Manual bilateral quick-release CPR levers accessible from either side, and a one-button electric CPR function that rapidly flattens the bed and lowers its height.

D. Controls, Side Rails and Ergonomics:
1. Side Rails: Four-section split side rails with damped, one-handed lowering mechanism and zero transfer gap, providing full-length protection when raised.
2. Integrated Side Rail Controls: Dual-sided inner patient controls with nursing lockout, and outer caregiver controls integrated in the head-end side rails.
3. Nurse Control Panel: Dedicated foot-end or flexible gooseneck panel with backlit LCD/touch display, real-time angle readouts, scale interface and selective function lockouts.
4. Headboard and Footboard: Lightweight, tool-free removable polymer boards; the headboard shall remain fixed to the base frame during Trendelenburg and height changes, to protect airway and vascular lines.

E. Mobility, Braking and Accessories:
1. Castors and Steering: Four heavy-duty antistatic castors of 150 mm or larger, plus an integrated fifth directional steering wheel.
2. Central Braking System: Central braking and steering pedals accessible from all four corners, with audible "brake not set" alarm when connected to mains power.
3. Wall Protection and Line Management: Corner roller bumpers at all four corners, IV pole sockets at all corners, drainage bag hooks, restraint loops and a dedicated oxygen cylinder holder.

F. Electrical Safety and Compliance:
1. Power Supply and Battery Backup: 220–240 V AC, 50/60 Hz (adaptable to the hospital voltage), with heavy-duty integrated rechargeable lead-acid or lithium battery supporting full articulation during internal transport.
2. Ingress Protection: Minimum IPX4 (IPX6 preferred) for all actuators, control boxes and handsets.

3. Standards: IEC 60601-1, IEC 60601-1-2 and IEC 60601-2-52; valid CE mark or US FDA clearance.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE AND HANDLING

A. Deliver beds in the manufacturer's original packaging; store under cover in locations agreed with the hospital administration, protected from damage and dust.

3.2 INSTALLATION

A. Assemble and install beds in the locations indicated, in accordance with the manufacturer's instructions, by technicians trained by the manufacturer.

B. Remove all packaging from the hospital the same day and dispose of it as specified.

3.3 FIELD QUALITY CONTROL

A. Test every function of each bed, including battery backup, CPR release, brakes, alarms and weighing system, and perform electrical safety testing in accordance with IEC 62353; submit the test records.

B. Commissioning shall be witnessed by the Engineer and the hospital biomedical engineering department.

3.4 TRAINING AND HANDOVER

A. Provide the clinical and technical training specified in Part 1, and hand over manuals, warranty certificates and test records with the beds.

3.5 SCHEDULES

A. Quantities as indicated in the Bill of Quantities.

END OF SECTION

SECTION 13 49 00

RADIATION PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes radiation shielding of the PET-CT unit, comprising:
1. Lead lining to walls, low level from finished floor level up to 2.50 m and high level from 2.50 m up to ceiling level.
2. Lead lining to ceilings, covering the full ceiling area of the shielded rooms.
3. Steel support structure for fixing the lead lining.
4. Lead-lined wood doors with lead-lined steel frames.
5. Lead shield glass vision panels.
6. Lead-shielded contamination monitoring box.
7. Lead shielding of penetrations by pipes, ducts, conduits and cables.
8. Radiation-protection survey of the completed shielding.

B. Related Sections:
1. Section 05 50 00 - Metal Fabrications: Steel sections, connections and protective coatings for the support structure.
2. Section 08 11 13 - Hollow Metal Doors and Frames: Steel frames.
3. Section 08 14 16 - Flush Wood Doors: Lead-lined and fire rated wood doors.
4. Section 08 80 00 - Glazing.
5. Section 07 84 00 - Firestopping.
6. Section 09 21 16 - Gypsum Board Assemblies: Gypsum board and precast cement board cladding over lead lining.
7. Divisions 22, 23 and 26: Services penetrating the shielded enclosure.

1.2 REFERENCES

A. ASTM International:
1. ASTM B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
2. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units.

B. National Council on Radiation Protection and Measurements (NCRP):
1. NCRP Report No. 147 - Structural Shielding Design for Medical X-Ray Imaging Facilities.

C. American Association of Physicists in Medicine (AAPM):
1. AAPM Task Group 108 - PET and PET/CT Shielding Requirements.

D. International Atomic Energy Agency (IAEA):
1. IAEA Safety Standards Series No. SSG-46 - Radiation Protection and Safety in Medical Uses of Ionizing Radiation.

E. Requirements of the Lebanese Atomic Energy Commission (LAEC) and of authorities having jurisdiction.

1.3 PERFORMANCE REQUIREMENTS

A. Provide continuous radiation shielding of the lead equivalence indicated on the drawings and in the Bill of Quantities, and in any case not less than the following:

1. Walls and Ceilings: 2 mm lead.
2. Lead-Lined Doors: 2 mm, 6 mm or 15 mm lead, as scheduled for each door.
3. Vision Panels: Lead equivalence not less than that of the wall in which they are installed.
4. Contamination Monitoring Box: 36 mm lead.

B. Shielding shall be continuous without gaps at joints, corners, wall-to-ceiling and wall-to-floor junctions, door and window frames, fixings, and service penetrations.

C. The completed shielding shall limit dose rates in adjoining occupied areas to the dose constraints set by the approved shielding design and by the Lebanese Atomic Energy Commission.

1.4 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Shielding Design: Shielding calculations and layout prepared or endorsed by a qualified medical physicist or radiation-protection expert, based on the workload of the PET-CT equipment, for approval by the Engineer and the radiation protection officer of the hospital before procurement.

C. Shop Drawings: Indicate layout of lead sheets, lap and joint details, steel support structure, fixing details, details at corners, ceilings, door and window frames, and details of shielding at each service penetration.

D. Product Data: Submit manufacturer's data for lead sheet, lead-lined doors and frames, lead glass and contamination monitoring box, with certificates of lead purity and thickness.

E. Samples: Submit 300 x 300 mm sample of each lead lining assembly.

F. Method Statement: Submit method statement for handling, cutting and fixing of lead, including health and safety measures for lead work and management of lead offcuts.

G. Test Reports: Submit the radiation-protection survey report on completion.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with the approved shielding design, NCRP Report No. 147, AAPM Task Group 108 and the requirements of the Lebanese Atomic Energy Commission.

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing radiation shielding products with minimum ten years documented experience.

B. Installer: Company specializing in installing radiation shielding for medical imaging facilities with minimum five years documented experience.

C. Radiation-Protection Expert: Qualified medical physicist or radiation-protection expert recognized by the Lebanese Atomic Energy Commission, independent of the installer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver lead sheets on pallets, flat and in manufacturer's packaging, labeled with thickness and lead weight.

B. Store under cover on a level surface, protected from damage and away from areas used by patients and staff.

C. Handle lead sheets and lead-lined doors with mechanical aids or team lifts; do not drag or fold lead sheets.

1.8 HEALTH AND SAFETY

A. Cut lead mechanically; do not cut, burn or weld lead with heat.

B. Assess lead exposure before lead work starts; apply engineering controls, lead-safe housekeeping and hygiene, and undertake exposure monitoring where required by the assessment.

C. Provide gloves, washing facilities and segregated storage; prohibit eating, drinking and smoking in lead-working areas.

D. Collect lead offcuts separately and hand them over to a licensed lead recycler; retain receipts.

E. Do not bring radioactive sources into the unit while the Works are in progress.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Any internationally recognized manufacturer having an official technical agreement to conformity with standards specified in this section.

2.2 MATERIALS

A. Lead Sheet: ASTM B749, Grade C (chemical-copper lead), minimum purity 99.9 %, free of pinholes, cracks and laminations, thickness tolerance not exceeding -5 %.

B. Lead-Lined Panels: Lead sheet laminated to gypsum board or plywood backing, where indicated on the approved shop drawings.

C. Lead Strips: Same thickness as adjoining lead sheet, minimum 50 mm wide, for covering joints and fixings.

D. Lead Shield Glass: Radiation-shielding glass, 100 x 80 cm or as indicated, lead equivalence as scheduled, set in lead-lined steel frame with lead overlap to wall shielding.

E. Contamination Monitoring Box: Factory-fabricated, 36 mm lead shielding, with steel casing and finish as selected.

F. Lead-Lined Doors: As specified in Section 08 14 16, with lead lining of thickness scheduled, continuous over door edges and overlapping frame lining.

G. Lead-Lined Frames: Steel frames as specified in Section 08 11 13, lined with lead of the same thickness as the door and overlapping the wall shielding.

2.3 STEEL SUPPORT STRUCTURE

A. Steel Sections: Hot-dip galvanized steel channels, angles, hollow sections and studs, designed to carry the weight of the lead lining, cladding and fixtures.

B. Design: Support structure designed by the Contractor's qualified structural engineer, with calculations submitted for approval; anchors into existing concrete and masonry to be verified on site.

C. Fasteners: Galvanized or stainless steel; fasteners penetrating lead to be covered with lead discs or lead-headed nails of the same thickness as the lining.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify dimensions, quantities and substrate conditions through a site survey before fabrication.

C. Verify that services to be concealed by the shielding are installed, tested and approved.

3.2 INSTALLATION

A. Install steel support structure plumb, level and rigid, securely anchored to the building structure.

B. Fix lead sheets vertically with joints over supports; lap joints minimum 15 mm or cover butt joints with lead strips of the same thickness.

C. Extend wall lining continuously behind door and window frames and overlap frame lining by minimum 15 mm.

D. Turn wall lining into ceiling lining and lap ceiling lining over wall lining at junctions; extend wall lining down to the slab.

E. Penetrations: Shield every penetration by pipes, ducts, conduits, cables and boxes with lead sleeves, baffles or back plates of the same lead equivalence, to the approved details.

F. Fire-Rated Construction: Where penetrations pass through fire-rated walls or ceilings, provide in addition an approved firestopping system as specified in Section 07 84 00 and inspect it before concealment.

G. Electrical Boxes and Recesses: Provide lead back plates extending minimum 25 mm beyond the box on all sides.

H. Install lead-lined doors and frames, lead glass and contamination monitoring box to manufacturer's instructions and approved shop drawings.

I. Cover lead lining with gypsum board or precast cement board cladding as specified in Section 09 21 16, only after inspection and approval.

3.3 FIELD QUALITY CONTROL

A. Hold Points: Do not cover lead lining until the Engineer and the radiation protection officer of the hospital have inspected and approved it, wall by wall and ceiling by ceiling.

B. Construction-Stage Radiation-Protection Survey: On completion of the shielding and before the unit is taken over, the radiation-protection expert shall survey the shielding with a calibrated radiation source and instruments and report dose rates at all walls, ceilings, doors, windows and penetrations.

C. Rectify any shielding deficiency identified by the survey at no extra cost and repeat the survey until compliance is demonstrated.

D. Final Radiation-Protection Survey: After installation of the PET-CT equipment under the medical equipment contract and before clinical use or licensing, attend the final radiation-protection survey carried out for the hospital and rectify at no extra cost any shielding deficiency attributable to the Works, including during the Defects Liability Period.

E. Assist the hospital in obtaining the licence of the Lebanese Atomic Energy Commission for the unit.

3.4 PROTECTION

A. Protect installed shielding from damage by subsequent trades; do not drill or fix through lead lining without approved lead covering details.

3.5 SCHEDULES

A. As indicated on drawings, in the Bill of Quantities and where directed by the Engineer.

END OF SECTION

SECTION 31 23 00

EXCAVATION AND FILL

PART 1 GENERAL

1.1 SUMMARY

A. Section includes excavation for wall footings and slabs on grade inside the existing building; backfilling and compaction; and disposal of surplus excavated material.

B. Related Sections:
1. Section 02 41 00 - Demolition.
2. Section 03 30 00 - Cast-in-Place Concrete.
3. Section 07 26 00 - Vapor Retarders.

1.2 REFERENCES

A. ASTM International:
1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.
2. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method.
3. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.3 SUBMITTALS

A. General Requirements: Requirements for submittal procedures.

B. Method Statement: Submit method for excavation inside the occupied building, including protection of existing foundations and services, dust control and removal of spoil.

C. Product Data: Submit source and gradation of imported fill material.

D. Test Reports: Submit compaction test results.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with the drawings, the requirements of this section and to the approval of the Engineer.

B. Maintain one copy of each document on site.

1.5 PROJECT CONDITIONS

A. Locate existing buried services before excavation; excavate by hand near services.

B. Do not undermine existing foundations; where excavation is deeper than adjacent foundations, submit details of support for approval.

C. Notify the Engineer immediately of unexploded ordnance, suspected contaminated soil or archaeological finds, and stop work in the affected area.

PART 2 PRODUCTS

2.1 MATERIALS

A. Backfill: Selected excavated material or imported granular material, free of organic matter, debris, and stones larger than 75 mm.

B. Granular Sub-base Under Slabs: Well-graded crushed stone, maximum size 40 mm, compacted to 150 mm minimum thickness or as indicated on drawings.

PART 3 EXECUTION

3.1 EXCAVATION

A. Excavate to lines, levels and dimensions indicated on drawings, with sufficient working space for formwork.

B. Support sides of excavation as required to ensure stability and safety.

C. Keep excavations free of water.

D. Trim and compact bottoms of excavations; remove soft spots and replace with compacted granular material or lean concrete.

E. Obtain Engineer's approval of excavated formations before placing blinding or concrete.

3.2 BACKFILLING

A. Backfill in layers not exceeding 200 mm loose thickness, each compacted to minimum 95 % of maximum dry density in accordance with ASTM D1557.

B. Do not backfill against concrete until it has gained sufficient strength.

3.3 FIELD QUALITY CONTROL

A. Perform in-place density tests in accordance with ASTM D1556, minimum one test per layer per 50 m2 or as directed by the Engineer.

3.4 DISPOSAL

A. Remove surplus excavated material from site to approved disposal locations as Work progresses.

3.5 SCHEDULES

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

END OF SECTION

Lebanon Emergency Assistance Project (LEAP)

Rehabilitation of Governmental Hospitals

Tebnine, Nabatieh, Hasbaya and Marjayoun, South Lebanon

Name of Project:	Lebanon Emergency Assistance Project (LEAP)
Contract Title:	Rehabilitation of Governmental Hospitals – Tebnine, Nabatieh, Hasbaya and Marjayoun, South Lebanon
Loan No.:	9841 - LB
RFB Reference No.:	LEAP-SW-Hospitals

Tender Documents

Volume 2 - Technical Specifications

Part 2 - MEP Works

Rev. 01 – November 2026

Rafik El - Khoury & Partners
Consulting — Engineers

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SECTION 104400 – FIRE PROTECTION SPECIALTIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Portable Fire Extinguishers.
   2. Fire-protection accessories.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection specialties.

   1. Fire Extinguishers: Include rating and classification.

B. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of cabinet finish indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and cabinets through one source from a single manufacturer.
B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Standard for Portable Fire Extinguishers."
C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
   1. Provide extinguishers listed and labeled by UL & FM.

1.5 COORDINATION

A. Coordinate size of cabinets to ensure that type and capacity of fire extinguishers indicated and provided by Employer are accommodated.

PART 2 - PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

A. General: Provide fire extinguishers of type, size, and capacity as indicated on drawings.
B. Multipurpose Dry-Chemical Type FE-1: UL-rated 2-A:10-B:C, 10-lb (4.5-kg) nominal capacity, in enameled-steel container.
C. Carbon-Dioxide Type FE-2: UL-rated 10-B:C, 10-lb (4.5-kg) nominal capacity, in manufacturer's standard enameled-metal container.

D. Wet chemical Type: UL-rated 2-A:1-B:K, 6L or 9.5 L nominal capacity, or as indicated on drawings with potassium acetate - based chemical in stainless steel container; with pressure-indicating gage.

2.2 ACCESSORIES

A. Mounting Brackets: Manufacturer's standard steel, designed to secure extinguisher, of sizes required for types and capacities of extinguishers indicated, with plated or baked-enamel finish. Provide brackets for extinguishers not located in cabinets.
B. Identification: Provide lettering to comply with authorities having jurisdiction for letter style, color, size, spacing, and location. Locate as indicated by Engineer.
   1. Identify bracket-mounted extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to wall surface.

2.3 COLORS AND TEXTURES

A. Colors and Textures: As selected by Engineer from manufacturer's full range for these characteristics.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed and semi recessed cabinets are to be installed.
B. Examine fire extinguishers for proper charging and tagging. Remove and replace damaged, defective, or undercharged units.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire-protection specialties.
B. Install in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

End of Section 10 44 00

SECTION 210500 - COMMON WORK RESULTS FOR FIRE FIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 ACCURACY OF DATA AND CONTRACT DRAWINGS

A. The design drawings are diagrammatic and they may not show all physical arrangements, offsets, bends, or elbows which may be required for installation of various materials, equipment, piping, and ductwork systems in allotted spaces. The Contractor shall examine these and other available drawings to determine space limitations and interferences. The Contractor shall be responsible for making any minor changes in location of equipment, pipe and ductwork from that shown on drawings and for all physical details required for installation. Cost for adapting Contractor's work to jobsite conditions shall not be considered as basis of an extra cost to contract. The Contractor shall get approval before proceeding with any change.

B. Information pertaining to new and existing conditions that are described in the specifications or appear on drawings are based on available records. While such data has been collected with reasonable care, there is no expressed or implied guarantee that conditions so indicated are entirely representative of those actually existing or that unlooked for developments may not occur. Such information is merely provided to assist the Contractor in his investigation of conditions.

C. The Contractor must carefully examine the drawings, specifications and project site, and verify all measurements, distances, levels, materials, equipment, etc. before starting work.

D. Drawings shall not be scaled for determining exact dimensions or location of equipment.

E. All works not shown on drawings in complete detail shall be installed in conformance with accepted standard practice and manufacturer’s recommendations.

F. All items shall be installed in a manner and in locations avoiding all obstructions, preserving headroom and keeping openings and passageways clear. Changes shall be made to the location of equipment and materials as may be necessary in order to meet this requirement.

G. Work indicated on drawings, but not mentioned in Specifications, or vice versa, shall be performed as if specifically mentioned or indicated by both.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. AHJ: Authority having jurisdiction
F. UL: Underwriters Laboratories
G. FM: Factory Mutual

1.4 DESIGN CONDITIONS

A. All systems, materials, equipment and procedures associated with Fire Protection Systems shall be in accordance with NFPA requirements as well as the local civil defense code and requirements

B. Unless indicated otherwise, sprinkler protection shall be provided in all areas except where omission is allowed by NFPA 13

1.5 SUBMITTALS

A. Welding certificates.

B. Comply with the requirements of Section 013300, “Submittal Procedures”, and additional requirements specified below and in different sections of division 21

C. Shop Drawings:

1. Shop drawings shall be produced as required in the contract documents in addition to the following points.
2. Shop drawings shall be new drawings prepared by the Contractor and shall not be reproductions or tracings of the contract drawings.
3. Drawings shall be overlaid with shop drawings of other trades and checked for conflicts.
4. Shop drawings shall identify the related contract drawing number or related reference drawing.
5. Shop drawings shall be fully dimensioned, including both plan and elevation dimensions from building reference points.
6. Shop drawings shall show schedules and description of equipment, valves, piping and fittings
7. Shop drawings shall show complete system layout of equipment, components, plumbing fixtures, piping, indicating service clearances, and pipe sizes, fitting types and sizes and hanger support locations.
8. Planned piping layout, including valve and specialty locations and valve-stem movement. Clearances for installing and maintaining insulation.
9. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
10. Equipment and accessory service connections and support details. Exterior wall and foundation penetrations.
11. Fire-rated wall and floor penetrations.
12. Sizes and location of required concrete pads and bases.
13. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.

14. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
15. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, ceiling access panels and other ceiling-mounted items.
16. Mechanical equipment rooms. Interstitial space.
17. Hangers, inserts, supports, and bracing. Pipe sleeves.
18. Shop drawings shall include but not be limited to:
    Complete floor plans with firefighting to a minimum of 1/50 scale.
    Firefighting plant rooms to a minimum of 1/25 scale.
    Sections of congested areas to a minimum of 1/25 scale.
    Fabricated equipment to a minimum of 1/25 scale.
19. Submit shop drawings for review as required by the contract documents. Additional shop drawings may be requested when it appears that coordination issues are not clearly resolved, when there is a question as to whether contract documents are being complied with or the design intent is not being met.

D. Product Data:

1. In line with contract documents and requirements specified in different sections of division 21
2. The Contractor shall conform to any requirements with respect to ensuring that products, components and materials comply with any referenced standard. Such requirements may include, but not be limited to, samples, test results and supporting documentation
3. The Contractor shall supply original authenticated certificates for each type of material or equipment, confirming the standard they have been manufactured and tested to.

E. Calculations:

1. Submit full hydraulic calculations prepared as per NFPA and Local fire protection code requirements for all the Fire Fighting systems and covering all the different critical scenarios. The calculations shall be used to verify the duty of the fire pumps or utility connection requirements, pipe sizing and requirements of PRVs. All changes resulting from the approved hydraulic calculations shall be under the scope of the contractor.
2. Submit detailed calculation for the clean agent system by system manufacturer UL/FM software
3. Submit detailed calculation for the foam systems and any special pre-engineered system shown on the plans

F. Submit proof of license to undertake work as issued by the appropriate AHJ.

G. Where operating or warning instructions are provided or specified, they shall be clearly denoted in English and the native language of the area where the project is located.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire Fighting Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Installer shall be qualified with at least 5 years of successful installation experience on projects incorporating firefighting systems and equipment similar to that required for the project and licensed by the AHJ to undertake such works.

E. Components shall be UL listed and/or FM approved

F. All Material and equipment shall be new, unless stated otherwise and approved by the employer.

G. Manufacturer's written directions and recommendations shall be followed. If these instructions are different from the contract documents or referenced international standards, the more stringent requirements shall establish the minimum standard. Any conflict shall be brought to the attention of the engineer for clarification. Prior to the execution of the work.

H. All electrical work related to Fire Fighting items shall be as specified under Division 26, Electrical.

I. Asbestos products or equipment or materials containing asbestos shall not be used.

J. Equipment and materials to be installed outdoors shall be of the type that is designed, manufactured and listed or approved for outdoor installation by being resistant to the adverse effects of weather prevailing at the project location. The additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.

K. Where two or more equipment or components are of the same class, the same manufacturer shall be used for selecting the equipment; component parts of the entire system need not be products of the same manufacturer.

L. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

M. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

N. Supply mechanical equipment complete with electrical motors

O. All equipment with moving parts shall be protected against personal injury

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. The equipment supplied shall be packed for protection against damage during handling, transport, warehousing and installation. The efficiency of the packing shall be the responsibility of the

Contractor. The Contractor shall repair or replace any damaged items, at no additional cost, as instructed by the Engineer even after delivery of the equipment, if it is proven that the damage was caused by packing, storage, or handling deficiencies.

C. Protect stored sprinklers, pipes, tubes, flanges, fittings, and piping specialties from moisture and dirt. Elevate above grade.

D. Hose reels/racks, fire extinguishers and fire blankets shall be covered in protective packaging and stored on well compartmented racks or shelving. Fire extinguishers, shall be secured to prevent damage resulting from falling and in no instance shall they be subject to temperatures in excess of 45 ºC or to direct sunlight.

1.8 COORDINATION

A. Coordinate mechanical equipment installation with other trades and building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for Fire Fighting installations.

C. For large equipment make provisions for the necessary openings in the building to allow for admittance of all equipment before closing in.

D. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

E. Coordinate requirements for access panels and doors for Fire Fighting items requiring access for operation, service or maintenance that are concealed behind finished surfaces whether indicated on plans or not. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

F. Coordinate connection of Fire Fighting systems with exterior underground and overhead utilities and services where required.

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.9 CODES AND REGULATIONS

A. The entire firefighting system including all materials, components, equipment and accessories and their installation shall conform to the requirements of the Authority having jurisdiction and / or the Civil Defense Requirements.

B. AHJ requirements for permit approval shall be considered mandatory to the construction

C. All local codes and regulations shall become part of this specification and must be adhered to where they exceed requirements as shown on the drawings or stated in the specifications, without additional cost to the Contract. Contract documents may contain more stringent requirements than the code.

1.10 CONTINUITY OF EXISTING SERVICES

A. Do not interrupt or change existing services. When interruption is required, temporary equipment or pipe installation or relocation will be required and shall be provided to maintain continuity of operation of existing facilities.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall provide operating and maintenance instruction manuals covering each and every item of equipment and devices furnished or erected by the Contractor prior to "Substantial Completion" as required by Division 1.

B. Each separate manual shall consist of the following:

1. Neatly typewritten table of contents including contractor's name, address and telephone number; list of each product referenced in manual; and name, address and telephone number of installing contractor and maintenance contractor for each product.
2. Tabbed sections of catalog data and literature for each product including model number, description and component parts; operating procedures; maintenance procedures; servicing and lubrication schedules; description of sequence of operations; parts lists; illustrations, assembly drawings and diagrams required for maintenance; any additional drawings, diagrams, charts or written text which may be required to supplement product data for particular installation; certified test and balance report; list of control point labels, and wiring diagrams.
3. Copy of warranty, bond and/or service contract issued for each product including an information sheet for operations personnel with proper procedures in event of a product failure and instances which might affect validity of warranties or bonds.
4. Full size sheets, if required, shall be folded into special holding pockets. Faxed, handwritten, or illegible materials are not acceptable.

C. Prior to final inspection or acceptance, fully instruct designated facility operating and maintenance personnel on operation, adjustment and maintenance of products, equipment and systems. Review contents of operating and maintenance manual with personnel in full detail to explain all aspects of operations and maintenance.

1.12 PROTECTION OF ROOF

A. Contractors are cautioned that they must exercise extreme care in any activity involving contact with any installed roof membrane.

B. Construct protective plywood (3/4 in. thick) runways across the roof for moving, setting, and installing equipment and piping systems. No activity on the roof will be permitted without this protection. Start runways at the point of origin of any equipment placed on roof and terminate at the point of installation on curb or base. Any and all repairs necessary to bring the roofing system to its original condition shall be made by an approved Roofing Contractor and paid for by the Contractor responsible for the damage.

1.13 WORK COORDINATION

A. All Trades shall work in cooperation with each other, and fit their work into the structure as job conditions may demand. In general, priority shall be arranged as follows: (in order of preference)

1. Recessed lighting fixtures
2. Piping which must be drainable
3. Sheet metal ductwork
4. Lighting fixtures
5. Plumbing waste lines, downspouts, vents and sprinkler piping
6. Gravity water lines
7. Heating hot and chilled water lines

8. Refrigerant lines
9. Plumbing water and gas and air lines
10. Electrical conduit
11. Control wiring conduit

1.14 INSPECTION

A. The Contractor shall verify the location of underground service, utilities, structures, etc., which may be encountered or be affected by his work and shall be responsible for any damage caused by neglect to provide proper precautions or protection.

1.15 TRAINING OF OWNER PERSONNEL

A. Training of Owner's personnel shall include:

1. A minimum of 8 hours of on-site overview of the overall Firefighting System.
2. Refer to Division 21 sections for specific training on each of the components of the Fire Fighting System.

1.16 WELDING

A. The below compliments other divisions of section 21

B. The Contractor is entirely responsible for the quality of the welding and shall:

1. Conduct tests of the welding procedures used by his organization, determine the suitability of the procedures used, determine that the welds made will meet the required tests, and also determine that the welding operators have the ability to make sound welds under standard conditions.
2. Comply with the set standards in the specification.
3. Perform all welding operations required for construction and installation of the piping and systems.

C. Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1, Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications, and AWS B2.1 /B2.1M, and / or, as approved by the Qualifications."

D. Examine each welder at job site, in the presence of the Engineer, to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall be allowed to weld only in the position in which he has qualified and shall be required to identify his welds with his specific code marking signifying his name and number as signed.

E. Provide the Engineer with a list of names and corresponding code markings. Retest welders who fail to meet the prescribed welding qualifications. Disqualify welders, who fail the second test, for work on the project.

F. Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.

G. Utilize split welding rings or approved alternate method for joints on all pipes above 50 mm to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe.

H. Piping shall not be split, bent, flattened, or otherwise damaged either before, during or after installation.

I. Replace and re-inspect defective welds. Repairing defective welds by adding weld material over the defect or by peening will not be permitted. Welders responsible for defective welds must be re- qualified.

J. Electrodes shall be stored in a dry heated area, and be kept free of moisture and dampness during the fabrication operations. Discard electrodes that have lost part of their coating.

1.17 NOISE AND VIBRATION

A. Refer to Division 23, Vibration and Seismic Controls for HVAC Piping and Equipment section, for sound and vibration requirements.

B. Equipment is to operate under all conditions of load without objectionable sound or vibration, noticeable sound outside the room in which moving equipment are installed, or annoyingly noticeable inside the room, will be considered objectionable.

C. Conditions considered objectionable are to be corrected by approved means and as directed.

D. Vibration control shall be designed, tested and installed in accordance with manufacturer's instructions.

1.18 WARRANTY

A. Comply with Division 01 for all components and with special warranties listed in individual section of Division 21

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

B. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products in a similar service for at least 10 years.

C. Material and equipment shall be supported by a service organization that maintains a complete inventory of repair parts and is reasonably located within the project reach

PART 3 - EXECUTION

3.1 FIRE FIGHTING SYSTEMS - COMMON REQUIREMENTS

A. All items shall be installed in the locations shown on the Drawings and strictly in accordance with the manufacturer's instructions as well as the local civil defense requirements.

B. The installation shall comply fully with all applicable standards and codes listed in individual sections of Division 21.

C. Landing valves, Hose reels and fire extinguishers shall be securely fixed with approved fixings in a position offering unobstructed access.

3.2 CUTTING AND PATCHING

A. Refer to Division 01 Section "Cutting and Patching"

B. Additional openings required in building construction shall be made by drilling or cutting.

C. Fill holes which are cut oversize so that a tight fit is obtained around the objects passing through.

D. Do not pierce beams or columns without written permission from the structural engineer and then only as directed.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Comply with requirements of NFPA 13 and NFPA 14 for installation of fire protection piping materials.

D. Install drain piping at low points of piping systems.

E. Install pressure gages at top of each standpipe.

F. Install manual shutoff at each audible alarm station.

G. Install test connection where indicated, and at most remote point from risers.

H. Make sprinkler piping connections to the top of cross mains and feed mains.

I. Provide flush and test connections at ends of cross and feed mains.

J. Provide dedicated supports for the firefighting piping. Common supports with other building services shall not be utilized.

K. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

L. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

N. Install piping to permit valve servicing.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install piping to allow application of insulation where required.

R. Select system components with pressure rating equal to or greater than system operating pressure.

S. Size reduction shall be made using reducing fittings; bushings are not acceptable.

T. Independently support piping so that its weight shall not be supported by the equipment to which it is connected.

U. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

V. Cover ends of piping during installation to keep inside of piping clean.

W. Piping shall not be routed through electrical rooms or transformer vaults, or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

X. Use only wrenches having square flat jaws, or non-metallic strap wrenches on brass specialties; wrench marks not permitted.

Y. Select system components with pressure rating equal to or greater than system operating pressure.

Z. Install escutcheons for penetrations of walls, ceilings, and floors in finished spaces.

AA. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

BB. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

CC. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

DD. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

EE. Verify final equipment locations for roughing-in.

FF. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

GG. Conveniently locate control panels, hardware and devices, valves, gauges, cleanout fittings, and other equipment or specialties requiring frequent reading, adjustments, inspection, repairs, or removal and replacement.

HH. Install gauges to be easily read from floors, platforms, and walkways.

II. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install Fire Fighting equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 SPRINKLER INSTALLATION - GENERAL REQUIREMENTS

A. Handle, transport and store sprinklers with care to prevent damage. Use only wrenches supplied by manufacturer to tighten sprinklers in fittings.

B. Install sprinklers only in position for which they are designed.

C. Do not alter or apply ornamentation, coatings or paint to sprinklers. Exercise care when painting sprinkler piping to avoid touching sprinklers with paint.

3.6 LABELING AND IDENTIFYING

A. Refer to Division 21 specification section "Identification for Fire Suppression Piping and Equipment."

B. Relocate devices Identifying the items for unobstructed view in finished construction.

3.7 PAINTING

A. Painting of Fire Fighting systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor Fire Fighting materials and equipment.
C. Field Welding: Comply with AWS D1.1.

3.9 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.10 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor Fire Fighting

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.11 GROUTING

A. Mix and install grout for Fire Fighting equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's written instructions.

3.12 TESTING AND COMMISSIONING

A. Complete all phases of work so the system, equipment, and components can be checked out, started, calibrated, operationally tested, adjusted, balanced, functionally tested, and otherwise commissioned. Complete systems, including all subsystems, so they are fully functional.

B. Testing and commissioning shall be as required under the applicable sections of Division 21.

C. Additional tests may be required in the case of products, materials, and equipment if:

1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.

3.13 PROTECTION, CARE AND CLEANING

A. The following shall be provided:

1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
2. Protect installed Work.
3. In case of damage, immediately provide repairs and/or replacements as required.
4. Protect covering for bearings, open connections to tanks, pumps, compressors and similar equipment.
5. Interior of piping shall be maintained free of dirt, grit, dust, and other foreign materials.
6. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
7. Prior to connecting sprinkler risers for flushing, flush water feed mains, lead-in connections and control portions of sprinkler piping.
8. After fire sprinkler piping installation has been completed and before piping is placed in service, flush entire sprinkler system, as required to remove foreign substances, under pressure as specified in NFPA 13. Continue flushing until water is clear, and check to ensure that debris has not clogged sprinklers.

End of Section 21 05 00

SECTION 210517 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Silicone sealants.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Sustainable Design Submittals:

1. Product Data: For sealants, indicating VOC content.
2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Pipes Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends and integral welded waterstop collar

C. Galvanized-Steel-Pipe: ASTM A 53/A 53M, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

E. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

F. PVC-Pipe: ASTM D 1785, Schedule 40. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

A. Description: Manufactured cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

2. Designed to form a hydrostatic seal of 20 psig (137 kPa) minimum.

3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
4. Pressure Plates: Stainless steel

5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide not less than [1-inch (25-mm)] annular clear space and as required by manufacturer between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Division 07 Section "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07 Section "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe

penetrations with fire and smoke stop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

A. Perform inspections for sleeves and sleeve seals:

B. Prepare inspection reports.

3.6 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. For Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Comply with requirements to firestopping and fill materials specified in Division 07 Section "Penetration Firestopping."

B. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

    a. Piping Smaller Than NPS 6 (DN 150) Galvanized-steel-pipe sleeves
    b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves

2. Exterior Concrete Walls below Grade:

    a. Piping Smaller Than NPS 6 (DN 150) Galvanized-steel-pipe sleeves with sleeve- seal system

1) Select sleeve size to allow for not less than 1-inch (25-mm) annular clear space and as required by manufacturer between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system

1) Select sleeve size to allow for not less than 1-inch (25-mm) annular clear space and as required by manufacturer between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for not less than 1-inch (25-mm) annular clear space and as required by manufacturer between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.

1) Select sleeve size to allow for not less than 1-inch (25-mm) annular clear space and as required by manufacturer between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade that are not fire rated nor smoke rated:

a. Piping Smaller Than NPS 6 (DN 150) Galvanized-steel-pipe sleeves.
b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe.

5. Interior Partitions that are not fire rated nor smoke rated:

a. Piping Smaller Than NPS 6 (DN 150 Galvanized steel pipe
b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves

End of Section 21 05 17

SECTION 211200 – FIRE SUPPERSSION STANDPIPES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes piping and equipment for the following building systems:
   1. Automatic wet-type, Class I standpipes.
   2. Automatic wet-type, Class II standpipes.

1.3 DEFINITIONS

A. Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.

B. Hose Station: Hose connection, fire hose rack/reel, and fire hose.

C. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 14 for obtaining approval from Engineer and authorities having jurisdiction.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Verify the design of standpipes for compliance with NFPA, and obtain approval from Engineer and authorities having jurisdiction. Include minimum residual pressures at hydraulically remote outlets according to the following:

   1. DN25 (NPS 1) Hose Connections: 250 kPa (35 psig).
   2. DN40 (NPS 1-1/2) Hose Connections: 450 kPa (65 psig).
   3. DN65 (NPS 2-1/2) Hose Connections: 690 kPa (100 psig).

B. Components and Installation: Capable of producing piping systems with 1200-kPa (175-psig) minimum working-pressure rating, unless otherwise indicated.

C. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ECP201 and **ASCE/SEI 7**.

1.5 SUBMITTALS

A. Product Data: For the following:

   1. Pipe and fitting materials and methods of joining for standpipe piping.
   2. Pipe hangers and supports.
   3. Piping seismic restraints.
   4. Valves, including specialty valves, accessories, and devices.

5. Alarm devices. Include electrical data.
6. Fire department connections. Include type; number, size, and arrangement of inlets; caps and chains; size and direction of outlet; escutcheon and marking; and finish.
7. Hose connections. Include size, type, and finish.
8. Hose stations. Include size, type, and finish of hose connections; type and length of fire hoses; finish of fire hose couplings; type, material, and finish of nozzles; and finish of rack.

B. Welding certificates.

C. Field Test Reports and Certificates: As specified in "Field Quality Control" and "Commissioning" Articles in Part 3 of this Section. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

D. Operation and Maintenance Data: For each type of standpipe specialty to include in operation and maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has designed, installed and obtained approvals for fire-suppression piping similar to that indicated for this Project.

B. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer. Base calculations on results of fire-hydrant flow test.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of fire- suppression piping that are similar to those indicated for this Project in material, design, and extent.

D. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Fire Protection Approval Guide" and that comply with other requirements indicated.

E. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code Section IX.

F. Standpipe Components: Listing/approval stamp, label, or other marking by a testing agency acceptable to Engineer and authorities having jurisdiction.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Engineer.

H. NFPA Standard: Equipment, specialties, accessories, installation, and testing complying with NFPA 14, "Standpipe and Hose Systems."

I. Components shall be UL listed and/or FM approved.

PART 2 – PRODUCTS

2.1 SYSTEM DESCRIPTIONS

A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

B. Automatic Wet-Type, Class II Standpipe System: Includes NPS 1-1/2 (DN 40) hose stations or NPS 1 (DN25). Has open water-supply valve with pressure maintained and is capable of supplying water demand.

2.2 PIPING MATERIALS

A. Refer to Part 3 “Piping Applications” Article for applications of pipe, tube, fitting, and joining materials.

2.3 PIPES

A. Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135/A 135M, or ASTM A 795/A 795M; Type S, Grade B, Schedule 40 in DN150 (NPS 6) and smaller, and Schedule 30 in DN200 (NPS 8) and larger.
B. Schedule 30 Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, with wall thickness less than Schedule 40 and equal to or greater than Schedule 30 or ASTM A 795/A 795M and ASME B36.10M, Schedule 30 wrought-steel pipe.

2.4 PIPE FITTINGS

A. Steel Threaded Couplings: ASTM A 865/A 865M.
B. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.
C. Steel Flanges and Flanged Fittings: ASME B16.5.
D. Steel, Grooved-End Fittings: UL-listed and FM-approved, ASTM A 47/A 47M, malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.5 JOINING MATERIALS

A. Steel, Keyed Couplings: UL 213 and AWWA C606, for steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts. Include listing for dry-pipe service for couplings for dry piping.
B. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick.
   1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
   2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
C. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 FIRE-PROTECTION-SERVICE VALVES

A. General: UL listed and FM approved, with minimum 1200-kPa (175-psig) nonshock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.
B. Gate Valves, DN50 (NPS 2) and Smaller: UL 262; cast-bronze, threaded ends; solid wedge; OS&Y; and rising stem.

C. Gate Valves, DN65 (NPS 2-1/2) and Larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing rings and flanged ends.

D. Swing Check Valves, DN50 (NPS 2) and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.

E. Swing Check Valves, DN65 (NPS 2-1/2) and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.

F. Split-Clapper Check Valves, DN100 (NPS 4) and Larger: UL 312, cast-iron body with rubber seal, bronze-alloy discs, and stainless-steel spring and hinge pin.

G. Compact-Wafer, Center-Guided Check Valves: MSS SP-125; Class 150, ASTM A395/A395M or ASTM A536, or equivalent European standard, ductile iron body, bronze disc/plates, stainless-steel springs.

H. Globe, Center-Guided Check Valves (For Circuits up to PN 16): MSS SP-125; Class 150, ASTM A395/A395M or ASTM A536, or equivalent European standard, ductile iron body, bronze disc/plates, stainless-steel springs, installed between flanges.

2.7 SPECIALTY VALVES

A. Pressure-Regulating Valves: UL 1468, 2760-kPa (400-psig) minimum rating, brass. Include DN25, DN40 or DN65 (NPS 1, NPS 1-1/2 or NPS 2-1/2), female NPS inlet and outlet; adjustable setting feature; and straight or 90-degree angle pattern design as indicated.

1. Finish: Rough chrome-plated.

B. Ball Drip Valves: UL 1726, automatic drain valve, DN20 (NPS ¾), ball check device with threaded ends.

2.8 MANUAL CONTROL STATIONS

A. Manual Control Stations: Hydraulic operation, with union, DN15 (NPS ½) pipe nipple, and bronze ball valve. Include metal enclosure labeled “MANUAL CONTROL STATION” with operating instructions and cover held closed by breakable strut to prevent accidental opening.

2.9 HOSE CONNECTIONS

A. Description: UL 668, 2070-kPa (300-psig) minimum pressure rating, brass, hose valve for connection of fire hose. Include 90-degree angle pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include DN25, DN40 or DN65 (NPS 1, NPS 1-1/2 or NPS 2-1/2) as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.

1. Valve Operation: Nonadjustable type, unless pressure-regulating type is indicated.
2. Valve Operation: Nonadjustable type.
3. Valve Operation: Pressure-regulating type.
4. Finish: Rough brass.
5. Finish: Rough chrome-plated.

2.10 HOSE STATIONS

A. Description: UL 47, semiautomatic hose stations. Include brass, rack nipple; hose rack; Or hose reel and the following features:

1. Valves: UL 668, 2070-kPa (300-psig) minimum pressure rating, 90-degree angle pattern hose valve with female NPS inlet and outlet, unless otherwise indicated.
   a. Valve Operation: Pressure-regulating type.

2. Threads and Gaskets: NFPA 1963 and matching local fire department threads.
3. Flow-Restricting Devices: DN40 (NPS 1-1/2)/DN25 (NPS 1) brass or bronze, adjustable for DN25/DN40 (NPS 1/NPS 1-1/2) fire hose inlet.
4. Fire Hose: NFPA 1961 and UL 219, lined fire hose with couplings, gaskets, and nozzle. Include the following fire hose materials:
   a. Jacket: Combination of natural and synthetic threads.
   b. Lining: Combination of rubber and plastic compounds.
   c. Cover: Rubber, plastic, or combination of compounds.

5. Nozzles: UL 401.
6. Drain Valves: UL 1726.
7. Mountings: Pipe clamp or wall bracket for freestanding units.
8. Mountings: Pipe escutcheon for cabinet-mounted units.

B. DN65, DN40 and DN25 (NPS 2-1/2 and NPS 1-1/2) Hose Stations: DN65 (NPS 2-1/2) hose valve with male threaded outlet, cap, and chain and DN40/DN25 (NPS 1-1/2/NPS 1) hose valve; hose rack with water- retention device and pins for folded, DN40 (NPS 1-1/2) lined hose; and DN40 (NPS 1-1/2) lined hose with swivel inlet coupling and nozzle.

1. Hose Valve and Trim Finish: Polished chrome-plated.
2. Fire Hose: Lined, 30-m (100-foot) length.
3. Nozzle UL401: Polished chrome-plated brass, adjustable from shutoff to fog spray or straight stream.
4. Cabinet, shall be powder coated
5. One 4.5 kg ABC nitrogen operated dry chemical fire extinguisher, with steel body and red enamel finish, complete with hose.

2.11 ALARM DEVICES

A. General: Types matching piping and equipment connections.

B. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector; with 1725- kPa (250-psig) pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

C. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

D. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

E. Indicator-Post Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

2.12 PRESSURE GAGES

A. Pressure Gages: UL 393, 90- to 115-mm diameter dial with dial range of 0 to 1725 kPa (0 to 250 psig).

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 291. Use results for system design calculations required in "Quality Assurance" Article in Part 1 of this Section.

B. Report test results promptly and in writing.

3.2 EARTHWORK

A. Refer to Section "Earthwork" for excavating, trenching, and backfilling.

3.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS

A. Do not use welded joints with galvanized steel pipe.

B. Flanges, unions, and transition and special fittings with pressure ratings the same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

C. Piping between Fire Department Connections and Check Valves, and other dry-type fire-suppression standpipe piping: Use galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.

D. Piping between Fire Department Connections and Check Valves, and other dry-type fire-suppression standpipe piping: Use galvanized, standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.

E. Underground Service-Entrance Piping: Use ductile-iron, mechanical-joint pipe and fittings and restrained joints.

F. Standpipes: Use the following:
1. DN100 (NPS 4) and Smaller: Standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
2. DN100 (NPS 4) and Smaller: Standard-weight steel pipe with plain ends, steel welding fittings, and welded joints.
3. DN125 and DN150 (NPS 5 and NPS 6): Standard-weight steel pipe with grooved ends; steel, grooved-end fittings; steel, keyed couplings; and grooved joints.
4. DN125 and DN150 (NPS 5 and NPS 6): Standard-weight steel pipe with plain ends, steel welding fittings, and welded joints.
5. DN200 (NPS 8) and Larger: Standard-weight steel pipe with grooved ends; steel, grooved- end fittings; steel, keyed couplings; and grooved joints.
6. DN200 (NPS 8) and Larger: Standard-weight steel pipe with plain ends, steel welding fittings, and welded joints.

3.5 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Fire-Protection-Service Valves: UL listed and FM approved for applications where required by NFPA 14.

a. Shutoff Duty: Use gate valves.

2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 14.

a. Shutoff Duty: Use gate, ball, or butterfly valves.
b. Throttling Duty: Use globe, ball, or butterfly valves.

3.6 JOINT CONSTRUCTION

A. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

3.7 SERVICE-ENTRANCE PIPING

A. Connect standpipe piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 22 Section "Facility Water Distribution Piping" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.

3.8 WATER-SUPPLY CONNECTION

A. Connect standpipe piping to building interior water distribution piping. Refer to Division 22 Section "Domestic Water Piping" for interior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water distribution piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.

3.9 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from Engineer and authorities having jurisdiction. File written approval with Engineer before deviating from approved working plans.

B. Install underground service-entrance piping according to NFPA 24 and with restrained joints.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes DN50 (NPS 2) and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install flanges or flange adapters on valves, apparatus, and equipment having DN65 (NPS 2-1/2) and larger connections.

F. Install drain valves on standpipes.

G. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

H. Install alarm devices in piping systems.

I. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 14.

J. Earthquake Protection: Install piping according to NFPA 13 to protect from earthquake damage.

K. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than DN8 (NPS 1/4) and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

3.10 VALVE INSTALLATION

A. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and authorities having jurisdiction.

B. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

3.11 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes, unless otherwise indicated.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install DN40 (NPS 1-1/2) hose-connection valves with flow-restricting device, unless otherwise indicated.

D. Install DN65 (NPS 2-1/2) hose connections with quick-disconnect DN65 to DN40 (NPS 2-1/2 by NPS 1-1/2) reducer adapter and flow-restricting device, unless otherwise indicated.

E. Install wall-mounting-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Refer to Section "Fire-Protection Specialties" for cabinets.

3.12 HOSE-STATION INSTALLATION

A. Install freestanding hose stations for access and minimum passage restriction.

B. Install DN40 (NPS 1-1/2) hose-station valves with flow-restricting device, unless otherwise indicated.

C. Install DN65 (NPS 2-1/2) hose connections with quick-disconnect DN65 by DN40 (NPS 2-1/2 by NPS 1-1/2) reducer adapter and flow-restricting device, unless otherwise indicated.

D. Install freestanding hose stations with support or bracket attached to standpipe or substrate.

E. Install wall-mounting, rack-type hose stations in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Cabinets are specified in Division 10 Section "Fire Extinguisher Cabinets."

F. Install hose-reel hose stations on wall with bracket attached to substrate.

3.13 ROOF HOSE CABINET INSTALLATION

A. Install cabinets according to manufacturer's written instructions.

3.14 CONNECTIONS

A. Connect water-supply piping and standpipes to fire pumps. Include backflow preventers.

B. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

C. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

D. Electrical Connections: Power wiring is specified in Division 26.

E. Connect alarm devices to fire alarm.

F. Connect compressed-air supply to dry-pipe valve.

G. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire alarm system devices, including low-pressure alarm.

3.15 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14 and in Section "Identification for Fire-Suppression Piping and Equipment."

3.16 FIELD QUALITY CONTROL

A. Flush, test, and inspect standpipes according to NFPA 14, "System Acceptance" Chapter.

B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.

C. Report test results promptly and in writing to Engineer and authorities having jurisdiction.

3.17 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that air compressors and their accessories are installed and operate correctly.

C. Verify that specified tests of piping are complete.

D. Verify that potable-water supplies have correct types of backflow preventers.

E. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.

F. Drain dry-type standpipe piping.

G. Pressurize and check dry-pipe valve air-pressure maintenance devices and air compressors.

H. Fill wet-pipe standpipe piping with water.

I. Verify that hose connections are correct type and size.

J. Verify that hose stations are correct type and size.

K. Energize circuits to electrical equipment and devices.

L. Start and run air compressors.

M. Adjust operating controls and pressure settings.

N. Coordinate with fire alarm tests. Operate as required.

3.18 DEMONSTRATION

A. Demonstrate equipment, specialties and accessories, and train Employer's maintenance personnel to adjust, operate, and maintain standpipes and hoses. Refer to Division 1.

End of Section 21 12 00

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SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 ACCURACY OF DATA AND CONTRACT DRAWINGS

A. The design drawings are diagrammatic and they may not show all physical arrangements, offsets, bends, or elbows which may be required for installation of various materials, equipment, piping, and ductwork systems in allotted spaces. The Contractor shall examine these and other available drawings to determine space limitations and interferences. The Contractor shall be responsible for making any minor changes in location of equipment, pipe and ductwork from that shown on drawings and for all physical details required for installation. Cost for adapting Contractor's work to jobsite conditions shall not be considered as basis of an extra cost to contract. The Contractor shall get approval before proceeding with any change.

B. Information pertaining to new and existing conditions that are described in the specifications or appear on drawings are based on available records. While such data has been collected with reasonable care, there is no expressed or implied guarantee that conditions so indicated are entirely representative of those actually existing or that unlooked for developments may not occur. Such information is merely provided to assist the Contractor in his investigation of conditions.

C. The Contractor must carefully examine the drawings, specifications and project site, and verify all measurements, distances, levels, materials, equipment, etc. before starting work.

D. Drawings shall not be scaled for determining exact dimensions or location of equipment.

E. All works not shown on drawings in complete detail shall be installed in conformance with accepted standard practice and manufacturer’s recommendations.

F. All items shall be installed in a manner and in locations avoiding all obstructions, preserving headroom and keeping openings and passageways clear. Changes shall be made to the location of equipment and materials as may be necessary in order to meet this requirement.

G. Work indicated on drawings, but not mentioned in Specifications, or vice versa, shall be performed as if specifically mentioned or indicated by both.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

1.4 DESIGN CONDITIONS

A. Climatic Conditions: The outdoor design conditions to be adopted for the project are as follows:
   1. Climatic Conditions:
      a. Latitude: 33.85 °N
      b. Longitude: 35.86 °E.
   2. Summer Outside Temperatures:
      a. Dry Bulb: 36 deg.C.
      b. Wet Bulb: 29 deg.C.

B. Indoor Design Conditions: Indoor comfort conditions are based on the recommendations of ASHRAE Standard 55 and 170 and as indicated in the concept report.

1.5 SUBMITTALS

A. Welding certificates.

B. Comply with the requirements of Section 013300, “Submittal Procedures”, and additional requirements specified below and in different sections of division 22.

C. Shop Drawings:

1. Shop drawings shall be produced as required in the contract documents in addition to the following points
2. Shop drawings shall be new drawings prepared by the Contractor and shall not be reproductions or tracings of the contract drawings.
3. Drawings shall be overlaid with shop drawings of other trades and checked for conflicts.
4. Shop drawings shall identify the related contract drawing number or related reference drawing.
5. Shop drawings shall be fully dimensioned, including both plan and elevation dimensions from building reference points.
6. Shop drawings shall show schedules and description of equipment, valves, piping and fittings.
7. Shop drawings shall show complete system layout of equipment, components, plumbing fixtures, piping, indicating service clearances, and pipe sizes, fitting types and sizes and hanger support locations.
   a. Planned piping layout, including valve and specialty locations and valve-stem movement.
   b. Clearances for installing and maintaining insulation.
   c. Clearances for servicing and maintaining equipment, accessories, and specialties, including space for disassembly required for periodic maintenance.
   d. Equipment and accessory service connections and support details.
   e. Exterior wall and foundation penetrations.
   f. Fire-rated wall and floor penetrations.
   g. Sizes and location of required concrete pads and bases.
   h. Scheduling, sequencing, movement, and positioning of large equipment into building during construction.
   i. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
   j. Reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, ceiling access panels and other ceiling-mounted items.
   k. Mechanical equipment rooms.
   l. Interstitial space.

m. Hangers, inserts, supports, and bracing.
n. Pipe sleeves.

8. Shop drawings shall include but not be limited to:
   a. Complete floor plans with plumbing to a minimum of 1/50 scale.
   b. Plumbing of mechanical rooms to a minimum of 1/25 scale.
   c. Sections of congested areas to a minimum of 1/25 scale.
   d. Fabricated equipment to a minimum of 1/25 scale.
   e. Toilet details with relevant isometric diagram to a minimum of 1/20 scale.

9. Submit shop drawings for review as required by the contract documents. Additional shop drawings may be requested when it appears that coordination issues are not clearly resolved, when there is a question as to whether contract documents are being complied with or the design intent is not being met.

D. Product Data:

1. In line with contract documents and requirements specified in different sections of division 22
2. The Contractor shall conform to any requirements with respect to ensuring that products, components and materials comply with any referenced standard. Such requirements may include, but not be limited to, samples, test results and supporting documentation with relevant calculation.
3. The Contractor shall supply original authenticated certificates for each type of material or equipment, confirming the standard they have been manufactured and tested to.

E. Where operating or warning instructions are provided or specified, they shall be clearly denoted in English and the native language of the area where the project is located.

1.6 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
D. Installer shall be qualified with at least 5 years of successful installation experience on projects incorporating Plumbing systems and equipment similar to that required for the project.
E. All Material and equipment shall be new, unless stated otherwise and approved by the employer.
F. Manufacturer’s written directions and recommendations shall be followed. If these instructions are different from the contract documents or referenced international standards, the more stringent requirements shall establish the minimum standard. Any conflict shall be brought to the attention of the engineer for clarification, prior to the execution of the work.
G. All electrical work related to Plumbing items shall be as specified under Division 26, Electrical.
H. All pipes used in drinking water shall be Lead-free water pipe, solder and flex. Plastic pipes used for drinking water shall be NSF-61 certified. In-line devices shall comply with NSF 61 and NSF 372, End point devices used to dispense drinking water must meet the requirements of NSF 61 and NSF 372.
I. Asbestos products or equipment or materials containing asbestos shall not be used.

J. Equipment and materials to be installed outdoors shall be of the type that is designed, manufactured and listed or approved for outdoor installation by being resistant to the adverse effects of weather prevailing at the project location. The additional protective measures against outdoor weather required by the manufacturers' installation instructions and prevalent practice shall be provided.

K. Where two or more equipment or components are of the same class, the same manufacturer shall be used for selecting the equipment; component parts of the entire system need not be products of the same manufacturer.

L. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

M. Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.

N. Supply mechanical equipment complete with electrical motors

O. All equipment with moving parts shall be protected against personal injury

P. Compliance with the equivalent relevant EN/BS standards are acceptable subject to submitting a comparison sheet showing equivalency of the requirements with the US standard for engineers' approval.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. The equipment supplied shall be packed for protection against damage during handling, transport, warehousing and installation. The efficiency of the packing shall be the responsibility of the Contractor. The Contractor shall repair or replace any damaged items, at no additional cost, as instructed by the Engineer even after delivery of the equipment, if it is proven that the damage was caused by packing, storage, or handling deficiencies.

D. Protect stored pipes, tubes, flanges, fittings, and piping specialties from moisture and dirt. Elevate above grade.

1.8 COORDINATION

A. Coordinate mechanical equipment installation with other trades and building components.

B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

C. For large equipment make provisions for the necessary openings in the building to allow for admittance of all equipment before closing in.

D. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

E. Coordinate requirements for access panels and doors for Plumbing items requiring access for operation, service or maintenance that are concealed behind finished surfaces whether indicated on plans or not. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

F. Coordinate connections of Plumbing systems with exterior underground and overhead utilities and services where required.

G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

1.9 CODES AND REGULATIONS

A. All local codes and regulations shall become part of this specification and must be adhered to where they exceed requirements as shown on the drawings or stated in the specifications, without additional cost to the Contract. Contract documents may contain more stringent requirements than the code.

1.10 CONTINUITY OF EXISTING SERVICES

A. Do not interrupt or change existing services without prior written approval. When interruption is required, coordinate length of service time with employer to minimize disruption of occupant activities. Depending on the length of the service time temporary equipment or pipe installation or relocation might be required and shall be provided to maintain continuity of operation of existing facilities.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall provide operating and maintenance instruction manuals covering each and every item of equipment and devices furnished or erected by the Contractor prior to "Substantial Completion" as required by Division 1.

B. Each separate manual shall consist of the following:
   1. Neatly typewritten table of contents including contractor's name, address and telephone number; list of each product referenced in manual; and name, address and telephone number of installing contractor and maintenance contractor for each product.
   2. Tabbed sections of catalog data and literature for each product including model number, description and component parts; operating procedures; maintenance procedures; servicing and lubrication schedules; description of sequence of operations; parts lists; illustrations, assembly drawings and diagrams required for maintenance; any additional drawings, diagrams, charts or written text which may be required to supplement product data for particular installation; certified test and balance report; list of control point labels, and wiring diagrams.
   3. Copy of warranty, bond and/or service contract issued for each product including an information sheet for operations personnel with proper procedures in event of a product failure and instances which might affect validity of warranties or bonds.
   4. Full size sheets, if required, shall be folded into special holding pockets. Faxed, handwritten, or illegible materials are not acceptable.

C. Prior to final inspection or acceptance, fully instruct designated facility operating and maintenance personnel on operation, adjustment and maintenance of products, equipment and systems. Review contents of operating and maintenance manual with personnel in full detail to explain all aspects of operations and maintenance.

1.12 PROTECTION OF ROOF

A. Contractors are cautioned that they must exercise extreme care in any activity involving contact with any installed roof membrane.

B. Construct protective plywood (3/4 in. thick) runways across the roof for moving, setting, and installing equipment and piping systems. No activity on the roof will be permitted without this protection. Start runways at the point of origin of any equipment placed on roof and terminate at the point of installation on curb or base. Any and all repairs necessary to bring the roofing system to its original condition shall be made by an approved Roofing Contractor and paid for by the Contractor responsible for the damage.

1.13 WORK COORDINATION

A. All Trades shall work in cooperation with each other, and fit their work into the structure as job conditions may demand. In general, priority shall be arranged as follows: (in order of preference)
   1. Recessed lighting fixtures
   2. Piping which must be drainable
   3. Sheet metal ductwork
   4. Lighting fixtures
   5. Plumbing waste lines, downspouts, vents and sprinkler piping
   6. Gravity water lines
   7. Heating hot and chilled water lines
   8. Refrigerant lines
   9. Plumbing water and gas and air lines
   10. Electrical conduit
   11. Control wiring conduit

1.14 INSPECTION

A. The Contractor shall verify the location of underground service, utilities, structures, etc., which may be encountered or be affected by his work and shall be responsible for any damage caused by neglect to provide proper precautions or protection.

1.15 TRAINING OF OWNER PERSONNEL

A. Training of Owner's personnel shall include:
   1. A minimum of 12 hours of on-site overview of the overall Plumbing System.
   2. Refer to Division 22 sections for specific training on each of the components of the Plumbing System.

1.16 WELDING

A. The below compliments other divisions of section 22
B. The Contractor is entirely responsible for the quality of the welding and shall:
   1. Conduct tests of the welding procedures used by his organization, determine the suitability of the procedures used, determine that the welds made will meet the required tests, and also determine that the welding operators have the ability to make sound welds under standard conditions.
   2. Comply with the set standards in the specification.
   3. Perform all welding operations required for construction and installation of the piping and systems.
C. Rules of procedure for qualification of all welders and general requirements for fusion welding shall conform with the applicable portions of ASME B31.1, Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications, and AWS B2.1 /B2.1M, and / or, as approved by the Qualifications."
D. Examine each welder at job site, in the presence of the Engineer, to determine the ability of the welder to meet the qualifications required. Test welders for piping for all positions, including welds with the axis horizontal (not rolled) and with the axis vertical. Each welder shall be allowed to weld only in the position in which he has qualified and shall be required to identify his welds with his specific code marking signifying his name and number as signed.
E. Provide the Engineer with a list of names and corresponding code markings. Retest welders who fail to meet the prescribed welding qualifications. Disqualify welders, who fail the second test, for work on the project.

F. Field bevels and shop bevels shall be done by mechanical means or by flame cutting. Where beveling is done by flame cutting, surfaces shall be thoroughly cleaned of scale and oxidation just prior to welding. Conform to specified standards.
G. Utilize split welding rings or approved alternate method for joints on all pipes above 50 mm to assure proper alignment, complete weld penetration, and prevention of weld spatter reaching the interior of the pipe.
H. Piping shall not be split, bent, flattened, or otherwise damaged either before, during or after installation.
I. Replace and re-inspect defective welds. Repairing defective welds by adding weld material over the defect or by peening will not be permitted. Welders responsible for defective welds must be re-qualified.
J. Electrodes shall be stored in a dry heated area, and be kept free of moisture and dampness during the fabrication operations. Discard electrodes that have lost part of their coating.

1.17 NOISE AND VIBRATION

A. Refer to Division 23, Vibration and Seismic Controls for HVAC Piping and Equipment section, for sound and vibration requirements.
B. Equipment is to operate under all conditions of load without objectionable sound or vibration. Noticeable sound outside the room in which moving equipment are installed, or annoyingly noticeable inside the room, will be considered objectionable.
C. Conditions considered objectionable are to be corrected by approved means and as directed.
D. Vibration control shall be designed, tested and installed in accordance with manufacturer's instructions.

1.18 WARRANTY

A. Comply with Division 01 for all components and with special warranties listed in individual section of Division 22.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
    1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
    2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
B. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. The standard products shall have been in satisfactory commercial or industrial use for 5 years prior to bid opening. The 5 year experience shall be satisfactorily completed by a product that has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years
C. Material and equipment shall be supported by a service organization that maintains a complete inventory of repair parts and is reasonably located within the project reach.

2.2 JOINING MATERIALS

A. Refer to individual Division 22 piping sections for special and other approved joining materials not listed below. In case of conflicting information between individual sections of division 23 and this section, individual sections' requirements shall prevail.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:
   1. CPVC Piping: ASTM F 493.
   2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

2.3 DIELECTRIC FITTINGS

A. Refer to individual Division 22 piping sections for special and other approved dielectric fittings not listed below. In case of conflicting information between individual sections of division 23 and this section, individual sections' requirements shall prevail.

B. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder joint, plain, or weld-neck end connections that match piping system materials.

C. Insulating Material: Suitable for system fluid, pressure, and temperature.

D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.4 MECHANICAL SLEEVE SEALS

A. Refer to individual Division 23 piping sections for special and other approved mechanical sleeve seals not listed below. In case of conflicting information between individual sections of division 22 and this section, individual sections' requirements shall prevail.

B. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

C. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

D. Pressure Plates: Carbon steel or Stainless steel. Include two for each sealing element.

E. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 FLEXIBLE CONNECTORS

A. Refer to individual Division 22 piping sections for special and other approved flexible connectors not listed below. In case of conflicting information between individual sections of division 23 and this section, individual sections' requirements shall prevail
B. General: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. Include 860 kPa (125-psig) minimum working-pressure rating, unless higher working pressure is indicated, and ends according to the following:
   1. DN50 (2-Inch NPS) and Smaller: Threaded.
   2. DN65 (2-1/2-Inch NPS) and Larger: Flanged.
   3. Option for DN65 (2-1/2-Inch NPS) and larger: Grooved for use with keyed couplings.
C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Stainless-Steel-Hose / Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.
E. Rubber, Flexible Connectors: CR or EPDM elastomer rubber construction, with multiple plies of NP fabric, molded and cured in hydraulic presses. Include 860 kPa (125-psig) minimum working-pressure rating at 104. Units may be straight or elbow type, unless otherwise indicated.

2.6 SLEEVES

A. Refer to individual Division 22 piping sections for special and other approved sleeves not listed below. In case of conflicting information between individual sections of division 23 and this section, individual sections' requirements shall prevail.
B. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
C. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
D. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
E. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.
F. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
G. PVC Pipe: ASTM D 1785, Schedule 40.
H. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.7 ESCUTCHEONS

A. Refer to individual Division 22 piping sections for special and other approved escutcheons not listed below. In case of conflicting information between individual sections of division 23 and this section, individual sections' requirements shall prevail.
B. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
D. One-Piece, Stamped-Steel Type: With spring clips and chrome-plated finish.
E. Split-Plate, Stamped-Steel Type: With concealed hinge, spring clips, and chrome-plated finish.

F. One-Piece, Floor-Plate Type: Cast-iron floor plate.
G. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

A. Refer to individual Division 22 piping sections for special and other approved grout not listed below. In case of conflicting information between individual sections of division 22 and this section, individual sections' requirements shall prevail.
B. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.9 SCREWS

A. Provide Stainless Steel screws for outdoor and wet applications.

PART 3 – EXECUTION

3.1 CUTTING AND PATCHING

A. Refer to Division 01 Section "Cutting and Patching"
B. Additional openings required in building construction shall be made by drilling or cutting.
C. Fill holes which are cut oversize so that a tight fit is obtained around the objects passing through.
D. Do not pierce beams or columns without written permission from the structural engineer and then only as directed.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
F. Install piping to permit valve servicing.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.
J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Size reduction shall be made using reducing fittings; bushings are not acceptable.
L. Independently support piping so that its weight shall not be supported by the equipment to which it is connected.
M. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.
N. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.
O. Cover ends of piping during installation to keep inside of piping clean.

P. Piping shall not be routed through electrical rooms or transformer vaults, or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.
Q. Use only wrenches having square flat jaws, or non-metallic strap wrenches on brass specialties; wrench marks not permitted.
R. Select system components with pressure rating equal to or greater than system operating pressure.
S. Install escutcheons for penetrations of walls, ceilings, and floors in finished spaces.
T. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
U. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
V. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
    1. Install steel pipe for sleeves smaller than 6 inches in diameter.
    2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
    3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
W. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
    1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
X. Verify final equipment locations for roughing-in.
Y. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
Z. Conveniently locate control panels, hardware and devices, valves, gauges, cleanout fittings, and other equipment or specialties requiring frequent reading, adjustments, inspection, repairs, or removal and replacement.
AA. Install thermometers and gauges to be easily read from floors, platforms, and walkways.
BB. Install piping at the required slope indicated in the specification and/or drawings.
CC. Install piping to allow application of insulation plus 25 mm clearance around insulation.
DD. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead- free solder alloy complying with ASTM B 32.
E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   3. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
   1. Plain-End Pipe and Fittings: Use butt fusion.
   2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install Plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts.

3.6 LABELING AND IDENTIFYING

A. Refer to Division 22 specification section "Identification for Plumbing Piping and Equipment."

B. Relocate devices Identifying the items for unobstructed view in finished construction

3.7 PAINTING

A. Painting of Plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.9 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.10 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor Plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.11 GROUTING

A. Mix and install grout for Plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.
D. Avoid air entrapment during placement of grout.
E. Place grout, completely filling equipment bases.
F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.
H. Cure placed grout according to manufacturer's written instructions.

3.12 TESTING AND COMMISSIONING

A. Complete all phases of work so the system, equipment, and components can be checked out, started, calibrated, operationally tested, adjusted, balanced, functionally tested, and otherwise commissioned. Complete systems, including all subsystems, so they are fully functional.
B. Testing and commissioning shall be as required under the applicable sections of Division 22.
C. Additional tests may be required in the case of products, materials, and equipment if:
   1. Submitted items are altered, changed, or cannot be determined as exactly conforming to the Contract Documents.

3.13 PROTECTION, CARE AND CLEANING

A. The following shall be provided:
   1. Provide for the safety and good condition of materials and equipment until Substantial Completion. Protect materials and equipment from damage.
   2. Protect installed Work.
   3. In case of damage, immediately provide repairs and/or replacements as required.
   4. Protect covering for bearings, open connections to tanks, pumps, compressors and similar equipment.
   5. Interior of piping shall be maintained free of dirt, grit, dust, and other foreign materials.
   6. Fixtures, piping, finished brass or bronze, and equipment shall have grease, adhesive, labels, and foreign materials removed. Chromium, nickel plate, polished bronze or brass Work shall be polished. Glass shall be cleaned inside and out.
   7. Before Substantial Completion, piping shall be drained and flushed to completely remove grease and foreign matter. Pressure regulating assemblies, traps, strainers, boilers, flush valves, and similar items shall be thoroughly cleaned. Compressed air, oil, and gas piping shall be blown out with oil-free compressed air or inert gas.

End of Section 22 05 00

SECTION 220516 – EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 -GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Particular Conditions and Division 01 Specification Sections, apply to this Section.

.1.2 SUMMARY

A. This Section includes pipe expansion fittings and loops for Plumbing piping systems.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products suitable for piping system fluids, materials, working pressures, and temperatures.
B. Capability: Absorb 200 percent of maximum piping expansion between anchors.

1.4 SUBMITTALS

A. Product Data: For each type of expansion fitting indicated.
B. Shop Drawings: Signed and sealed by a qualified professional engineer.
   1. Design Calculations: For thermal expansion of piping systems and selection and design of expansion fittings and loops.
   2. Anchor Details: Detail fabrication of each indicated. Show dimensions and methods of assembly.
   3. Alignment Guide Details: Detail field assembly and anchorage**.**
C. Welding Certificates: Copies of certificates for welding procedures and personnel
D. Schedule: Indicate manufacturer's number, size, location, and features for each expansion fitting and loop.

1.5 QUALITY ASSURANCE

A. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for expansion fittings and loops by a qualified professional engineer.
B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

PART 2 – PRODUCTS

2.1 PACKLESS EXPANSION JOINTS

A. Metal-Bellows Expansion Joints: 1200 kPa (175-psig) minimum pressure rating, with end fittings and external tie rods for limiting maximum travel, and flanged-end connections, unless otherwise indicated**.**
   1. Configuration: Single- and double-bellows type, with base, unless otherwise indicated.
   2. Joints for Steel Piping: Single- and two-ply, stainless-steel bellows and carbon-steel shroud**.**
B. Expansion Compensators: 1200 kPa (175-psig) minimum pressure rating, with internal guides, antitorque device, and removable end clip for positioning.
   1. End Connections for DN50 and Smaller: Threaded.
   2. End Connections for DN65 and Larger: Flanged.
   3. Joints for Steel Piping: Two-ply, stainless-steel bellows and carbon-steel shroud.

C. Rubber Expansion Joints: ASTM F 1123, fabric-reinforced butyl rubber, and pressure rated for 1200 kPa (175-psig) at 116 deg C minimum.
   1. Configuration: Full-faced, integral, steel-flanged-end connections; external control rods; and steel retaining rings drilled to match flange bolt holes.
   2. Types: Single and double sphere.

D. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius 180-degree return bend with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.
   1. Joints for Steel Piping: Carbon-steel fittings.
      a) End Connections for DN50 and Smaller: Threaded.
      b) End Connections for DN65 and Larger: Flanged.
      c) Joints for DN50 and Smaller: Stainless-steel hoses and double-braid, stainless-steel sheaths with 4800 kPa (700-psig) at 21 deg C and 3550 kPa at 315deg C minimum pressure ratings.
      d) Joints for DN65 to DN150: Stainless-steel hoses and double-braid, stainless-steel sheaths with 1900 kPa (275-psig) at 21 deg C and 1380 kPa at 315 deg C minimum pressure ratings.
      e) Joints for DN200 and Larger: Stainless-steel hoses and double-braid, stainless-steel sheaths with 1130 kPa (165-psig) at 21 deg C and 830 kPa at 315 deg C minimum pressure ratings**.**

2.2 PACKED EXPANSION JOINTS

A. Slip Expansion Joints: Carbon-steel, packing-type pipe expansion joint designed for repacking under pressure and pressure rated for 1725 kPa (250-psig) at 204 deg C minimum with compound limit stops, flanged or weld ends to match piping system, drip connection if used for steam piping systems, and flanged-end connections, unless otherwise indicated**.**
   1. Packing: Asbestos-free polytetrafluoroethylene.
   2. Double-Slip Type: With base**.**

B. Flexible Ball Joints: Carbon-steel assembly with asbestos-free composition packing, designed for 360-degree rotation and angular deflection, and 1725 kPa (250-psig) at 204 deg C minimum pressure rating; comply with ASME Boiler and Pressure Vessel Code: Section II, "Materials Specifications," and with ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
   1. End Connections for DN50 and Smaller: Threaded.
   2. End Connections for DN65 and Larger: Flanged.
   3. Joints for DN150 and Smaller: 30-degree angular deflection minimum.
   4. Joints for DN200 and Larger: 15-degree angular deflection minimum.

2.3 GUIDES

A. Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

2.4 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M.
B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.
C. Washers: ASTM F 844, steel, plain, flat washers.
D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, and tension and shear capacities appropriate for application.
   1. Stud: Threaded, zinc-coated carbon steel.
   2. Expansion Plug: Zinc-coated steel.
   3. Washer and Nut: Zinc-coated steel.

E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened Portland cement concrete, and tension and shear capacities appropriate for application.
   1. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
   2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
   3. Washer and Nut: Zinc-coated steel**.**

F. Concrete: Portland cement mix, 21 MPa minimum. Division 09 for formwork, reinforcement, and concrete.

G. Grout: ASTM C 1107/C 1107M, Grade B, factory-mixed and -packaged no shrink and nonmetallic grout; suitable for interior and exterior applications**.**
   1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout.
   2. Properties: Nonstinging, noncorrosive, and nongaseous.
   3. Design Mix: 34.5-MPa, 28-day compressive strength.

PART 3 – EXECUTION

3.1 APPLICATION

A. Expansion fittings and loops shall be selected and installed with respect to design requirements and based on the shop drawings and calculations prepared by the Professional Engineer assigned by the Contractor.

3.2 EXPANSION FITTING INSTALLATION

A. Install expansion fittings according to manufacturer's written instructions.

B. Install expansion fittings in sizes matching pipe size in which they are installed.

C. Align expansion fittings to avoid end-loading and torsional stress.

3.3 PIPE BEND AND LOOP INSTALLATION

A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Attach pipe bends and loops to anchors**.**
   1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualifications."
   2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.4 GUIDE INSTALLATION

A. Install guides on piping adjoining expansion fittings and loops.

B. Attach guides to pipe and secure to building structure.

3.5 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1/D1.1M.

C. Construct concrete anchors of cast-in-place concrete of dimensions indicated, or otherwise required, and include embedded fasteners.

D. Install pipe anchors according to expansion fitting manufacturer's written instructions if expansion fittings are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete**.**

3.6 PAINTING

A. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section “Painting”.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

End of Section 22 05 16

SECTION 220517 – SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Particular Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Sleeves.
2. Sleeve-seal systems.
3. Grout**.**

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 – PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
C. Galvanized-Steel Sheet Sleeves: 0.6-mm minimum thickness; round tube closed with welded longitudinal joint.
D. uPVC Pipe Sleeves: ASTM D1785, Schedule 40.

2.2 SLEEVE-SEAL SYSTEMS

A. Description:
1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
B. Characteristics: Nonshrink; recommended for interior and exterior applications.
C. Design Mix: 34.5 MPa, 28-day compressive strength.
D. Packaging: Premixed and factory packaged**.**

PART 3 -EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 25-mm annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.
C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
   1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
   2. Cut sleeves to length for mounting flush with both surfaces.
      a) Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 50 mm above finished floor level.
   3. Using grout, seal space outside of sleeves in slabs and walls without sleeve-seal system.
D. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 6.4-mm annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.
E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Division 07.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal-system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Exterior Concrete Walls Above Grade:
      a) Piping Smaller Than DN 150: Galvanized Steel pipe sleeves Galvanized-steel-pipe sleeves.
      b) Piping DN 150 and Larger: Galvanized-steel-pipe sleeves.
   2. Exterior Concrete Walls Below Grade:
      a) Piping Smaller Than DN 150: Galvanized Steel pipe sleeves with sleeve-seal system.
         i. Select sleeve size to allow for 25 mm annular clear space between piping and sleeve for installing sleeve-seal system.
      b) Piping DN 150 and Larger: Galvanized Steel pipe sleeves with sleeve-seal system.
         i. Select sleeve size to allow for 25 mm annular clear space between piping and sleeve for installing sleeve-seal system.
   3. Concrete Slabs-on-Grade:
      a) Piping Smaller Than DN 150: Galvanized Steel pipe sleeves with sleeve-seal system.
         i. Select sleeve size to allow for 25-mm annular clear space between piping and sleeve for installing sleeve-seal system.

b) Piping DN 150 and Larger: Galvanized Steel pipe sleeves with sleeve-seal system.
   i. Select sleeve size to allow for 25-mm annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs Above Grade:
   a) Piping Smaller Than DN 150: Galvanized-steel-pipe sleeves.
   b) Piping DN 150 and Larger: Steel pipe sleeves Galvanized-steel-pipe sleeves.
5. Interior Partitions:
   a) Piping Smaller Than DN 150: Galvanized-steel-pipe sleeves or uPVC sleeves schedule 40.
   b) Piping DN 150 and Larger: Galvanized-steel sheet sleeves.

End of Section 22 05 17

SECTION 220523 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Particular Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes general duty valves and motorized valves common to Plumbing piping systems.

1.3 SUBMITTALS

A. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
B. Listing of Product Installation shall be submitted for valve assemblies indicating at least 5 installed units, similar to those proposed for use, that have been in successful service for a minimum of 5 years.
C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

A. Single-Source Responsibility: Comply with the requirements specified in Division 1 Section "Products Requirements", under "Source Limitations" Paragraph.
B. ASME Compliance:
   1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
   2. ASME B31.1 for power piping valves.
   3. ASME B31.9 for building services piping valves.
C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.
D. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set globe and gate valves closed to prevent rattling.
   4. Set ball valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.
B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store indoors and maintain valve temperature higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
C. Use a sling to handle large valves; Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

1.6 DEFINITIONS

A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non-rising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem.
G. SWP: Steam working pressure.

1.7 EXTRA MATERIALS

A. Provide list of extra materials described below, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Valves: for each type and size installed provide list of extra material as per the below:
      a) From 1 to 4 valves installed: Not required
      b) From 5 to 9 valves installed: Furnish 1 extra valve
      c) From 10 to 99 valves installed: Furnish 2 extra valves
      d) From 100 and above valves installed: Furnish 2% of amount installed

1.8 WARRANTY

A. Manufacturer's Warranty: Submit a written warranty signed by the manufacturer agreeing to repair, restore or replace any defective equipment specified in this section during the specified warranty period.
   1. Warranty Period: 5 years from date of substantial completion.

PART 2 – PRODUCTS

2.1 BASIC, COMMON FEATURES

A. Design: Rising or non-rising stem.
   1. Non-rising stem valves may be used only where headroom prevents full extension of rising stems.
B. Internal and external parts of all cast-iron and ductile-iron valves installed underground or above ground, in trenches or in valve chambers, or exposed to outdoors shall be factory coated with minimum 150-micron fusion bonded epoxy coating.
   1. Valves Installed Indoors: Epoxy coating (min. 150 micron) shall be applied to internal parts only.
C. Pressure and Temperature Ratings: Not less than indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
D. Sizes: Same size as upstream pipe, unless otherwise indicated.
E. Operators: Use specified operators and handwheels, except provide the following special operator features:
   1. Handwheels: For valves other than quarter turn.
   2. Lever Handles: For quarter-turn valves DN150 and smaller.
   3. Chain-Wheel Operators: For valves DN100 and larger, installed 2400 mm or higher above finished floor elevation.
   4. Gear-Drive Operators: For quarter-turn valves DN200 and larger.
F. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
G. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
H. Threads: ASME B1.20.1.
I. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
J. Grooved: With grooves according to AWWA C606.
K. All valves shall be in an accessible location. If not, suitable means of access shall be provided.

2.2 GATE VALVES

A. Gate Valves, DN50 and Smaller: MSS SP-80; Class 125, 1380 kPa (200-psig) cold working pressure (CWP), or Class 150, 2070 kPa (300-psig) CWP; ASTM B 62 cast-bronze body and bonnet, EPDM lined solid-bronze wedge, copper-silicon alloy stem, mechanical packing, threaded connections; and with aluminum or malleable-iron handwheel.

B. Gate Valves, DN65 and Larger: MSS SP-70, Class 125, 1380 kPa (200-psig) CWP, ASTM A 126 cast-iron body and bonnet, EPDM lined solid cast-iron wedge, brass-alloy stem, mechanical packing, flanged end connections; and with cast-iron hand wheel.

2.3 BALL VALVES

A. Ball Valves, DN100 and Smaller: MSS SP-110, Class 150, 2070 kPa (300-psig) CWP, ASTM B 584 bronze body and bonnet, 2-piece construction; chrome-plated brass ball, standard port for DN15 valves and smaller and conventional port for DN20 valves and larger; blowout proof; bronze or brass stem; Teflon seats and seals; threaded or soldered end connections:
   1. Operator: Steel handwheel.
   2. Stem Extension: For valves installed in insulated piping.
   3. Memory Stop: For operator handles.

2.4 GLOBE VALVES

A. Globe Valves, DN50 and Smaller: MSS SP-80; Class 125, 1380 kPa (200-psig) CWP, or Class 150, 2070 kPa (300-psig) CWP; ASTM B 62 cast-bronze body and screwed bonnet, rubber, or bronze disc, silicon bronze-alloy stem, mechanical packing, threaded end connections; and with aluminum or malleable-iron handwheel.
B. Globe Valves, DN65 and Larger: MSS SP-85, Class 125, 1380 kPa (200-psig) CWP, ASTM A 126 cast-iron body and bolted bonnet with bronze fittings, renewable bronze seat and disc, brass-alloy stem, outside screw and yoke, mechanical packing, flanged end connections; and with cast-iron handwheel.

2.5 PLUG VALVES

A. Plug Valves: non-lubricated MSS SP-78, 1200-kPa (175-psi) CWP, ASTM A 126 cast-iron body and bonnet, cast-iron plug, Buna N, Viton, or teflon packing, flanged or grooved end connections:

   1. Operator: Lever.
   2. Operator: Square head with 1 wrench for every 10 valves.
   3. Operator: Worm and gear with handwheel, sizes DN150 (6 inches) and larger.
   4. Operator: Worm and gear with chain wheel, sizes DN150 (6 inches) and larger, 2400 mm (96 inches) or higher above floor.

2.6 CHECK VALVES

A. Swing Check Valves, DN50 and Smaller: MSS SP-80; Class 125, 1380 kPa (200-psig) CWP, or Class 150, 2070 kPa (300-psig) CWP; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, rotating bronze disc with rubber seat or composition seat, threaded end connections:
B. Swing Check Valves, DN65 to DN150: MSS SP-71, Class 125, 1380 kPa (200-psig) CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing, weighted non-slam, silent type, bronze disc, flanged or grooved end connections.
C. Air Cushioned Check Valves, DN 200 and Larger: Cast iron, ASTM A126, AWWA C508 having integral flanges, stainless steel shaft, lever and weight, air cushioned side mounted cylinder, cast iron disk, double clevis connected to ductile iron disc arm, flanged or grooved connection.

2.7 DOUBLE REGULATING VALVES

A. Double regulating valve shall be of the Y-pattern bronze globe valves for 50 mm and below and cast iron for 65 mm and above.
B. It shall have a characterized throttling disk with sufficient authority to regulate flow in a circuit incorporating a Flow Measurement Valve. The valves shall have a unique device which enables the disk to be locked in position to control flow at a pre-determined rate. An Allen key (3mm) shall be supplied for lock adjustment.

C. Tight closure of the valve shall be assured by use of a PTFE disc insert. The valves shall be rendered 'tamper proof'.
D. An in-built drain valve shall be used for draining, back filling or air venting.
E. Valves up to 50 mm diameter shall be PN20 and for valves 65 mm and above to be PN16.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operations.
D. Examine threads on valve and mating pipe for form and cleanliness.
E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves as indicated, according to manufacturer's written instructions
B. Piping installation requirements are specified in other Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
D. Locate valves for easy access and provide separate support where necessary.
E. Install valves in horizontal piping with stem at or above the center of the pipe.
F. Install valves in position to allow full stem movement.
G. For chain-wheel operators, extend chains to 1500 mm above finished floor elevation.
H. Installation of Check Valves: Install for proper direction of flow as follows:
    1. Swing Check Valves: Horizontal position with hinge pin level.

3.3 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
B. Align threads at point of assembly.
C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.4 FLANGED CONNECTIONS

A. Align flange surfaces parallel.
B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

3.5 VALVE END SELECTION

A. Select valves with the following ends or types of pipe/tube connections:
   1. Steel Pipe Sizes, DN50 and Smaller: Threaded or grooved end.
   2. Steel Pipe Sizes, DN65 and Larger: Grooved end or flanged.

3.6 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe and ball valves for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements. Refer to the Drawings also for the requirement of the valve's type.

B. Domestic Water Systems: Use the following valve types:
   1. Gate Valves: Class 125, cast-iron body.
   2. Ball Valves: Class 150, 2070 kPa (300-psig) CWP, with stem extension.
   3. Globe Valves: Class 125, bronze body with bronze disc; or Class 125, cast-iron body.
   4. Check Valves: Class 125, bronze body swing check with rubber seat.

3.7 ADJUSTING

A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

End of Section 22 05 23

SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Particular Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes hangers and supports for Plumbing system piping and equipment.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
B. Terminology: As defined in MSS SP-58, "Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation."

1.4 PERFORMANCE REQUIREMENTS

A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
C. Design seismic restraint hangers and supports for piping and equipment.
D. All hangers and supports installation details and any cutting and drilling in structural elements shall be approved by the Engineer.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
B. Shop Drawings: Signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include stress analysis calculations justifying forces, sizes, embedments and characteristics of components and fabrication details.
C. Welding Certificates: Copies of certificates for welding procedures and operators.

1.6 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.

PART 2 – PRODUCTS

2.1 MANUFACTURED UNITS

A. Pipe Hangers, Supports, and Components: MSS SP-58 or equivalent relevant standards, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
    1. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.

2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

B. Channel Support Systems: MFMA-4, factory-fabricated components for field assembly.
   1. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
   2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

C. Thermal-Hanger Shield Inserts: 690-kPa minimum compressive-strength insulation, encased in sheet metal shield.
   1. Material for Cold Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier or approved equal.
   2. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
   3. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
   4. Insert Length: Extend 50 mm beyond sheet metal shield for piping operating below ambient air temperature.

2.2 MISCELLANEOUS MATERIALS

A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
C. Grout: ASTM C 1107/C 1107M, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
   1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
   2. Properties: Non-staining, noncorrosive, and nongaseous.
   3. Design Mix: 34.5-MPa, 28-day compressive strength

PART 3 – EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in Sections specifying equipment and systems.
B. Comply with MSS SP-69 and MSS SP-58 or equivalent relevant standard for pipe hanger selections and applications that are not specified in piping system Specification Sections.
C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
   1. Adjustable Steel Clevis Hangers (MSS Type 1 or equivalent relevant standard): For suspension of non-insulated or insulated stationary pipes, DN15 to DN750.
   2. Yoke-Type Pipe Clamps (MSS Type 2 or equivalent relevant standard): For suspension of 49 to 232 deg. C pipes, DN100 to DN400, requiring up to 100 mm of insulation.
   3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3 or equivalent relevant standard): For suspension of pipes, DN20 to DN600, requiring clamp flexibility and up to 100 mm of insulation.
   4. Steel Pipe Clamps (MSS Type 4 or equivalent relevant standard): For suspension of cold pipes, DN15 to DN600, if little or no insulation is required.
   5. Pipe Hangers (MSS Type 5 or equivalent relevant standard): For suspension of pipes, DN15 to DN100, to allow off-center closure for hanger installation before pipe erection.
   6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6 or equivalent relevant standard): For suspension of non-insulated stationary pipes, DN20 to DN200.
   7. Adjustable Steel Band Hangers (MSS Type 7 or equivalent relevant standard): For suspension of non-insulated stationary pipes, DN15 to DN200).
   8. Adjustable Band Hangers (MSS Type 9 or equivalent relevant standard): For suspension of non-insulated stationary pipes, DN15 to DN200.
   9. Adjustable Swivel-Ring Band Hangers (MSS Type 10 or equivalent relevant standard): For suspension of non-insulated stationary pipes, DN15 to DN50.

10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11 or equivalent relevant standard): For suspension of non-insulated stationary pipes, DN10 to DN200.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12 or equivalent relevant standard): For suspension of non-insulated stationary pipes, DN10 to DN80.
12. U-Bolts (MSS Type 24 or equivalent relevant standard): For support of heavy pipe, DN15 to DN750.
13. Clips (MSS Type 26 or equivalent relevant standard): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36 or equivalent relevant standard): For support of pipes, DN100 to DN900, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37 or equivalent relevant standard): For support of pipes, DN100 to DN900, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38 or equivalent relevant standard): For stanchion-type support for pipes, DN65 to DN900, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41 or equivalent relevant standard): For suspension of pipes, DN25 to DN750, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43 or equivalent relevant standard): For suspension of pipes, DN65 to DN500, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44 or equivalent relevant standard): For support of pipes, DN50 to DN1050, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45 or equivalent relevant standard): For support of pipes, DN50 to DN600, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46 or equivalent relevant standard): For support of pipes, DN50 to DN750, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
    1. Extension Pipe or Riser Clamps (MSS Type 8 or equivalent relevant standard): For support of pipe risers, DN20 to DN500.
    2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42 or equivalent relevant standard): For support of pipe risers, DN20 to DN500, if longer ends are required for riser clamps.
E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
    1. Steel Turnbuckles (MSS Type 13 or equivalent relevant standard): For adjustment up to 150 mm for heavy loads.
    2. Steel Clevises (MSS Type 14 or equivalent relevant standard): For 49 to 232 deg. C piping installations.
    3. Swivel Turnbuckles (MSS Type 15 or equivalent relevant standard): For use with MSS Type 11, split pipe rings.
    4. Malleable-Iron Sockets (MSS Type 16 or equivalent relevant standard): For attaching hanger rods to various types of building attachments.
    5. Steel Weldless Eye Nuts (MSS Type 17 or equivalent relevant standard): For 49 to 232 deg. C piping installations.
F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
    1. Steel or Malleable Concrete Inserts (MSS Type 18 or equivalent relevant standard): For upper attachment to suspend pipe hangers from concrete ceiling.
    2. Top-Beam C-Clamps (MSS Type 19 or equivalent relevant standard): For use under roof installations with bar-joist construction to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20 or equivalent relevant standard): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21 or equivalent relevant standard): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22 or equivalent relevant standard): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23 or equivalent relevant standard): For structural shapes.
7. Top-Beam Clamps (MSS Type 25 or equivalent relevant standard): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27 or equivalent relevant standard): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28 or equivalent relevant standard): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29 or equivalent relevant standard): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30 or equivalent relevant standard): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a) Light (MSS Type 31 or equivalent relevant standard): 340 kg.
    b) Medium (MSS Type 32 or equivalent relevant standard): 675 kg.
    c) Heavy (MSS Type 33 or equivalent relevant standard): 1350 kg.
13. Side-Beam Brackets (MSS Type 34 or equivalent relevant standard): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57 or equivalent relevant standard): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58 or equivalent relevant standard): For supporting piping systems subject to linear horizontal movement where head room is limited.

G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
    1. Steel Pipe-Covering Protection Saddles (MSS Type 39 or equivalent relevant standard): To fill interior voids with insulation that matches adjoining insulation.
    2. Protection Shields (MSS Type 40 or equivalent relevant standard): Of length recommended by manufacturer to prevent crushing insulation.
    3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360 degrees insert of high-density, 690 kPa minimum compressive-strength, water-repellent-treated calcium silicate, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.

H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
    1. Restraint-Control Devices (MSS Type 47 or equivalent relevant standard): Where indicated to control piping movement.
    2. Spring Cushions (MSS Type 48 or equivalent relevant standard): For light loads if vertical movement does not exceed 32 mm.
    3. Spring-Cushion Roll Hangers (MSS Type 49 or equivalent relevant standard): For equipping Type 41 roll hanger with springs.
    4. Spring Sway Braces (MSS Type 50 or equivalent relevant standard): To retard sway, shock, vibration, or thermal expansion in piping systems.
    5. Variable-Spring Hangers (MSS Type 51 or equivalent relevant standard): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
    6. Variable-Spring Base Supports (MSS Type 52 or equivalent relevant standard): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

7. Variable-Spring Trapeze Hangers (MSS Type 53 or equivalent relevant standard): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    a. Horizontal (MSS Type 54 or equivalent relevant standard): Mounted horizontally.
    b. Vertical (MSS Type 55 or equivalent relevant standard): Mounted vertically.
    c. Trapeze (MSS Type 56 or equivalent relevant standard): Two vertical-type supports and one trapeze member.

3.2 HANGER AND SUPPORT INSTALLATION

A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89 or equivalent relevant standard. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
    1. Field assemble and install according to manufacturer's written instructions.
C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
    1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
    2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69 or equivalent relevant standard. Install additional attachments at concentrated loads, including valves, flanges, and strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 100 mm thick.
F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
G. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 for "Building Services piping" is not exceeded.
J. Insulated Piping: Comply with the following:
    1. Attach clamps and spacers to piping.
        a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
        b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
        c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
    2. Install MSS SP-58, Type 39, (or equivalent relevant standard) protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
        a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe DN 100 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40 (or equivalent relevant standard) protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe DN 100 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
    a. DN 8 to DN 90: 300 mm long and 1.22 mm thick.
    b. DN 100: 300 mm long and 1.52 mm thick.
    c. DN 125 and DN 150: 450 mm long and 1.52 mm thick.
    d. DN 200 to DN 350: 600 mm long and 1.91 mm thick.
    e. DN 400 to DN 600: 600 mm long and 2.67 mm thick.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

K. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
B. Grouting: Place grout under supports for equipment and make bearing surface smooth.
C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. All fabricated channels and trapeze support shall be hot dipped galvanized steel.
B. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
C. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
D. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
    1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
    2. Obtain fusion without undercut or overlap.
    3. Remove welding flux immediately.
    4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.
    5. All supports exposed to external weather condition shall be hot dipped galvanized with zinc coated edges.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
B. Trim excess length of continuous-thread hanger and support rods.

3.6 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
    1. Apply paint by brush or spray to provide a minimum dry film thickness of 0.05 mm.
B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09
C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780/A780M.

End of Section 22 05 29

SECTION 220719 – PLUMBING PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Particular Conditions and Division 01 Specification Sections, apply to this Section.

.1.2 SUMMARY

A. This Section includes preformed rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 PERFORMANCE REQUIREMENTS

A. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which they are applied in either the wet or dry state. Materials to be used on stainless-steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free.
B. Thermal-insulation system materials shall be noncombustible, non-melting/dripping as defined by NFPA 220 & EN 13823, Euro Class B-S2, d0. Adhesives, coatings, sealants, facings, jackets, and thermal-insulation materials, except cellular elastomers, shall have a maximum flame-spread classification (FSC) of 25 and a smoke-developed classification (SDC) of 50. Flame-contributed classification (FCC) shall be as specified for the application. These maximum values shall be determined in accordance with ASTM E 84, EN 13823 and NFPA 255.
C. Adhesives, coatings, and sealants shall be nonflammable in their wet state. Adhesives, coatings, and sealants shall have published or certified temperature ratings suitable for the entire range of working temperatures normal for the surfaces to which they are to be applied.

1.4 ACTION SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
B. Local Standards & Regulations shall be followed for adhesives and sealants, submit documentation including printed statement of VOC content and chemical components.
C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use.
    1. Preformed Pipe Insulation Materials: 300 mm long by DN 50.
    2. Sheet Form Insulation Materials: 300 mm square.
    3. Jacket Materials for Pipe: 300 mm long by DN 50.
    4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
D. Material Test Reports: From a qualified testing agency acceptable to Engineer, indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.
E. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed a craft training program certified by an agency acceptable to Engineer.
B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, or UL-723, by a testing and inspecting agency acceptable to Engineer.

Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

C. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
D. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.
E. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups according to the following requirements, using materials indicated for the completed Work:
    1. Include the following mockups:
        a. One 3-m section of DN50 (NPS 2) straight pipe.
        b. One 90-degree elbow.
        c. One tee fitting.
        d. One DN50 (NPS 2) valve.
        e. Four support hangers, including hanger shield and insert.
        f. One strainer with removable portion of insulation.
        g. One reducer.
    2. Build mockups with cutaway sections to allow observation of application details for insulation materials, mastics, attachments, and jackets.
    3. Build mockups in the location indicated or, if not indicated, as directed by Engineer.
    4. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
    5. Obtain Engineer's approval of mockups before starting insulation application.
    6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
    7. Demolish and remove mockups when directed.

1.6 WARRANTY

A. Manufacturer’s Warranty: Submit a written warranty signed by the manufacturer agreeing to repair, restore or replace any defective equipment specified in this section during the specified warranty period.
    1. Warranty Period: 2 years from date of substantial completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size, as well as ASTM standard designation, and maximum use temperature.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
C. Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS

A. Products do not contain asbestos, lead, mercury, or mercury compounds.
B. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
C. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
D. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
E. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:
   1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all- purpose, vapor-retarder FSK jacket.
      a. Thermal Conductivity: 0.038 W/mK at 20 deg. C (68 deg. F).
      b. Density: 64 kg/m^3.
   2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
   3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
      a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.

   4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
   5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
   6. Expanded or Exfoliated Vermiculite Insulating Cements: Comply with ASTM C 196.
   7. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
   8. Fiber should be non combustible when tested to BS 476 (part 4), ASTM E84- 136.
F. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
   1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class 1.
   2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.
G. Flexible Elastomeric: Closed-cell, or expanded-rubber materials; suitable for maximum use temperature between minus 57 deg C and 104 deg C. Comply with ASTM C534/C534M, Type I, for tubular materials, Type II for sheet materials.
   1. Adhesive: Solvent base, contact adhesive, as recommended by insulation material manufacturer.
   2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
   3. Thermal Conductivity: 0.038 W/mK at 20 deg. C (68 deg. F).
   4. Density: 65 to 80 kg/m3.
   5. Water Vapor Permeability: 0.15 perm-inch.
   6. Noise Reduction up to 27 ΔL for 20 mm thick insulation.

H. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.2 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces. Minimum tensile strength, 6.1 N/mm width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.
B. PVC Jacket: High-impact, ultraviolet-resistant PVC; 0.5 mm thick; roll stock ready for shop or field cutting and forming.
   1. Adhesive: As recommended by insulation material manufacturer.
   2. PVC Jacket Color: White or gray.

C. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 0.5-mm thick, high-impact, ultraviolet-resistant PVC.
   1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
   2. Adhesive: As recommended by insulation material manufacturer.

D. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209M, 3003 alloy, H-14 temper. Aluminum shall be made from smooth polished temper Alloy. Straps shall be AISI 300 series corrosion-resistant steel, minimum 0.381 mm thick unless specified differently in application clause of this section, 13 mm wide, for pipe under DN300 diameter and 20 mm wide for pipe over DN300 diameter.
   1. Finish and Thickness: Stucco embossed finish minimum 0.6 mm thick for indoor installation and minimum 0.8 mm for outdoor installation, unless specified differently in application clause of this section.
   2. Moisture Barrier: 0.025-mm thick, heat-bonded polyethylene and kraft paper.
   3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket. Elbows shall be deep-drawn, die-shaped, 2-piece components for long-radius.
   4. Pipe jackets shall have not less than 2 inch (50-mm) longitudinal and circumferential lap.
   5. Sealant for longitudinal and butt joints of aluminum jacketing shall be an aluminum-pigmented, butyl, polymer sealant with high-butyl solids.

2.3 ACCESSORIES AND ATTACHMENTS

A. Glass Cloth: Comply with MIL-C-20079H, Type I for cloth woven glass-fiber fabrics, plain weave, and presized a minimum of 270 g/sq. m.

B. Tape: Vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136
   1. Tape Width: 100 mm.

C. Bands: 19 mm wide, in one of the following materials compatible with jacket:
   1. Stainless Steel: ASTM A 666, Type 304; 0.5 mm thick.
   2. Galvanized Steel: 0.13 mm thick.
   3. Aluminum: 0.18 mm thick.
   4. Brass: 0.25 mm thick.
   5. Nickel-Copper Alloy: 0.13 mm thick.

D. Wire: 2.0-mm, nickel-copper alloy; 1.6-mm, soft-annealed, stainless steel; or 1.6-mm, soft- annealed, galvanized steel.

2.4 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
   1. Verify that systems to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
B. Insulation materials shall be installed in a first-class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm.
C. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
E. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
F. Install multiple layers of insulation with longitudinal and end seams staggered.
G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
H. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the Contract Documents, unless otherwise approved by the engineer of record.
I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
J. Install insulation with least number of joints practical.
K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
    1. Apply insulation continuously through hangers and around anchor attachments.
    2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 300 mm from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
    3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
    4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
O. Apply insulation with integral jackets as follows:
    1. Pull jacket tight and smooth.
    2. Circumferential Joints: Cover with 75-mm wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 100 mm o.c.
    3. Longitudinal Seams: Overlap jacket seams at least 40 mm. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 100 mm o.c.
        a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
    4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.

5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
   1. Seal penetrations with vapor-retarder mastic.
   2. Apply insulation for exterior applications tightly joined to interior insulation ends.
   3. Extend metal jacket of exterior insulation outside roof flashing at least 50 mm below top of roof flashing.
   4. Seal metal jacket to roof flashing with vapor-retarder mastic.

Q. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

R. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

S. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
   1. Firestopping and fire-resistive joint sealers are specified in Sections "Penetration Firestopping" and "Fire-Resistive Joint Systems.".

T. All exposed refrigerant pipes on roof and in plant rooms shall be aluminum cladded on top of the insulation.

U. Floor Penetrations: Apply insulation continuously through floor assembly.
   1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:
   1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
   2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor- retarder mastic. Apply vapor retarder to ends of insulation at intervals of 4.5 to 6 m to form a vapor retarder between pipe insulation segments.
   3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 150 mm o.c.
   4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:
   1. Apply preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 25 mm, and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:
   1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
   2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
   3. Cover fittings with standard PVC fitting covers. Secure fitting covers with manufacturer's attachement and accessories. Seal seams with tape and vapor-retarder mastic.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.

3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor- retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 150 mm and less.
B. Apply insulation to straight pipes and tubes as follows:
   1. Follow manufacturer's written instructions for applying insulation.
   2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
C. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
D. Insulation Installation on Pipe Fittings and Elbows:
   1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
E. Insulation Installation on Valves and Pipe Specialties:
   1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
   2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Apply glass-cloth jacket, where indicated, directly over bare insulation or insulation with factory-applied jackets.
   1. Apply jacket smooth and tight to surface with 50-mm overlap at seams and joints.
   2. Embed glass cloth between two 1.6-mm thick coats of jacket manufacturer's recommended adhesive.
   3. Completely encapsulate insulation with jacket, leaving no exposed raw insulation.
B. Foil and Paper Jackets: Apply foil and paper jackets where indicated.
   1. Draw jacket material smooth and tight.
   2. Apply lap or joint strips with the same material as jacket.
   3. Secure jacket to insulation with manufacturer's recommended adhesive.
   4. Apply jackets with 40-mm laps at longitudinal seams and 75-mm wide joint strips at end joints.
   5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder mastic.
C. Apply PVC jacket where indicated, with 25-mm overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

D. Apply metal jacket where indicated, with 50-mm overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 300 mm o.c. and at end joints.

3.7 FINISHES

A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Section "Painting."
B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Final color as selected by Engineer. Vary first and second coats to allow visual inspection of the completed Work.

3.8 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
   1. Flexible connectors.
   2. Vibration-control devices.
   3. Drainage piping located in crawl spaces, unless otherwise indicated
   4. Below-grade piping, unless otherwise indicated.
   5. Chrome-plated pipes and fittings, unless potential for personnel injury.

3.9 FIELD QUALITY CONTROL

A. Inspection: Perform the following field quality-control inspections, after installing insulation materials, jackets, and finishes, to determine compliance with requirements:
   1. Inspect fittings and valves randomly selected by Engineer.
   2. Remove fitting covers from 20 elbows or 1 percent of elbows, whichever is less, for various pipe sizes.
   3. Remove fitting covers from 20 valves or 1 percent of valves, whichever is less, for various pipe sizes.
B. Insulation applications will be considered defective if sample inspection reveals noncompliance with requirements. Remove defective Works and replace with new materials according to these Specifications.
C. Reinstall insulation and covers on fittings and valves uncovered for inspection according to these Specifications.

3.10 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.11 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Domestic hot and recirculated hot water.

   4. Operating Temperature: 15 to 60 deg C (60 to 140 deg F).
   5. Insulation Material: Flexible elastomeric, with aluminum foil face.
   6. Insulation Thickness: Apply the following insulation thicknesses:

      a. Pipe, DN32 and Smaller: 19 mm.
      b. Pipe, Larger than DN32: 25 mm.

7. Field-Applied Jacket: Foil and paper where concealed; aluminum jacket where exposed to view
8. Vapor Retarder Required: No.
9. Finish: None.

B. Service: Condensate drains piping.
   1. Operating Temperature: 2 to 24 deg C.
   2. Insulation Material: Flexible elastomeric with aluminum foil facing or Polyolefin insulation.
   3. Insulation Thickness: 19 mm.
   4. Field-Applied Jacket: Where exposed to view or in mechanical rooms, use Aluminum jacket, complying with ASTM B 209, 0.41mm thickness.
   5. Vapor Retarder Required: No.

End of Section 22 07 19

SECTION 221116 – DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including Conditions of Contract and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water distribution piping from locations indicated to fixtures and equipment inside building.

1.3 DEFINITIONS

A. Water Service Piping: Water piping outside building that conveys water to building.
B. Service Entrance Piping: Water piping at entry into building between water service piping and water distribution piping.
C. Water Distribution Piping: Water piping inside building that conveys water to fixtures and equipment throughout the building.
D. The following are industry abbreviations for plastic piping materials:

1. CPVC: Chlorinated polyvinyl chloride.
2. NP: Nylon.
3. PE: Polyethylene.
4. PP: Polypropylene.
5. PVC: Polyvinyl chloride.
6. HDPE: High Density Polyethylene

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
1. Water Distribution Piping: 1600 kPa (232 psig).
B. Pressure class for pipes, specialties and valves shall be according to the working pressure of the system subject to Engineer’s approval.

1.5 SUBMITTALS

A. Manufacturer’s literature and data for piping and fittings
B. Test and Inspection Reports: Specified in "Field Quality Control" Article.
C. Water Samples: Specified in "Cleaning" Article.

1.6 QUALITY ASSURANCE

A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
B. Comply with ANSI/ASME B31.9, "Building Services Piping," for materials, products, and installation.
C. Comply with NSF/ANSI 14, "Plastics Piping Components and Related Materials," for plastic potable-water piping components. Include marking "NSF-pw" on plastic potable-water piping.
D. Comply with NSF/ANSI 61, "Drinking Water System Components--Health Effects," Sections 1 through 9 for potable-water piping and components.

1.7 EXTRA MATERIALS

A. provide list of extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents. Deliver materials to Employer.

1. Keyed Couplings, DN100 (4-Inch NPS) and Smaller: 12 of each type and size installed. Include one extra gasket with each coupling.
2. Keyed Couplings, DN125 (5-Inch NPS) and Larger: 6 of each type and size installed. Include one extra gasket with each coupling.

PART 2 - PRODUCTS

2.1 PIPES AND TUBES

A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
B. Galvanized Steel Pipe: ASTM A53/A53M, Type E or S, Grade A or B, Schedule 40.
C. Galvanized, Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, Schedule 40, seamless, steel pipe.
D. CPVC Plastic Pipe: ASTM F441/F441M, Schedules 40 and 80.
E. PPR pipes: ASTM F 2389, or DIN 8077 – 8078, PPR compound Type-1, PN 20.

2.2 PIPES GENERAL

A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.

B. Pipe for hot water application shall be selected for 70 °C continuous operation.

C. CPVC fittings:
1. Schedule 80, CPVC Threaded Fittings: ASTM F437.
2. Schedule 80, CPVC Socket Fittings: ASTM F439.
3. Schedule 40, CPVC Socket Fittings: ASTM F438.
4. CPVC Plastic-Piping-System Socket Fittings: ASTM D2846/D2846M.

D. SDR 7.4 PPR. Composite pipes shall withstand a maximum constant working pressure of 24.5 bars (355 psi) at 20°C with a life time expectancy of 50 years.

E. PPR Fittings:
1. PPR fittings shall be manufactured in accordance with DIN-16962 and shall be manufactured by ISO Certified Company.
2. All PPR fittings shall be from the same manufacturer.
3. All fittings supplied must be pressure rated Class 5 (PN25).
4. Fitting shall be one of the following; polyfusion welding or electro-fusion welding and comply with the International Standard requirements.
5. Fittings for PPR shall be approved to DIN 16962 or equivalent.

6. PPR pipes shall be supplied to DIN 8077 A1 as per the table below:

Nom. Ø (d) mm	Internal Diameter (di) mm	Weight Kg/m
20 mm	15.00 mm	0.127
25 mm	20.00 mm	0.163
32mm	25.00 mm	0.289
40 mm	32.00 mm	0.418
50mm	40.00 mm	0.653
75 mm	50.00 mm	2.270
90 mm	65.00 mm	2.815
110 mm	75.00 mm	4.704
160 mm	100.00 mm	11.333
200.00 mm	150.00 mm	12.714

Criteria shown above are indicative. PN-20 or suitable higher rating shall be adopted depending on building height, system operating and test pressures at the derated temperature condition.

F. Joints:

1. Unless indicated otherwise, either socket or butt-fusion or a combination of both should make the pipe joints in PP-R pipe work. Installer shall utilize the adequate tools for assembly, heating and jointing times in accordance with the manufacturer's instructions. The welding tool and heating bushes must be from the same manufacturer.

G. Pressure Testing:

1. All pressure testing shall be carried out strictly in accordance with the manufacturer's requirements and only after the specified cooling down period as indicated in the technical manual of the manufacturer.

H. Expansion:

1. Expansion loops or changes in pipe direction should be allowed for at regular intervals. Design advice should be taken from the manufacturer and also with reference to the technical manual or manufacturer.

I. Marking: Pipes shall be marked as follows:

1. Manufacturer's name
2. Standard
3. Nominal size of pipe in mm [nominal outside diameter x nominal wall thickness
4. SDR
5. Month and Year of manufacturing
6. Body of the fittings should have Manufacturer's name/logo.

J. Packaging:

1. All fittings shall be individually packed in transparent protective bags indicating its type and size.
2. All fittings shall be packed in cartoon boxes.
3. If only one type of product is packed all cartoon boxes shall have a label showing the manufacturer identification, the description of the product, the drawing of the product, the relevant size and the quantity.

K. Handling and Storage:

1. Care should be taken whilst off-loading, storing, and transporting about the site and whilst installing the pipe work and fittings to ensure that no accidental damage occurs. Also, the pipe

work and fittings should not be stored for long period (over 6 months) when they may be exposed to the effects of ultra-violet radiation including daylight.

2. The height of the stack of pipes shall be as per manufacturer’s recommendation.

2.3 VALVES

A. Refer to Section "General-Duty Valves for Plumbing Piping" for general-duty valves.

B. Refer to Section "Domestic Water Piping Specialties" for special-duty valves.

2.4 PIPING SPECIALTIES

A. Minimum Working Pressure for Domestic Water Piping Specialties: 860 kPa unless otherwise indicated.

B. Water Pressure Reducing Valves:
1. Standard: ASSE 1003.
2. Pressure Rating: Initial working pressure of 1035 kPa.
3. Body: Bronze with chrome-plated finish for DN 50 and smaller; bronze; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for DN 65 and DN 80.
4. End Connections: Threaded or solder for DN 50 and smaller; flanged or solder for DN 65 and DN 80.

C. Copper-Alloy Calibrated Balancing Valves:
1. Type: Ball valve with two readout ports and memory-setting indicator.
2. Body: bronze.
3. Size: Same as connected piping, but not larger than DN 50.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

D. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 2760-kPa minimum CWP.
3. Size: DN 20.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

E. Gate-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: DN 20.
4. Body: ASTM B62 bronze.
5. Inlet: DN 20 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

F. Water Hammer Arrestors:
1. Contractor to provide the water hammer arrestor in each toilet/wet area as per international standards.
2. Water-Hammer Arresters:
    a. Standard: ASSE 1010 or PDI-WH 201.
    b. Type: Metal bellows or Copper tube with piston.
    c. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.

B. Aboveground, Hot water supply and hot water return Distribution Piping shall be PPR Multi-Layer SDR 7.4 PN 16 to DIN 8077 & 8078 pipe and fittings.

C. Aboveground, Cold Water Distribution Piping shall be PPR Multi-Layer SDR 7.4.

D. All riser to be provided with AAV at the top and drain point at the bottom.

E. Water supply exposed pipe at roof shall be sun shaded and protected against weather conditions.

F. All hot water pipe work shall be insulated as specified.

G. For insulation refer to section 220719 “Plumbing Piping Insulation”

H. All water pipe work on roof shall be insulated with Flexible Elastomeric with aluminum foil facing as specified in section 220719 “Plumbing piping insulation”.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   1. Shutoff Duty: Use gate, ball, or butterfly valves.
   2. Throttling Duty: Use globe or ball valves.

B. Grooved-end butterfly valves may be used with grooved-end piping.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
B. Install shutoff valve immediately upstream of each dielectric fitting.
C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
F. Install piping to permit valve servicing.
G. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
H. Install piping free of sags and bends.
I. Install fittings for changes in direction and branch connections.
J. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

E. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric couplings, nipples or unions.
C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.
D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.6 VALVE INSTALLATION

A. Sectional Valves: Install sectional valves close to main on each branch and riser serving plumbing fixtures or equipment, and where indicated. Use gate or ball valves for piping DN50 (2-inch NPS) and smaller. Use gate or butterfly valves for piping DN65 (2-1/2-inch NPS) and larger.

B. Shutoff Valves: Install shutoff valve on each water supply to equipment, on each supply to plumbing fixtures without supply stops, and where indicated. Use gate or ball valves for piping DN50 (2-inch NPS) and smaller. Use gate or butterfly valves for piping DN65 (2-1/2-inch NPS) and larger.

C. Drain Valves: Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.

1. Install hose-end drain valves at low points in water mains, risers, and branches.
2. Install stop-and-waste drain valves where indicated.

D. Balancing Valves: Install in each hot-water circulation return branch, discharge side of each pump and circulator, and where indicated. Use ball valve for piping DN50 (2-inch NPS) and smaller and butterfly valve for piping DN65 (2-1/2-inch NPS) and larger. Refer to Section "Domestic Water Piping Specialties" for balancing valves.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment":

1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 30 m and less.
3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than 30 m.
4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than 30 m.
5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs 30 m or longer. Support pipe rolls on trapeze.
6. Spring hangers, MSS Type 52, for supporting base of vertical runs.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, with 10-mm minimum rods.

3.8 CONNECTIONS

A. Connect service entrance piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.

B. Connect water distribution piping to service entrance piping at shutoff valve, and extend to and connect to the following:
1. Booster Systems: Connect cold-water suction and discharge piping.
2. Water Heaters: Connect cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Connect hot- and cold-water supply piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect hot- and cold-water supply piping as indicated. Provide shutoff valve and union for each connection. Use flanges instead of unions for connections DN65 and larger.

C. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

3.9 IDENTIFICATION

A. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Inspect service entrance piping and water distribution piping as follows:
1. Do not enclose, cover, or put piping into operation until it is inspected and approved by Engineer.
2. During installation, notify Engineer at least 24 hours before inspection must be made. Perform tests specified below in presence of Engineer.
    a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    b. Final Inspection: Arrange for final inspection by Engineer to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If Engineer finds that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by Engineer.

B. Test service entrance piping and water distribution piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave uncovered and unconcealed new, altered, extended, or replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
4. Cap and subject piping to static water pressure of 345 kPa above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

C. Domestic water piping will be considered defective if it does not pass tests and inspections.
D. Prepare test and inspection reports.

3.11 CLEANING

A. Clean and disinfect service entrance piping and water distribution piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by the third-party specialist or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system in accordance with either of the following:
      i. Fill system or part thereof with water/chlorine solution with at least 50 mg/L of chlorine. Isolate with valves and allow to stand for 24 hours.
   c. Flush system with clean, potable water until no chlorine is no longer in water coming from system after the standing time.
   d. Submit water samples to an approved Third-party Specialist for analysis and for coliform count.
   e. Submit water samples in sterile bottles to Engineer. Repeat procedure if biological examination shows contamination. An acceptable test shall show absence of coliform organism

B. Prepare and submit reports of purging and disinfecting activities.
C. Clean interior of piping system. Remove dirt and debris as work progresses.

3.12 COMMISSIONING

A. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
B. Perform the following steps before putting into operation:
1. Close drain valves, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
5. Remove and clean strainer screens. Close drain valves and replace drains plugs.

C. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
D. Check plumbing specialties and verify proper settings, adjustments, and operation.
1. Water-Pressure Regulators: Set outlet pressure at 550 kPa maximum, unless otherwise indicated.

End of Section 22 21 16

SECTION 221316 – SANITARY WASTE VENT AND STORM DRAINAGE PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section Includes sanitary drainage, vent and storm drainage piping related to locations indicated in drawings.

1.3 DEFINITIONS

A. uPVC: Polyvinyl chloride, unplasticized.

1.4 SYSTEM DESIGN REQUIREMENTS

A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated or required to suit systems' operating pressures:

1. Soil, Waste, and Vent Systems: 60 kPa (20-foot head of water).
2. Storm Drainage Systems: 60 kPa (20-foot head of water).

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Local Standards & Regulations shall be followed for solvent cements and adhesive primers, submit documentation including printed statement of VOC content and chemical components
C. Submit Test and Inspection Reports: Specified in "Field Quality Control" Article, in Part3 of this Section.

1.6 QUALITY ASSURANCE

A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
B. Comply with ANSI/ASME B31.9, "Building Services Piping," for materials, products, and installation.
C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF- drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF- sewer" for plastic sewer piping.
D. Comply with International Plumbing Codes & Standards such as Uniform Plumbing Code "UPC" and American Society of Plumbing Engineers "ASPE" data books.

PART 2 – PRODUCTS

2.1 PIPES AND TUBES

A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.

B. UPVC Plastic Pipe: ASTM D2665, Schedule 40 or ASTM D1785, Schedule 40 or DIN 8061/8062.

C. Cast Iron Pipes and Fittings (For CSSD area Drainage Pipes):
   1. General Requirements:
      a. Pipes and fittings shall be cast iron, plain-end, socket-less type in full compliance with EN 877.
   2. For above ground use:
      a. Pipes shall be internally coated with a pure, high-temperature, and chemical-resistant epoxy. The external surface shall be coated with an anti-rust red primer followed by a pure red epoxy topcoat.
      b. Fittings shall be coated with pure red epoxy on both internal and external surfaces.
      c. Couplings shall be made entirely of stainless steel, including bolts and cylinders, and fitted with EPDM elastomer gaskets. Couplings shall comply with EN 877 and be suitable for continuous operation at temperatures up to 90°C, as well as resistant to disinfectants and enzymatic cleaning agents used in CSSD environments.
   3. For underground use:
      a. Pipes shall be manufactured to the same standards as above-ground piping, with the addition of a double-thickness protective internal coating of pure, high-temperature, chemical-resistant epoxy. The external surface shall be coated with a special metallic zinc layer and finished with an anthracite vinyl paint.
      b. Fittings shall be coated internally and externally with a furnace-backed epoxy resin coating.
      c. Couplings shall be identical to those specified for above-ground use.
   4. Certification and Performance Documentation:
      a. All coating systems and gasket materials shall be supported by manufacturer technical data sheets confirming resistance to CSSD effluent, disinfectants, and continuous exposure to temperatures up to 90°C.

2.2 PIPE AND TUBE FITTINGS

A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
B. Threaded-Fitting, End Connections: ANSI/ASME B1.20.1.
C. UPVC Socket Fittings: ASTM D2665, made to ASTM D3311, drain, waste, and vent pipe patterns.
D. UPVC Plastic, Tubular Fittings: ASTM F409 drainage pattern, with ends as required for application.

2.3 JOINING MATERIALS

A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.
B. Adhesive primer for UPVC fittings: ASTM F 656.
   1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Solvent cement for UPVC fittings: ASTM D 2564.
   1. UPVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Transition Couplings: Coupling or other manufactured fitting same size as, with pressure rating at least equal to, and with ends compatible with piping to be joined.

E. Flexible, Transition Couplings for Underground, Nonpressure Piping: ASTM C1173 with elastomeric sleeve. Include ends same sizes as piping to be joined and include corrosion-resistant metal band on each end.
   1. Sleeve Type for Plain-End Piping: Rubber or elastomeric sleeve and stainless-steel band assembly, fabricated to match outside diameters of piping to be joined. Include the following:

      b. Sleeves for Cast-Iron Soil Piping: ASTM C564 rubber.
      c. Sleeves for Plastic Piping: ASTM F477 elastomeric seal.
      d. Sleeves for Dissimilar Piping: Compatible with piping materials to be joined.
      e. Bands: Stainless steel, one at each pipe insert.

   2. Gasket Type for Dissimilar-End Piping: Rubber or elastomeric compression gasket, made to match inside diameter of pipe or hub, and outside diameter of adjoining pipe. Include the following:

      a. Gaskets for Cast-Iron Soil Piping: ASTM C564 rubber.
      b. Gaskets for Plastic Piping: ASTM F477 elastomeric seal.
      c. Gaskets for Dissimilar Piping: Compatible with piping materials to be joined.

2.4 VALVES

A. Refer to Section "General-Duty Valves for Plumbing Piping" for general-duty valves. Use valves specified for "Domestic Water Systems" applications.

2.5 LAGGING OF DRAINAGE PIPING

A. High performance sound sheathing material for reducing noise breakout from cast iron, Plastic soil, waste, and storm drainage piping:
   1. Designed for sound reduction in drainage piping
   2. Density: 5 kg/m2
   3. Thickness: maximum 25 mm
   4. Operating temperature: operate continuously to a maximum temperature of 100°C
   5. Low VOC emitting product
   6. Acoustic Performance: Insertion loss 25 dB(A)
   7. To be used with manufacturer recommended adhesive and tape and installed as per manufacturer issued instructions

B. Lagging shall have a performance of B-S1, d0 when tested under DIN EN ISO 13823 or 0.0.0.3 when tested according to AS 1530, Part 3 or a Flame-spread rating of 25 or less, and smoke- developed rating of 50 or less as determined by testing according to ASTM E 84, UL-723, or NFPA 225, by a testing and inspecting agency acceptable to Engineer. Factory label with appropriate markings of applicable testing and inspecting agency.

2.6 PIPING SPECIALTIES

A. Exposed Metal Cleanouts:
   1. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
   2. Size: Same as connected drainage piping
   3. Body Material: Hubless, cast-iron soil pipe test tee or as required to match connected piping.
   4. Closure: Countersunk or raised-head cast-iron plug.
   5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:
   1. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
   2. Size: Same as connected branch.
   3. Type: Heavy-duty, adjustable housing
   4. Body or Ferrule: Cast iron.

5. Clamping Device: Required.
6. Outlet Connection: Spigot
7. Closure: Cast-iron plug
8. Adjustable Housing Material: Cast iron with set-screws or another device.
9. Frame and Cover Material and Finish: Stainless steel or as per interior design requirements and sanitary book/selections.
10. Frame and Cover Shape: Round or Square as per interior design requirements and sanitary book/selections.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:
1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hub-and-spigot, cast-iron soil pipe as required to match connected piping.
4. Closure: Countersunk or raised-head cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round or Square, [nickel-bronze, copper-alloy, or stainless-steel wall- installation frame and cover.

D. Plastic Floor Cleanouts:
1. Size: Same as connected branch.
2. Body: PVC or HDPE.
3. Closure Plug: PVC or HDPE.
4. Riser: Drainage pipe fitting and riser to cleanout of same material as drainage piping.

E. Plastic Floor Drains:
1. Standard: ASME A112.6.3.
2. Material: PVC or PP
3. Seepage Flange: Required.
4. Clamping Device: Required.
5. Inlet/Outlet: Side. Three possible inlets of not less than DN50 and one outlet of DN75.
6. Top of Body, Cover and Strainer Finish: Stainless steel. Adjustable cover of not less 4mm thick.
7. Top Shape: Round or Square as per Arch/ID.
8. Trap Material: Plastic drainage piping.
9. Trap Pattern: Standard P-trap.

F. Vent Caps:
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 – EXECUTION

3.1 PIPING APPLICATIONS

A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
B. Flanges may be used on aboveground piping, unless otherwise indicated.

C. Soil, Waste, and Vent Piping: Use the following (except for CSSD area):
1. DN32 and DN40 (1-1/4- and 1-1/2-Inch NPS) – PN12: UPVC plastic pipe, UPVC socket fittings, and solvent-cemented joints.
2. DN50 to DN100 (2- to 4-Inch NPS) – PN12: UPVC plastic pipe, UPVC socket fittings, and solvent-cemented joints.

3. DN125 and DN150 (5- and 6-Inch NPS) – PN12: UPVC plastic pipe, UPVC socket fittings, and solvent-cemented joints.
4. DN200 and DN250 (8-Inch and 10-Inch NPS) – PN12: UPVC plastic pipe, UPVC socket fittings, and solvent-cemented joints.
5. DN300 (12-Inch NPS) – PN12: UPVC plastic pipe, UPVC socket fittings, and solvent- cemented joints.

D. Storm Drainage Piping: Use the following:
1. DN50 to DN150 (2- to 6-Inch NPS): UPVC plastic pipe SDR 21 (PN10), UPVC socket fittings, and solvent-cemented joints.
2. DN200 and DN250 (8-Inch and 10-Inch NPS): UPVC plastic pipe SDR 34.4 (PN6), UPVC socket fittings, and solvent-cemented joints.
3. DN300 (12-Inch NPS): UPVC plastic pipe SDR 34.4 (PN6), UPVC socket fittings, and solvent-cemented joints.

E. Condensate drain pipes: uPVC pipes, Schedule 40.

3.2 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use gate, ball, or butterfly valves.
2. Throttling Duty: Use globe or ball valves.

B. Grooved-end butterfly valves may be used with grooved-end piping.

3.3 PIPING INSTALLATION, GENERAL

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping to permit valve servicing.
F. Install piping at indicated slopes.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.
J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
L. Piping shall not be routed through electrical rooms or transformer vaults, or above transformers, panelboards, or switchboards, otherwise drain pan shall be installed under pipes with suitable slope to nearest drain point.

3.4 DRAINAGE AND VENT PIPING INSTALLATION

A. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in

direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8- bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.

B. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

C. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Sanitary Building Drain: 2 percent downward in direction of flow for piping DN63 (2.5- inch NPS) and smaller; 1 percent downward in direction of flow for piping DN80 (3-inch NPS) and larger.
   2. Horizontal, Sanitary Drainage Piping: 1 percent downward in direction of flow.
   3. Storm Building Drain: 1 percent downward in direction of flow.
   4. Horizontal, Storm Drainage Piping: 1 percent downward in direction of flow.
   5. Vent Piping: 0.5 percent down toward vertical fixture vent or toward vent stack.

D. Install force mains at elevations indicated.
E. Install PVC plastic drainage piping according to ASTM D2665.
F. Install underground, ABS and PVC plastic drainage piping according to ASTM D2321. Provide concrete protection for pipes installed at depth 1.2 m or less

3.5 JOINT CONSTRUCTION

A. UPVC Piping Joints: Join drainage piping according to ASTM D 2855 and ASTM D2665 or ASTM D1785 Appendixes.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements of Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices. Install the following:
   1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
   2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 30 m and less.
   3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than 30 m.
   4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than 30 m.
   5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs 30 m or longer. Support pipe rolls on trapeze.
   6. Spring hangers, MSS Type 52, for supporting base of vertical runs.
B. Support vertical piping and tubing at base and at each floor.
C. Support horizontal piping and tubing within 300 mm of each fitting, valve, and coupling.
D. Rod diameter may be reduced one size for double-rod hangers, with 10-mm minimum rods.
E. Install hangers for uPVC plastic piping with the following maximum spacing and minimum rod diameters:
   1. DN40 and DN50: Maximum horizontal spacing, 1200 mm with 10-mm minimum rod diameter; maximum vertical spacing, 1200 mm.
   2. DN100 and DN125: Maximum horizontal spacing, 1200 mm with 16-mm minimum rod diameter; maximum vertical spacing, 1200 mm.
   3. DN150: Maximum horizontal spacing, 1200 mm with 19-mm minimum rod diameter; maximum vertical spacing, 1200 mm.
   4. DN200 through DN300: Maximum horizontal spacing, 1200 mm with 22-mm minimum rod diameter; maximum vertical spacing, 1200 mm.
F. Support piping and tubing not listed above according to MSS SP 58 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.
B. Connect drainage piping to service entrance piping, and extend to and connect to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   3. Equipment: Connect drainage piping as indicated. Provide shutoff valve and union for each connection. Use flanges instead of unions for connections DN65 and larger.
C. Connect force-main piping to service entrance piping, and extend to and connect to the following:
   1. Sump Pumps: Connect force-main piping to sump-pump discharge.
   2. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste, vent and storm drainage piping.

3.9 FIELD QUALITY CONTROL

A. Inspect drainage and vent piping as follows:
   1. Do not enclose, cover, or put piping into operation until it is inspected and approved by Engineer.
   2. During installation, notify Engineer at least 24 hours before inspection must be made. Perform tests specified below in presence of Engineer.
      a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
      b. Final Inspection: Arrange for final inspection by Engineer to observe tests specified below and to ensure compliance with requirements.
   3. Reinspection: If Engineer finds that piping will not pass test or inspection, make required corrections and arrange for reinspection.
   4. Reports: Prepare inspection reports and have them signed by Engineer.
B. Test drainage and vent piping according to procedures of Engineer or, in absence of such procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 3.m of head. Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 250 Pa. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

C. Test force-main piping according to procedures of Engineer or, in absence of such procedures, as follows:
   1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
   2. Cap and subject piping to static-water pressure of 345 kPa above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
   3. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
   4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping system. Remove dirt and debris as work progresses.
B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
C. Place plugs in ends of uncompleted piping at end of day and when work stops.
D. Exposed uPVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water-based latex paint.

End of Section 22 13 16

SECTION 224000 – PLUMBING FIXTURES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes plumbing fixtures, fittings and accessories, including water closets, lavatories, sinks, faucets, supply stops, traps and fixture supports.

B. Toilet accessories are specified in Section 10 28 00 "Toilet, Bath and Laundry Accessories".

1.3 SUBMITTALS

A. Product Data: For each type of fixture, including materials, dimensions, finishes, water consumption and installation details.

B. Samples: Of fixtures and fittings when requested by the Engineer.

C. Operation and Maintenance Data: For faucets, flush valves and fittings.

1.4 QUALITY ASSURANCE

A. Comply with ASME A112.19.2/CSA B45.1 for vitreous china fixtures and ASME A112.18.1/CSA B125.1 for fittings, or equivalent EN standards.

B. Fixtures in clinical areas shall be suitable for healthcare use and for cleaning with hospital disinfectants.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Any internationally recognized manufacturer having an official technical agreement to conformity with standards specified in this Section.

2.2 FIXTURES

A. Water Closets: Vitreous china, wall-hung or floor-mounted as indicated, with concealed or close-coupled dual-flush cistern 3/6 litres, heavy-duty seat and cover.

B. Lavatories: Vitreous china, wall-hung or counter-mounted as indicated, without overflow in clinical areas.

C. Sinks: Stainless steel Type 304, single bowl with drainer where indicated.

2.3 FITTINGS

A. Faucets: Chrome-plated brass; elbow-, wrist- or sensor-operated in clinical areas, with laminar flow outlet without aerator; thermostatic mixing where hot water is provided.

B. Supply Stops: Chrome-plated angle valves with flexible stainless steel braided connectors.

C. Traps and Wastes: Chrome-plated brass or polypropylene bottle traps with waste fittings.

D. Fixture Supports: Concealed steel carriers for wall-hung fixtures, rated for the fixture loads.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install fixtures level and plumb, securely fixed to supports, at mounting heights indicated or as required for accessibility.

B. Connect water supply and drainage to fixtures as specified in Sections 221116 and 221316; install stops on each supply.

C. Seal joints between fixtures and walls or floors with mildew-resistant silicone sealant.

D. Where fixture supports or piping penetrate the lead shielding of the PET-CT unit, maintain shielding continuity as specified in Section 13 49 00.

3.2 FIELD QUALITY CONTROL

A. Test fixtures for leaks and proper operation; adjust flow rates and flush volumes.

3.3 CLEANING AND PROTECTION

A. Clean fixtures and fittings; protect from damage until handover.

End of Section 22 40 00

SECTION 226113 – COMPRESSED-AIR PIPING FOR LABORATORY&HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Medical compressed-air piping, designated "medical air."

B. Related Requirements:
   1. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities."
   2. Section 226400 "Medical Gas Alarms" for combined medical air, vacuum, and gas alarms.

1.3 DEFINITIONS

A. Medical compressed-air piping systems include medical air system.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.
B. Seismic Qualification Certificates: For medical compressed-air manifolds, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
C. Material Certificates: Signed by Installer certifying that medical compressed-air piping materials comply with requirements in HTM 02 01, HTM 2022 and HTM 08 06 for positive pressure medical gas systems.
D. Brazing certificates.
E. Field quality-control reports.
F. Coordination drawings: for compressed air equipment and piping, including relationships to other services that serve same work area.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Provide list of extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical compressed-air pressure outlets.
      a. Medical Air: Equal to 10 percent of amount installed.

   2. D.I.S.S. Service Connections: Furnish complete medical compressed-air pressure outlets complying with HTM 02 01 and BS EN 737.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Medical Air Piping Systems for Healthcare Facilities: According to HTM 02 01 for medical-gas-system installers.
   2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.
   1. Qualify testing personnel according to HTM 02 01 for medical-gas-system inspectors and medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

D. Listing and Labeling: provide equipment and accessories specified in this section that are listed and labeled.
   1. Terms “Listed” and “labeled”: as defined in BS EN 60529.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 5 years prior to bid opening. The 5-year use shall include applications of equipment and materials under similar circumstances and of similar size however, digital electronics devices, software and systems such as controls, instruments, Operator interface devices, shall be of the current generation of technology and basic design that has a proven satisfactory service record. The 5-year experience shall be satisfactorily completed by a product that has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 5 year field service record shall not be acceptable.

B. Products shall be supported by a local service organization, authorized and trained by the manufacturer of the equipment supplied. System components shall be environmentally suitable for the indicated locations.

2.2 SYSTEM DESCRIPTION

A. Medical air operating at [50 to 55 psig (345 to 380 kPa)].

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Medical compressed-air manifolds shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7]
   1. The term "withstand" means "the manifold will remain in place without separation of any parts when subjected to the seismic forces specified [**and the manifold will be fully operational after the seismic event**]."
   2. Component Importance Factor is [**1.5**] [**1.0**].

2.4 PIPES, TUBES, AND FITTINGS

A. Comply with HTM for medical air piping materials.

2.5 JOINING MATERIALS

A. Brazing technique should be used on all medical gas pipeline services
B. For copper-to-copper joint; the brazed joints should be made using a silvercopper- phosphorus brazing alloy CP104 to BS EN 1044:1999. No flux should be used.

2.6 VALVES

A. General Requirements for Valves:
   1. Manufacturer cleaned, purged, and bagged according to BCGA CP 4, BS EN ISO 7396-1 section -8 for oxygen service.
B. Lever-operated ball type shut-off valve with thread flanged O-ring seal connection which open and close 09- degree rotation, the handle should be in line with the pipeline when open, set of through and blanking spades, with bolts with sufficient length, The appropriate NIST connector bodies with self-sealing check valves and lockable blanking nuts should be provided upstream and downstream of the flanges. Gas identity and flow direction arrows should be provided for each valve Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.
   1. Zone-Valve Boxes:
      a. Steel Box with Aluminum Cover:
      b. Steel Box with Stainless-Steel Cover:
      c. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.
         1) Interior Finish: Factory-applied white enamel.
         2) Cover Plate: [**Aluminum**] [**or**] [**stainless-steel**] with frangible or removable windows.
         3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to HTM 02 01.
C. Ball Valves:
   1. Standard: MSS SP-110.
   2. Description: Three-piece body, brass or bronze.
   3. Pressure Rating: 300 psig (2070 kPa) minimum.
   4. Ball: Full-port, chrome-plated brass.
   5. Seats: PTFE or TFE.
   6. Handle: Lever[type with locking device].
   7. Stem: Blowout proof with PTFE or TFE seal.
   8. Ends: Manufacturer-installed BS EN 13348:2000, copper-tube extensions.

D. Check Valves:
   1. Description: In-line pattern, bronze.
   2. Pressure Rating: 300 psig (2070 kPa) minimum.
   3. Operation: Spring loaded.
   4. Ends: Manufacturer-installed BS EN 13348:2000, copper-tube extensions.

E. Safety Valves:
   1. Bronze body.
   2. Standard: BS EN 41261
   3. Settings to match system requirements.

F. Pressure Regulators:
   1. Bronze body and trim
   2. Standard: BS EN 738-2
   3. Spring-loaded, diaphragm-operated, relieving type.
   4. Manual pressure-setting adjustment.

5. Rated for [250-psig (1725-kPa)] minimum inlet pressure.
6. Capable of controlling delivered air pressure within 0.5 psig for each 10-psig (5.0 kPa for each 100-kPa) inlet pressure.

2.7 MEDICAL COMPRESSED-AIR SERVICE CONNECTIONS

A. Comply with HTM 02 01
B. General Requirements for Medical Compressed-Air Service Connections:
   1. Suitable for specific medical air pressure and service listed.
   2. Include roughing-in assemblies, finishing assemblies, and cover plates.
   3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
   4. Recessed-type units made for concealed piping unless otherwise indicated.
C. Roughing-in Assembly:
   1. Steel outlet box for recessed mounting and concealed piping.
   2. Brass-body outlet block with secondary check valve that will prevent gas flow when primary valve is removed.
   3. Double seals that will prevent air leakage.
   4. ASTM B 819, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.
D. Finishing Assembly:
   1. Brass housing with primary check valve.
   2. Double seals that will prevent air leakage.
   3. Cover plate with gas-service label.
E. Quick-Coupler Pressure Service Connections:
   1. Outlets for medical air with noninterchangeable keyed indexing to prevent interchange between services.
   2. Constructed to permit one-handed connection and removal of equipment.
   3. With positive-locking ring that retains equipment stem in valve during use.
F. D.I.S.S. Pressure Service Connections: Outlets, complying with HTM 02 01 and BS EN 737, with threaded indexing to prevent interchange between services, constructed to permit one handed connection and removal of equipment.
   1. Medical Air: D.I.S.S. No. 1160.
G. Cover Plates:
   1. One piece.
   2. Aluminum or stainless steel.
   3. Permanent, color-coded, identifying label matching corresponding service.

2.8 MEDICAL COMPRESSED-AIR PRESSURE CONTROL PANELS

A. Description:
   1. Steel box and support brackets for recessed roughing-in with stainless-steel or anodized- aluminum cover plate with printed operating instructions.
   2. Manifold assembly consisting of inlet supply valve, inlet supply pressure gage, line pressure control regulator, outlet supply pressure gage, D.I.S.S. service connection, and piping outlet for remote service connection.
   3. Minimum Working Pressure: [**200 psig (1380 kPa)**]
   4. Line-Pressure Control Regulator: Self-relieving diaphragm type with precision manual adjustment.
   5. Pressure Gages: 0 to 300 psig (0 to 2070 kPa).
   6. Service Connection: HTM 02 01 and BS EN 737, D.I.S.S. No. 1160, instrument air outlet.
   7. Before final assembly, provide temporary dust shield and U-tube for testing.
   8. Label cover plate "Air Pressure Control."

2.9 MEDICAL COMPRESSED-AIR MANIFOLDS

A. Comply with HTM 02 01
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in HTM 06 01, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
C. Central Control-Panel Unit:
    1. Weatherproof cabinet.
    2. Supply and delivery pressure gages.
    3. Electrical alarm-system connections and transformer.
    4. Indicator lights or devices.
    5. Manifold connection.
    6. Pressure changeover switch.
    7. Line-pressure regulator.
    8. Shutoff valves.
    9. Safety valve.
D. Manifold and Headers:
    1. Duplex, nonferrous-metal header for number of cylinders indicated, divided into two equal banks.
    2. Designed for 2000-psig (13.8-MPa) minimum inlet pressure.
    3. Cylinder-bank headers with inlet (pigtail) connections complying with HTM 02 01 and BS EN 737.
    4. Individual inlet check valves, shutoff valve, pressure regulator, check valve, and pressure gage.
E. Operation: Automatic, pressure-switch-activated changeover from one cylinder bank to the other when first bank becomes exhausted, without line-pressure fluctuation or resetting of regulators and without supply interruption by shutoff of either cylinder-bank header.
F. Mounting: [**Wall with mounting brackets for manifold control cabinet and headers**] [Floor **with support legs for manifold control cabinet**].
G. Label manifold control unit with permanent label identifying compressed air and system operating pressure.
H. Compressed-Air Cylinders: Number and type of compressed-air cylinders required for complete manifold system.

2.10 COMPRESSED-AIR-CYLINDER STORAGE RACKS

A. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks.

B. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

    1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to HTM 02 01 and BS EN 737.
    2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.

        a. Scrub to ensure complete cleaning.

b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with HTM 02 01 for installation of compressed-air piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install compressed-air piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

I. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and for branch connections.

O. Install medical air piping to medical air service connections specified in this Section, to medical air service connections in equipment specified in Section 226313 "Gas Piping for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical air service.

P. Piping Restraint Installation: Install seismic restraints on compressed-air piping.

Q. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

R. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.

S. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.

B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install pressure regulators on compressed-air piping where reduced pressure is required.

F. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

3.4 JOINT CONSTRUCTION

A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

B. Threaded Joints: Apply appropriate tape to external pipe threads.

C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free dry nitrogen during brazing.

D. Flanged Joints: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.5 COMPRESSED-AIR SERVICE COMPONENT INSTALLATION

A. Install compressed-air pressure control panel in walls. Attach to substrate.

B. Install compressed-air manifolds on concrete base anchored to substrate.

C. Install compressed-air cylinders and connect to manifold piping.

D. Install compressed-air manifolds with seismic restraints as indicated.

E. Install compressed-air-cylinder wall storage racks attached to substrate.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or Type 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.

H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
8. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
9. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
10. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
11. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
12. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
13. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
14. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.

J. Install supports for vertical copper tubing every 10 feet (3 m).

3.7 IDENTIFICATION

A. Install identifying labels and devices for medical compressed-air piping systems according to HTM 02 01 . Use the following or similar captions and color-coding for piping products where required by HTM 02 01 :

1. Medical Air: Black letters on yellow background.

3.8 FIELD QUALITY CONTROL FOR MEDICAL COMPRESSED-AIR PIPING IN HEALTHCARE FACILITIES

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical compressed-air piping in healthcare facilities and to prepare test and inspection reports.

B. Tests and Inspections:

1. Medical Compressed-Air Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air piping systems concurrently with tests, inspections, and certification of medical gas piping systems.
2. Preparation: Perform the following Installer tests according to requirements in HTM 02 01:

    a. Initial blowdown.
    b. Initial pressure test.
    c. Cross-connection test.
    d. Piping purge test.
    e. Standing pressure test for positive-pressure medical compressed-air piping.
    f. Repair leaks and retest until no leaks exist.

3. System Verification: Perform the following tests and inspections according to HTM 02 01:

    a. Standing pressure test.
    b. Individual-pressurization or pressure-differential cross-connection test.
    c. Valve test.
    d. Master and area alarm tests.
    e. Piping purge test.
    f. Piping particulate test.
    g. Piping purity test.
    h. Final tie-in test.
    i. Operational pressure test.
    j. Medical air purity test.
    k. Verify correct labeling of equipment and components.

4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

    a. Inspections performed.
    b. Procedures, materials, and gases used.
    c. Test methods used.
    d. Results of tests.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.9 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.10 PIPING SCHEDULE

A. Connect new tubing to existing tubing with memory-metal couplings.

B. Flanges may be used where connection to flanged equipment is required.

C. Medical Air Piping Larger Than NPS 3 (DN 80) and Operating at More Than 185 psig (1275 kPa): Type L, copper medical gas tube; wrought-copper fittings; and brazed joints.

3.11 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed HTM 02 01, copper-tube extensions.

B. Zone Valves: Ball valve with manufacturer-installed HTM 02 01, copper-tube extensions with pressure gage on one copper-tube extension.

End of Section 226113

SECTION 226213 –VACUUM PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

B. Section Includes:
   3. Medical-surgical vacuum piping, designated "medical vacuum."

C. Related Requirements:
   1. Section 226313 "Gas Piping for Laboratory and Healthcare Facilities."
   2. Section 226400 "Medical Gas Alarms" for vacuum piping alarms.

1.3 DEFINITIONS

A. Medical vacuum piping systems include medical vacuum, and piping systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.
B. Material Certificates: Signed by Installer certifying that medical vacuum piping materials comply with requirements in HTM 02 01.
C. Brazing certificates.
D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For vacuum piping specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Provide list of extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical vacuum suction inlets.
      a. Medical Vacuum: Equal to 10 percent of amount installed, but no fewer than 5 units.
   2. D.I.S.S. Service Connections: Furnish complete medical vacuum suction inlets complying with HTM 02 01 and BS EN 737.
      a. Medical Vacuum D.I.S.S. No. 1220: Equal to 10 percent of amount installed, but no fewer than 5 units.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Medical Vacuum Piping Systems for Healthcare Facilities: According to HTM 02 01 for medical-gas-system installers.

2. Pressure-Seal Joining Procedure for Copper Tubing: An authorized representative who is trained and approved by manufacturer.

3. Extruded-Tee Outlet Procedure: An authorized representative who is trained and approved by manufacturer.

4. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to HTM 02 01 for medical-gas-system inspectors and for medical-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ISO 13585 “specifies basic requirements for the qualification testing of brazers and brazing operators providing conditions for brazing, testing, examination, acceptance criteria and range of qualification for certificates.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 5 years prior to bid opening. The 5-year use shall include applications of equipment and materials under similar circumstances and of similar size. The 5-year experience shall be satisfactorily completed by a product that has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 5 year field service record shall not be acceptable.

B. Products shall be supported by a local service organization, authorized and trained by the manufacturer of the equipment supplied. System components shall be environmentally suitable for the indicated locations.

2.2 SYSTEM DESCRIPTION

A. Medical vacuum operating at [15 in. Hg (380 mm Hg)] [20 in. Hg (510 mm Hg)] [30 in. Hg (760 mm Hg)].

2.3 PIPES, TUBES, AND FITTINGS

A. Comply with HTM 02 01 for medical vacuum piping materials.

B. Medical gas pipes: Material for pipes should be manufactured from phosphorus deoxidized, non-arsenical copper to BS EN 1412:1996 grade CW024A (Cu-DHP) in metric outside diameters and to:

1. BS EN 13348:2001 – R250 (half hard) for sizes up to 54 mm; or
2. BS EN 13348:2001 – R220 (annealed) for larger sizes..

C. All medical gases pipes must be cleaned and degreased for oxygen service and be free of particulate matter and toxic residues in accordance with BS EN 13348:2001. They must be individually capper at both ends and delivered to site identified as medical gas pipes.

B. Pipes should only be cut with wheel pipe cutters, not hacksaws, to prevent the ingress of copper particles.

C. Pipe joining fittings: Pipe jointing fittings should be end-feed capillary fittings to BS EN 1254.

D. Flexible Pipe Connectors: flexible conduit shall comply with BS EN 737

E. Manufacturers:

1. The manufacturer should comply with BS EN ISO 9001:2000 for pipes and for all materials including fittings.
2. Where materials are obtained from suppliers from other countries, the suppliers should be registered in accordance with BS EN ISO 9001:2000.

2.4 JOINING MATERIALS

A. Brazing technique should be used on all medical gas pipeline services

B. For copper-to-copper joint; the brazed joints should be made using a silvercopper- phosphorus brazing alloy CP104 to BS EN 1044:1999. No flux should be used;

C. Brazing copper to brass/gun-metal/bronze is not performed on site. Manufacturers use copper-silverzinc brazing alloy AG203 to BS EN 1044:1999 with an appropriate flux

D. All pipe jointing fittings and sub-assemblies of fittings for connection to pipes must be cleaned and degreased for oxygen service and be free of particulate matter and toxic residues. They must be individually sealed in bags or boxes and delivered to site identified as medical gas fittings.

2.5 VALVES

A. General Requirements for Valves: Manufacturer cleaned, purged, and bagged according to BCGA CP 4, BS EN ISO 7396-1 for oxygen service.

B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.

1. Zone-Valve Boxes:

a. Steel Box with Aluminum Cover:

b. Steel Box with Stainless-Steel Cover:

c. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves. Medical air and medical vacuum tubing, valves, and gages may be incorporated in zone valve boxes for medical gases.

1) Interior Finish: Factory-applied white enamel.

2) Cover Plate: [Aluminum] [or] [stainless-steel] with frangible or removable windows.

3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to HTM 02 01.

C. Copper-Alloy Ball Valves:

1. Standard: MSS SP-110.
2. Description: Three-piece body, brass or bronze.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Ball: Full-port, chrome-plated brass.
5. Seats: PTFE or TFE.
6. Handle: Lever type with locking device.
7. Stem: Blowout proof with PTFE or TFE seal.
8. Ends: Manufacturer-installed BS EN 13348:2000, copper-tube extensions with pressure gage on one copper-tube extension.

D. Bronze Check Valves:

1. Description: In-line pattern, bronze. DN100 (4-Inch NPS) and Smaller:
2. Pressure Rating: 300 psig (2070 kPa) minimum.
3. Operation: Spring loaded.
4. Ends: Manufacturer-installed BS EN 13348:2000 , copper-tube extensions.

E. PVC Ball Valves:

1. Standard: MSS SP-122.
2. Description: With union ends and 150-psig (1035-kPa) minimum working-pressure rating and suitable for vacuum service.

F. PVC Butterfly Valves:

1. Description: Lug type with lever handle and 150-psig (1035-kPa) minimum working- pressure rating and suitable for vacuum service.

G. PVC Check Valves:

1. Description: Ball-, in-line-, piston-, or swing-check design with flanged or union ends and 100-psig (690-kPa) minimum working-pressure rating and suitable for vacuum service.

H. Safety Valves: Bronze body with settings to match system requirements.

1. Vacuum Relief Valves: Specialty manufacturer's option.

I. Vacuum Regulators: Bronze body, corrosion-resistant trim, spring-loaded, diaphragm operation, with adjustable setting, and suitable for vacuum service.

2.6 MEDICAL VACUUM SERVICE CONNECTIONS

A. General Requirements for Medical Vacuum Service Connections:

1. Suitable for specific medical vacuum service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

B. Roughing-in Assembly:

1. Steel outlet box for recessed mounting and concealed piping.
2. Brass-body inlet block.
3. Seals that will prevent vacuum leakage.
4. BS EN 737, NPS 3/8 (DN 10) copper outlet tube brazed to valve with service marking and tube-end dust cap.

C. Finishing Assembly:

1. Brass housing with primary check valve.
2. Seals that will prevent vacuum leakage.
3. Cover plate with gas-service label.

D. Quick-Coupler Suction Service Connections:

1. Inlets for [medical vacuum] with noninterchangeable keyed indexing to prevent interchange between services.
2. Constructed to permit one-handed connection and removal of equipment.
3. With positive-locking ring that retains equipment stem in valve during use.

E. D.I.S.S. Suction Service Connections:

1. Inlets complying with BS EN 737.
2. Threaded indexing to prevent interchange between services.
3. Constructed to permit one-handed connection and removal of equipment.
4. Medical Vacuum: BS EN 737 , D.I.S.S. No. 1220.

F. Vacuum Bottle Brackets: One piece, with pattern and finish matching corresponding service cover plate.

G. Cover Plates:

1. One piece.
2. [Aluminum] [or] [stainless steel].
3. Permanent, color-coded, identifying label matching corresponding service.

PART 3 - EXECUTION

3.1 PREPARATION

A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to BS EN 737 .
2. Wash medical gas tubing and components in hot, alkaline-cleaner-water solution of sodium carbonate or trisodium phosphate in proportion of 1 lb (0.453 kg) of chemical to 3 gal. (11.3 L) of water.
    a. Scrub to ensure complete cleaning.
    b. Rinse with clean, hot water to remove cleaning solution.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of vacuum piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, vacuum producer sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with HTM 02 01 for installation of vacuum piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install vacuum piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than piping pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

I. Install eccentric reducers, if available, where vacuum piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and vacuum gage on inlet piping to each vacuum producer and on each receiver and separator. Comply with requirements in Section 220519 "Meters and Gages for Plumbing Piping."

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and for branch connections. Extruded-tee branch outlets in copper tubing may be made where specified.

O. Install medical vacuum piping from medical vacuum service connections specified in this Section, to equipment specified in Section 226219 "Vacuum Equipment for Laboratory and Healthcare Facilities," and to equipment specified in other Sections requiring medical vacuum service.

P. Piping Restraint Installation: Install seismic restraints on vacuum piping. Seismic-restraint devices are specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

Q. Install medical vacuum service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

R. Install medical vacuum bottle bracket adjacent to each wall-mounted medical vacuum service connection suction inlet.

S. Connect vacuum piping to vacuum producers and to equipment requiring vacuum service.

T. Install unions in copper vacuum tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

U. Install unions in PVC vacuum piping NPS 2 (DN 50) and smaller adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

V. Install flanges in PVC vacuum piping NPS 2-1/2 (DN 65) and larger adjacent to flanged valves and at final connection to each machine, specialty, and piece of equipment.

W. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from vacuum equipment and specialties.

B. Install check valves to maintain correct direction of vacuum flow to vacuum-producing equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position. Single boxes may be used for multiple valves that serve same area or function.

E. Install flexible pipe connectors in suction inlet piping to each vacuum producer.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Apply appropriate tape to external pipe threads.

E. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Do not use flux. Continuously purge joint with oil-free dry nitrogen during brazing.

F. Soldered Joints: Apply BS EN 13348, water-flushable flux to tube end. Join copper tube and fittings according to BS EN 13348.

G. PVC-to-Copper Joints: Join transition fitting PVC socket end as solvent-cemented joint to PVC pipe and join fitting end with insert to copper tube as threaded joint.

H. Extruded-Tee Outlets: Form branches in copper tube according to BS EN 13348, with tools recommended by tube manufacturer.

I. Flanged Joints:

1. Copper Tubing: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

2. PVC Piping: Install PVC flange on PVC pipes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to BS EN 13348for bolting procedure.

J. Pressure-Sealed Joints: Join copper tube and copper and copper-alloy fittings with tools recommended by fitting manufacturer.

K. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

L. Solvent-Cemented Joints: Clean and dry joining surfaces. Join PVC pipe and fittings according to the following:

1. Comply with BS EN 13348for safe-handling practice of cleaners, primers, and solvent cements.

2. Apply primer and join according to BS EN 13348 for solvent-cemented joints.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or Type 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.

2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.

H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.

I. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4 (DN 8): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.

2. NPS 3/8 and NPS 1/2 (DN 10 and DN 15): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

3. NPS 3/4 (DN 20): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.

4. NPS 1 (DN 25): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.

5. NPS 1-1/4 (DN 32): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
6. NPS 1-1/2 (DN 40): 10 feet (3 m) with 3/8-inch (10-mm) rod.
7. NPS 2 (DN 50): 11 feet (3.4 m) with 3/8-inch (10-mm) rod.
8. NPS 2-1/2 (DN 65): 13 feet (4 m) with 1/2-inch (13-mm) rod.
9. NPS 3 (DN 80): 14 feet (4.3 m) with 1/2-inch (13-mm) rod.
10. NPS 3-1/2 (DN 90): 15 feet (4.6 m) with 1/2-inch (13-mm) rod.
11. NPS 4 (DN 100): 16 feet (4.9 m) with 1/2-inch (13-mm) rod.
12. NPS 5 (DN 125): 18 feet (5.5 m) with 1/2-inch (13-mm) rod.
13. NPS 6 (DN 150): 20 feet (6 m) with 5/8-inch (16-mm) rod.
14. NPS 8 (DN 200): 23 feet (7 m) with 3/4-inch (19-mm) rod.

J. Install supports for vertical copper tubing every 10 feet (3 m).

K. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1 (DN 25) and Smaller: 30 inches (760 mm) with 3/8-inch (10-mm) rod.
2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 36 inches (900 mm) with 3/8-inch (10-mm) rod.
3. NPS 2-1/2 and NPS 3 (DN 65 and DN 80): 42 inches (1150 mm) with 1/2-inch (13-mm) rod.
4. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1220 mm) with 1/2-inch (13-mm) rod.
5. NPS 6 and NPS 8 (DN 150 and DN 200): 54 inches (1350 mm) with 5/8-inch (16-mm) rod.

L. Install supports for vertical PVC piping every 48 inches (1220 mm).

3.6 IDENTIFICATION

A. Install identifying labels and devices for medical vacuum piping systems according to HTM 02 01. Use the following or similar captions and color-coding for piping products where required by HTM 02 01:

1. Medical Vacuum: Black letters on white background.

3.7 FIELD QUALITY CONTROL FOR HEALTHCARE FACILITY MEDICAL VACUUM PIPING

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections of medical vacuum piping systems in healthcare facilities and to prepare test and inspection reports.

B. Tests and Inspections:

1. Medical Vacuum Testing Coordination: Perform tests, inspections, verifications, and certification of medical vacuum piping systems concurrently with tests, inspections, and certification of [medical compressed-air piping] [and] [medical gas piping] systems.
2. Preparation: Perform the following Installer tests according to requirements in HTM 02 01 and ASSE Standard #6010:
    a. Initial blowdown.
    b. Initial pressure test.

c. Cross-connection test.

d. Piping purge test.

e. Standing pressure test for vacuum systems.

f. Repair leaks and retest until no leaks exist.

3. System Verification: Perform the following tests and inspections according to HTM 02 01,:

a. Standing pressure test.

b. Individual-pressurization or pressure-differential cross-connection test.

c. Valve test.

d. Master and area alarm tests.

e. Piping purge test.

f. Final tie-in test.

g. Operational vacuum test.

h. Verify correct labeling of equipment and components.

4. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

a. Inspections performed.

b. Procedures, materials, and gases used.

c. Test methods used.

d. Results of tests.

C. Remove and replace components that do not pass tests and inspections and retest as specified above.

3.8 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.9 PIPING SCHEDULE

A. Connect new copper tubing to existing copper tubing with memory-metal couplings.

B. Connect PVC pipe to copper tube with transition fittings.

C. Flanges may be used where connection to flanged equipment is required.

D. Medical Vacuum Piping: Use copper medical gas tube, wrought-copper fittings, and brazed joints.

3.10 VALVE SCHEDULE

A. Shutoff Valves:

1. Copper Tubing: Copper-alloy ball valve with manufacturer-installed HTM 02 01, copper- tube extensions.
2. PVC Piping:
    a. NPS 4 (DN 100) and Smaller: [Copper-alloy ball valve with manufacturer- installed BS EN 13348, copper-tube extensions] [PVC ball valve].
    b. NPS 5 (DN 125) and Larger: PVC butterfly valve.

B. Zone Valves: Copper-alloy ball valve with manufacturer-installed HTM 02 01, copper-tube extensions with pressure gage on one copper-tube extension.

End of Section 22 62 13

SECTION 226313 – GAS PIPING FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Section Includes:
   1. Oxygen gas piping, designated "medical oxygen gas."

B. Related Requirements:
   1. Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities"
   2. Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities"

1.3. DEFINITIONS

A. Abbreviations:
   1. CR: Chlorosulfonated polyethylene synthetic rubber.
   2. PVC: Polyvinyl chloride.
   3. TFE: Tetrafluoroethylene.

B. Medical gas piping systems include medical carbon dioxide, medical helium, medical nitrogen, medical nitrous oxide, and medical oxygen for healthcare facility patient care.

1.4. ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: Include diagrams for power, signal, and control wiring.
C. Wiring diagrams for medical gas systems and tanks. Differentiate between manufacturer-installed and field-installed wiring.
D. Coordination Drawings: For medical gas systems, including relationship to other services that serve same work areas.

1.5. INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.
B. Material Certificates: Signed by Installer certifying that medical gas piping materials comply with requirements in HTM 02 01, HTM 0222 Sup 1 and HTM 08 06 for positive-pressure medical gas systems.
C. Brazing certificates.
D. Field quality-control reports.

1.6. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For medical gas piping specialties to include in emergency, operation, and maintenance manuals. Refer to Division 1 requirements.

1.7. MAINTENANCE MATERIAL SUBMITTALS

A. Provide list of extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Quick-Coupler Service Connections: Furnish complete noninterchangeable medical gas pressure outlets and suction inlets.
   a. Medical Oxygen: Equal to 10 percent of quantity installed, but no fewer than 5 units.

2. D.I.S.S. Service Connections: Furnish complete medical gas pressure outlets and suction inlets complying with HTM 0201 & BS EN 737.

1.8. QUALITY ASSURANCE

A. Installer Qualifications:
   1. Medical Gas Piping Systems for Healthcare Facilities: According to HTM 02 01 for medical-gas-system installers.
   2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the medical gas piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.
   1. Qualify testing personnel according to HTM 02 01 for medical-gas-system inspectors verifiers.

C. Brazing: Qualify processes and operators according to ISO 13585 “specifies basic requirements for the qualification testing of brazers and brazing operators providing conditions for brazing, testing, examination, acceptance criteria and range of qualification for certificates.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 5 years prior to bid opening. The 5- year use shall include applications of equipment and materials under similar circumstances and of similar size however, digital electronics devices, software and systems such as controls, instruments, Operator interface devices, shall be of the current generation of technology and basic design that has a proven satisfactory service record. The 5-year experience shall be satisfactorily completed by a product that has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 5 year field service record shall not be acceptable.

B. Products shall be supported by a local service organization, authorized and trained by the manufacturer of the equipment supplied. System components shall be environmentally suitable for the indicated locations.

2.2 SYSTEM DESCRIPTION

A. Medical oxygen operating at [53 to 60 psig (370 to 420 kPa)].

2.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: [Medical gas manifolds] shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement>.

B. The term "withstand" means "the [medical gas manifolds] will remain in place without separation of any parts when subjected to the seismic forces specified [and the manifolds and tanks will be fully operational after the seismic event]."

C. Component Importance Factor is [1.5] [1.0].

2.4 PIPES, TUBES, AND FITTINGS

A. Comply with HTM 02 01 for medical gas piping materials.

B. Medical gas pipes: Material for pipes should be manufactured from phosphorus deoxidized, non-arsenical copper to BS EN 1412:1996 grade CW024A (Cu-DHP) in metric outside diameters and to:

1. BS EN 13348:2001 – R250 (half hard) for sizes up to 54 mm; or
2. BS EN 13348:2001 – R220 (annealed) for larger sizes.

C. All medical gases pipes must be cleaned and degreased for oxygen service and be free of particulate matter and toxic residues in accordance with BS EN 13348:2001. They must be individually capper at both ends and delivered to site identified as medical gas pipes.

D. Pipes should only be cut with wheel pipe cutters, not hacksaws, to prevent the ingress of copper particles.

E. Pipe joining fittings: Pipe jointing fittings should be end-feed capillary fittings to BS EN 1254.

F. Flexible Pipe Connectors: flexible conduit shall comply with BS EN 737.

G. Manufacturers:

1. The manufacturer should comply with BS EN ISO 9001:2000 for pipes and for all materials including fittings.
2. Where materials are obtained from suppliers from other countries, the suppliers should be registered in accordance with BS EN ISO 9001:2000.

2.5 JOINING MATERIALS

A. Brazing technique should be used on all medical gas pipeline services.

B. For copper-to-copper joint; the brazed joints should be made using a silver copper-phosphorus brazing alloy CP104 to BS EN 1044:1999. No flux should be used.

C. Brazing copper to brass/gun-metal/bronze is not performed on site. Manufacturers use copper- silver zinc brazing alloy AG203 to BS EN 1044:1999 with an appropriate flux.

D. All pipe jointing fittings and sub-assemblies of fittings for connection to pipes must be cleaned and degreased for oxygen service and be free of particulate matter and toxic residues. They must be individually sealed in bags or boxes and delivered to site identified as medical gas fittings.

2.6 VALVES AND VALVE BOXES

A. General Requirements for Valves:

1. Manufacturer cleaned, purged, and bagged according to BCGA CP 4, BS EN ISO 7396-1 section -8 for oxygen service.
2. Lever-operated ball type shut-off valve with thread flanged O-ring seal connection which open and close 09- degree rotation, the handle should be in line with the pipeline when open, set of through and blanking spades, with bolts with sufficient length, The appropriate NIST connector bodies with self-sealing check valves and lockable blanking nuts should be provided upstream and downstream of the flanges. Gas identity and flow direction arrows should be provided for each valve.

B. Zone-Valve Box Assemblies: Box with medical gas valves, tube extensions, and gages.

1. Zone-Valve Boxes:
   a. Steel Box with Aluminum Cover:
      1) Manufacturers: Subject to compliance with requirements,

   b. Steel Box with Stainless-Steel Cover:
      1) Manufacturers: Subject to compliance with requirements,

   c. Description: Formed steel box with cover, anchors for recessed mounting, holes with grommets in box sides for tubing extension protection, and of size for single or multiple valves with pressure gages and in sizes required to permit manual operation of valves.

      1) Interior Finish: Factory-applied white enamel.
      2) Cover Plate: [Aluminum] [or] [stainless steel] with frangible or removable windows.
      3) Valve-Box Windows: Clear or tinted transparent plastic with labeling that includes rooms served, according to HTM 02 01.

C. Ball Valves:
1. Ball valve with lockable NIST connections, and single key for each service ,
2. Manufacturers: Subject to compliance with HTM 02 01 requirements.
3. Description: Two-piece body brass or bronze.
4. Ball: Full-port, chrome-plated brass.
5. Handle: Lever [type with locking device].
6. Stem: Blowout proof with Teflon ball seals stem packing seal, stem ‘O’ ring seal and a hard-chrome plated brass ball.
7. Ends: Manufacturer-installed BS EN 13348:2000, copper-tube extensions.

D. Check Valves:

1. Manufacturers: Subject to compliance with HTM 02 01 requirements.
2. Description: In-line pattern, bronze.
3. Operation: Spring loaded.
4. Ends: Manufacturer-installed BS EN 13348:2000, copper-tube extensions.

E. Emergency Oxygen Connections: Low-pressure oxygen inlet assembly for connection to building oxygen piping systems.
1. Manufacturers: Subject to compliance with HTM 02 01requirements

F. Safety Valves:
1. Standard: BS EN 41261
2. Settings to match system requirements.

G. Pressure Regulators:
1. BS EN 738-2
2. Settings to match system requirements.

2.7 MEDICAL GAS SERVICE CONNECTIONS

A. Manufacturers: Subject to compliance with HTM 02 01 requirements
B. General Requirements for Medical Gas Service Connections:

1. Suitable for specific medical gas pressure and suction service listed.
2. Include roughing-in assemblies, finishing assemblies, and cover plates.
3. Individual cover plates are not required if service connection is in multiple unit or assembly with cover plate.
4. Recessed-type units made for concealed piping unless otherwise indicated.

PART 3 – EXECUTION

3.1 PREPARATION

A. Cleaning of Medical Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if precleaned fittings or tubing must be recleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

1. Clean medical gas tube and fittings, valves, gages, and other components of oil, grease, and other readily oxidizable materials as required for oxygen service according to BCGA CP 4.1.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling and for underground warning tapes.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of gas piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with HTM 02 01 for installation of medical gas piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

H. Install piping to permit valve servicing.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and for branch connections.

K. Install medical gas piping to medical gas service connections specified in this Section, to medical gas service connections in equipment specified in this Section, and to equipment specified in other Sections requiring medical gas service.

L. Install exterior, buried medical gas piping in protective conduit fabricated with PVC pipe and fittings. Do not extend conduit through foundation wall.

M. Piping Restraint Installation: Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

N. Install medical gas service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

O. Connect gas piping to gas sources and to gas outlets and equipment requiring gas service.

P. Install unions in copper tubing adjacent to each valve and at final connection to each specialty and piece of equipment.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 VALVE INSTALLATION

A. Install shutoff valve at each connection to gas laboratory and healthcare equipment and specialties.

B. Install check valves to maintain correct direction of gas flow from laboratory and healthcare gas supplies.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Arrange valves so largest valve is lowest. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install pressure regulators on gas piping where reduced pressure is required.

F. Install emergency oxygen connection with pressure relief valve and full-size discharge piping to outside, with check valve downstream from pressure relief valve, and with ball valve and check valve in supply main from bulk oxygen storage tank.

3.5 JOINT CONSTRUCTION

A. Ream ends of PVC pipes and remove burrs.

B. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

3.6 GAS SERVICE COMPONENT INSTALLATION

A. Assemble patient-service console with service connections. Install with supplies concealed in walls. Attach console box or mounting bracket to substrate.

B. Assemble ceiling columns and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.

C. Assemble ceiling-hose assemblies and install anchored to substrate. Provide structural steel, hanger rods, anchors, and fasteners in addition to components furnished with specialties necessary to fabricate supports.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Section 220548 "Vibration and Seismic Controls for Plumbing

Piping and Equipment" for seismic-restraint devices.

B. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support devices.

C. Vertical Piping: MSS Type 8 or Type 42, clamps.

D. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer Than 100 Feet (30 m): MSS Type 43, adjustable, roller hangers.

E. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment" for trapeze hangers.

F. Base of Vertical Piping: MSS Type 52, spring hangers.

G. Support horizontal piping within 12 inches (300 mm) of each fitting and coupling.

H. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- (10-mm-) minimum rods.

3.8 IDENTIFICATION

A. Install identifying labels and devices for specialty gas piping, valves, and specialties. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Install identifying labels and devices for healthcare medical gas piping systems according to HTM 02 01. Use the following or similar captions and color-coding for piping products where required by HTM 02 01.

3.9 PIPING SCHEDULE

A. Connect new tubing to existing tubing with memory-metal couplings.

B. Medical Gas Piping except Medical Nitrogen Piping Larger Than NPS 3 (DN 76) and Operating at More Than 185 psig (1275 kPa): Type L, copper tube; wrought-copper fittings; and brazed joints.

3.10 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed HTM 02 01 copper-tube extensions.

B. Zone Valves: Ball valve with manufacturer-installed HTM 02 01 copper-tube extensions with pressure gage on one copper-tube extension and area alarm.

End of Section 22 63 13

SECTION 226400 – MEDICAL GAS ALARM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Master alarm panels.
2. Anesthetizing-area alarm panels.
3. Area alarm panels.
4. Local alarm panels.
5. Computer-interface cabinet.

1.3 DEFINITIONS

A. Low Voltage: As defined in HTM 06 01 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Test Reports: For each alarm panel, for tests performed by a qualified testing agency.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For alarm panels and computer-interface cabinet to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Qualify Installers for air, vacuum, and gas piping systems for healthcare facilities according to HTM 02 01 for medical-gas-system installers.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the air, vacuum, and gas piping testing indicated, that is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel for air, vacuum, and gas piping systems for healthcare facilities according to HTM 02 01 for medical-gas-system inspectors and medical-gas-system verifiers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 5 years prior to bid opening. The 5-year use shall include applications of equipment and materials under similar circumstances and of similar size however, digital electronics devices, software and systems such as controls, instruments, Operator interface devices, shall be of the current generation of technology and basic design that has a proven satisfactory service record. The 5-year experience shall be satisfactorily completed by a product that has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 5 year field service record shall not be acceptable.

B. Products shall be supported by a local service organization, authorized and trained by the manufacturer of the equipment supplied. System components shall be environmentally suitable for the indicated locations.

C. Source Limitations: Obtain medical alarm systems and components from single manufacturer.

2.2 SYSTEM DESCRIPTION

A. Gas and Vacuum Systems Monitored:

1. Medical compressed air, designated "medical air."
2. Medical-surgical vacuum, designated "medical vacuum."
3. Nitrous oxide, designated "medical nitrous oxide."
4. Oxygen, designated "medical oxygen."
5. Waste anesthetic gas disposal, designated "WAGD."

2.3 GENERAL REQUIREMENTS FOR ALARM PANELS

A. Description: Factory wired with audible and color-coded visible signals to indicate specified functions.

1. Mounting: [**Exposed, surface**] [**Recessed**] installation

2. Enclosures: Fabricated from minimum 0.047-inch- (1.2-mm-) thick steel or minimum 0.05- inch- (1.27-mm-) thick aluminum, with knockouts for electrical and piping connections.

B. Components: Designed for continuous service and to operate on power supplied from [**120**] [**240**] [**277**]-V ac power source to alarm panels and with connections for low-voltage wiring to remote sensing devices. Include step-down transformers if required.

C. Dew Point Monitors: Continuous line monitoring, having panel with gage or digital display, pipeline sensing element, electrical connections for alarm system, factory- or field-installed valved bypass, and visual and cancelable audio signal for dryer site and master alarm panels. Alarm signals when pressure dew point rises above 39 deg F (4 deg C) at 55 psig (380 kPa).

1. Operation: [**Chilled-mirror method**] [**or**] [**hygrometer moisture analyzer with sensor probe**].

D. Pressure Switches or Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.

1. Low-Pressure Operating Range: 0 to 100 psig (0 to 690 kPa).
2. High-Pressure Operating Range: Up to 250 psig (1725 kPa).

E. Vacuum Switches or Pressure Transducer Sensors: Continuous line monitoring with electrical connections for alarm system.

1. Vacuum Operating Range: 0 to 30 in. Hg (0 to 760 mm Hg).

2.4 MASTER ALARM PANELS

A. Master Alarm Panels Separate trouble alarm signals and indicators for each system.

1. Standards: Comply with HTM 2 01 and CE Marking.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in HTM 06 01, by a qualified testing agency, and marked for intended location and application.
3. Include alarm signals when the following conditions exist:

a. Medical Air: Pressure drops below [**40 psig (275 kPa)**] or rises above [**60 psig (415 kPa)**] backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig (13.8 kPa), dew point rises above 39 deg F (4 deg C) at 55 psig (380 kPa), carbon-monoxide level rises above 10 ppm, and high water level is reached in receiver for liquid-ring, medical air compressor systems.
b. Medical Vacuum: Vacuum drops below [**12 in. Hg (305 mm Hg)**] and backup vacuum pump is in operation.
c. WAGD: Vacuum drops below [**12 in. Hg (305 mm Hg)**].
d. Medical Nitrous Oxide: Liquid level is low, pressure downstream from main shutoff valve drops below [**40 psig (275 kPa)**] or rises above [**60 psig (415 kPa)**] changeover is made to reserve, reserve is in use, and reserve level is low.
e. Medical Nitrous Oxide: Pressure drops below [**40 psig (275 kPa)**] or rises above [**60 psig (415 kPa)**] and changeover is made to alternate bank.

f. Medical Oxygen: Liquid level is low, pressure downstream from main shutoff valve drops below [**40 psig (275 kPa)**] or rises above [**60 psig (415 kPa)]** changeover is made to reserve, reserve is in use, reserve level is low, and reserve pressure is low.
g. Medical Oxygen: Pressure downstream from main shutoff valve drops below [**40 psig (275 kPa)**] or rises above [**60 psig (415 kPa)**] and changeover is made to alternate bank.

2.5 ANESTHETIZING-AREA ALARM PANELS

A. Anesthetizing-Area Alarm Panels: Separate trouble alarm signals and indicators for each system.

1. Standards: Comply with HTM 02 01and CE marking.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in HTM 06 01, by a qualified testing agency, and marked for intended location and application.
3. Include alarm signals when the following conditions exist:

a. Medical Air: Pressure drops below [**40 psig (275 kPa)**] or rises above [**60 psig (415 kPa)**]
b. Medical Vacuum: Vacuum drops below [**12 in. Hg (305 mm Hg)**]
c. WAGD: Vacuum drops below [**12 in. Hg (305 mm Hg)**]
d. Medical Nitrous Oxide: Pressure drops below [**40 psig (275 kPa)**] <**Insert value**> or rises above [**60 psig (415 kPa)**]
e. Medical Oxygen: Pressure drops below [**40 psig (275 kPa)**] <**Insert value**> or rises above [**60 psig (415 kPa)**]

2.6 AREA ALARM PANELS

A. Area Alarm Panels Separate trouble alarm signals and indicators for each system.

1. Standards: Comply with HTM 02 01 and CE marking.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Include alarm signals when the following condition exists:

a. Medical Air: Pressure drops below [**40 psig (275 kPa)**] or rises above [**60 psig (415 kPa)**]
b. Medical Vacuum: Vacuum drops below [**12 in. Hg (305 mm Hg)**].
c. Medical Oxygen: Pressure drops below [**40 psig (275 kPa)**] or rises above [**60 psig (415 kPa)**].

2.7 LOCAL ALARM PANELS

A. Local Alarm Panels Separate trouble alarm signals and indicators for each system.

1. Standards: Comply with HTM 02 01and CE marking.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Include alarm signals when the following conditions exist:

a. Medical Air: Pressure drops below [40 psig (275 kPa)] or rises above [60 psig (415 kPa)] backup air compressor is in operation, pressure drop across filter assembly increases more than 2 psig (13.8 kPa), dew point rises above 39 deg F (3.9 deg C) at 55 psig (380 kPa), carbon-monoxide level rises above 10 ppm, and the following:

1) Oil-Free and Oilless Air Compressor: High discharge-air temperature and high-water level in receiver.
2) Liquid-Ring Air Compressor: High water level in receiver and high-water level in separator.

b. Medical Vacuum: Vacuum drops below [**12 in. Hg (305 mm Hg)**], backup vacuum producer is in operation, and high-water level is in receiver.
c. WAGD: Vacuum drops below [**12 in. Hg (305 mm Hg)**], backup vacuum producer is in operation, and high-water level is in receiver.

2.8 COMPUTER-INTERFACE CABINET

A. Description:

1. Wall-mounted, welded-steel, control cabinet with gasketed door.
2. Mounting brackets.
3. Grounding device.
4. White-enamel finish.
5. Factory-installed signal circuit boards.
6. Power transformer.
7. Circuit breaker.
8. Wiring terminal board, and internal wiring capable of interfacing 20 alarm signals

PART 3 - EXECUTION

3.1 ALARM-PANEL INSTALLATION

A. Install alarm panels in locations required by and according to HTM 02 01.
B. Install computer-interface cabinet with connection to alarm panels and facility computer.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 226113 "Compressed-Air Piping for Laboratory and Healthcare Facilities," Section 226213 "Vacuum Piping for Laboratory and Healthcare Facilities," and Section 226313 "Gas Piping for Laboratory and Healthcare Facilities." Drawings indicate general arrangement of piping, fittings, and specialties.
B. Where installing piping adjacent to alarm panels, allow space for service and maintenance.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment" and according to HTM 02 01.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning panels and equipment.

D. Alarm panels will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup check according to manufacturer's written instructions.

3.6 ADJUSTING

A. Adjust initial alarm panel pressure and vacuum set points.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain alarm panels and computer-interface cabinet. Refer to Division 1 requirements.

End of Section 22 64 00

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SECTION 230500 – COMMON WORK RESULTS FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Section 220500 "Common Work Results for Plumbing" applies to the work of Division 23 for accuracy of data and contract drawings, definitions, design conditions, submittals, quality assurance, coordination, delivery, storage and handling, record documents, operation and maintenance manuals, cutting and patching, and painting and identification, except as modified herein.

1.2 SUMMARY

A. This Section includes general requirements for HVAC work, comprising the following:
1. Ductwork, duct insulation and sound liner, dampers, air outlets and filters.
2. Non-magnetic flexible ducts.
3. Split-system air-conditioning units with refrigerant copper piping and condensate drains.
4. Toilet extract fans and fresh-air and exhaust fans.
5. Testing, adjusting and balancing.

B. The work includes the HVAC services of the PET-CT unit at Tebnine Governmental Hospital and any other HVAC work indicated on the drawings and in the Bill of Quantities.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, including rated capacities, operating characteristics, sound data, electrical characteristics and furnished specialties and accessories.

B. Shop Drawings: Coordinated drawings of ductwork, equipment and refrigerant piping, showing sizes, routes, levels, supports, access points and coordination with structure, ceilings, lighting and other services.

C. Coordination with Radiation Shielding: Details of every duct and pipe penetration through the lead shielding of the PET-CT unit, prepared in coordination with Section 13 49 00 "Radiation Protection".

D. Operation and Maintenance Data and Record Drawings: As specified in Section 220500.

1.4 QUALITY ASSURANCE

A. Comply with ASHRAE 62.1, ASHRAE 170 "Ventilation of Health Care Facilities", SMACNA "HVAC Duct Construction Standards – Metal and Flexible", and NFPA 90A.

B. Electrical Components: Listed and labeled as defined in NFPA 70 or IEC equivalent.

C. Installer: Company specializing in HVAC installations in healthcare facilities with minimum five years documented experience.

1.5 PROJECT CONDITIONS

A. Works in Occupied Hospital: Coordinate shutdowns of existing systems with the hospital administration; give minimum seven days notice; maintain ventilation of clinical areas adjoining the works.

B. Infection Control: Seal open ends of ducts and equipment during construction; do not operate air-handling systems during dusty work without temporary filters.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Any internationally recognized manufacturer having an official technical agreement to conformity with standards specified in this Division, subject to the approval of the Engineer.

B. Materials and equipment shall be new, of current manufacture, and supported by a local service organization.

2.2 SUPPORTS AND ANCHORS

A. Hangers, rods, channels and anchors: Hot-dip galvanized steel, sized for the loads supported, in accordance with SMACNA.

B. Vibration Isolation: Neoprene or spring isolators for fans and air-conditioning units as recommended by equipment manufacturer.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install equipment, ductwork and piping in accordance with manufacturers' instructions, approved shop drawings and the requirements of this Division.

B. Provide access panels in ceilings for dampers, filters, fans and equipment requiring maintenance.

C. Penetrations: Seal penetrations through walls and slabs; at fire-rated construction provide fire dampers and firestopping as specified; at the lead shielding of the PET-CT unit provide lead sleeves, baffles or offsets to maintain shielding continuity as specified in Section 13 49 00.

D. Isolate dissimilar metals; protect equipment from damage until handover.

3.2 CLEANING AND HANDOVER

A. Clean ductwork and equipment internally before operation; replace temporary filters with permanent filters before handover.

B. Train hospital staff in operation and maintenance of the systems.

End of Section 23 05 00

SECTION 230593 – TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes testing, adjusting and balancing of air systems, fans and split-system air-conditioning units.

1.3 SUBMITTALS

A. TAB Procedures and Forms: Submit before commencing work.

B. TAB Report: Submit final report with measured and design values, instruments used and their calibration certificates.

1.4 QUALITY ASSURANCE

A. Perform TAB in accordance with AABC National Standards or NEBB Procedural Standards, by a qualified TAB agency or specialist approved by the Engineer.

PART 2 – PRODUCTS

2.1 INSTRUMENTS

A. Calibrated instruments with calibration certificates not older than twelve months.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that systems are complete and operable, filters are clean, dampers are open and ducts are sealed before testing.

3.2 TESTING AND BALANCING

A. Duct Leakage Tests: Test ductwork in accordance with SMACNA "HVAC Air Duct Leakage Test Manual" before insulation is applied and ceilings are closed.

B. Air Balancing: Adjust air quantities at fans, branch dampers and outlets to within plus or minus 10 percent of design values.

C. Room Pressure Relationships: Verify and record pressure relationships between rooms as indicated on drawings and as required by ASHRAE 170, including negative pressure of toilets and of rooms where radiopharmaceuticals are handled.

D. Air-Conditioning Units: Measure air flow, supply and return temperatures, refrigerant pressures, current and voltage; verify control functions.

E. Sound: Measure sound levels in occupied rooms and report against the design criteria.

End of Section 23 05 93

SECTION 230713 – DUCT INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes external thermal insulation of supply, return and fresh-air ductwork, and internal acoustic sound liner.

1.3 SUBMITTALS

A. Product Data: For each type of insulation, including thermal conductivity, density, thickness, facing, fire performance and installation instructions.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: Flame-spread index of 25 or less and smoke-developed index of 50 or less, tested to ASTM E84.

B. Insulation and liner materials shall be free of asbestos and shall not release fibers into the air stream.

PART 2 – PRODUCTS

2.1 INSULATION MATERIALS

A. External Duct Insulation: Glass-fiber blanket or board to ASTM C553 or ASTM C612, density minimum 24 kg/m3, with factory-applied reinforced aluminum foil vapor retarder (FSK), thickness 50 mm for concealed supply and fresh-air ducts unless otherwise indicated.

B. Sound Liner: Glass-fiber duct liner to ASTM C1071, 25 mm thick, with black acrylic or mat-faced air-stream surface resistant to erosion at air velocities up to 20 m/s, for the first 3 m of supply and return ducts from air-conditioning units and fans and where indicated.

C. Adhesives, Mastics and Tapes: As recommended by the insulation manufacturer, compatible with the insulation and low VOC.

D. Fasteners: Mechanical pins and speed washers.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install insulation on clean, dry ducts after leakage testing; seal all joints and penetrations of the vapor retarder with aluminum tape.

B. Secure external insulation with adhesive and mechanical pins on ducts wider than 600 mm.

C. Apply sound liner to the inside of ducts with full-coverage adhesive and mechanical fasteners; coat cut edges; install metal nosing on leading edges.

D. Protect insulation and liner so that no fibers enter occupied areas or the ventilation system.

End of Section 23 07 13

SECTION 233113 – METAL DUCTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes rectangular and round galvanized steel ducts and fittings for supply, return, fresh-air and exhaust systems.

1.3 PERFORMANCE REQUIREMENTS

A. Construct ducts to SMACNA "HVAC Duct Construction Standards – Metal and Flexible" for the following pressure classes:
   1. Supply Ducts: 500 Pa.
   2. Return, Exhaust and Fresh-Air Ducts: 250 Pa.

B. Leakage Class: SMACNA seal class A.

1.4 SUBMITTALS

A. Shop Drawings: Duct layout, sizes, fittings, reinforcement, supports, access doors and connections to equipment.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Galvanized Steel Sheet: ASTM A653, coating designation G90 (Z275), lock-forming quality.

B. Stainless Steel Sheet: ASTM A240, Type 304, for exhaust ducts from areas where radiopharmaceuticals are handled, where indicated.

C. Sealants: Water-based joint sealant, UL 181B listed, low VOC.

2.2 FABRICATION

A. Fabricate ducts with gauges, joints, seams and reinforcement in accordance with SMACNA for the pressure class indicated.

B. Elbows: Radius elbows with centerline radius 1.5 times duct width, or square elbows with turning vanes.

C. Branch Connections: 45-degree entry or bell-mouth fittings with volume dampers.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install ducts true to line and level, with minimum number of joints, and supported in accordance with SMACNA.

B. Seal all joints and seams to the specified seal class.

C. Provide access doors upstream of dampers and at filters and equipment.

D. Where ducts penetrate the lead shielding of the PET-CT unit, provide offset or lead-lined sleeves as detailed and as specified in Section 13 49 00; coordinate with the shielding installer before ducts are installed.

3.2 FIELD QUALITY CONTROL

A. Leakage Test: Test ductwork in accordance with Section 230593 before insulation; repair and retest until leakage is within the allowable limit.

End of Section 23 31 13

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes control and volume dampers, fire dampers, flexible connectors, flexible ducts including non-magnetic flexible ducts, and duct access doors.

1.3 SUBMITTALS

A. Product Data: For each type of product, including pressure drop, leakage and fire rating data.

PART 2 – PRODUCTS

2.1 VOLUME AND CONTROL DAMPERS

A. Manual Volume Dampers: Galvanized steel frame and opposed blades, with locking quadrant and position indicator.

B. Motorized Control Dampers: Low-leakage opposed-blade dampers with blade and jamb seals, leakage not exceeding 50 L/s per m2 at 1 kPa, with electric actuator suitable for the control sequence indicated.

C. Backdraft Dampers: Gravity type, aluminum blades, for exhaust fan discharges.

2.2 FIRE DAMPERS

A. Fire Dampers: UL 555 listed, curtain type, rated for the fire rating of the wall or slab penetrated, with fusible link rated 74 °C.

2.3 FLEXIBLE DUCTS

A. Insulated Flexible Ducts: UL 181 Class 1, factory-fabricated, with inner liner, glass-fiber insulation and vapor-barrier jacket, maximum length 1.5 m, for connection of air outlets.

B. Non-Magnetic Flexible Ducts: Aluminum-free and steel-free construction of non-magnetic, non-ferrous materials (polyester or PVC-coated glass-fabric with polymer helix), UL 181 Class 1 or equivalent fire classification, insulated where serving supply air, for use in the PET-CT unit and where indicated.

2.4 ACCESSORIES

A. Flexible Connectors: Fire-resistant neoprene-coated glass fabric, for connection of fans and air-conditioning units to ducts.

B. Duct Access Doors: Double-wall, insulated, gasketed, with cam latches.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install dampers and accessories in accordance with manufacturer's instructions and SMACNA; provide access to every damper.

B. Install flexible ducts fully extended without sags or kinks, supported at maximum 1.2 m centers, secured with clamps and sealed.

C. Install fire dampers in sleeves with retaining angles, to the listing.

3.2 FIELD QUALITY CONTROL

A. Operate each damper to verify full range of movement; test fire dampers by removing fusible link.

End of Section 23 33 00

SECTION 233423 – HVAC POWER VENTILATORS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes toilet extract fans, in-line duct fans, and fresh-air and exhaust fans.

1.3 SUBMITTALS

A. Product Data: Fan curves, air flow, static pressure, sound power levels, motor data and accessories.

1.4 QUALITY ASSURANCE

A. Fan performance rated in accordance with AMCA 210 and sound in accordance with AMCA 300 or equivalent.

PART 2 – PRODUCTS

2.1 FANS

A. Toilet Extract Fans: Ceiling or wall mounted, centrifugal or mixed-flow, with integral backdraft damper, low-noise, capacity as indicated.

B. In-Line Duct Fans: Mixed-flow or centrifugal in-line fans with galvanized or plastic casing, EC or AC motor with speed controller.

C. Fresh-Air and Exhaust Fans: Centrifugal cabinet or in-line fans with acoustically lined casing, access panel, motor and drive on vibration isolators; filters on fresh-air fans as specified in Section 234100.

D. Motors: Totally enclosed, IP 54 minimum, efficiency class IE3 or EC motors, with thermal protection.

2.2 ACCESSORIES

A. Backdraft dampers, flexible connectors, wall cowls with insect screen, isolator switches adjacent to each fan.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install fans level and plumb on vibration isolators; connect to ducts with flexible connectors.

B. Interlock exhaust and fresh-air fans as indicated so that the required pressure relationships are maintained.

3.2 FIELD QUALITY CONTROL

A. Check rotation, measure air flow and current; adjust in accordance with Section 230593.

End of Section 23 34 23

SECTION 233713 – DIFFUSERS, REGISTERS AND GRILLES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes ceiling diffusers, supply and return registers and grilles, and exhaust valves.

1.3 SUBMITTALS

A. Product Data: Air flow, throw, pressure drop and noise criteria for each type and size.

PART 2 – PRODUCTS

2.1 AIR OUTLETS AND INLETS

A. Ceiling Diffusers: Square or round, multi-cone or swirl type, extruded aluminum, with opposed-blade volume damper and plenum box where indicated.

B. Supply Registers: Double-deflection, aluminum, with opposed-blade damper.

C. Return and Exhaust Grilles: Fixed 45-degree blades or egg-crate, aluminum, with damper where indicated.

D. Exhaust Valves: Round, adjustable, plastic or steel, for toilets.

E. Finish: Polyester powder coating, white or as selected; surfaces suitable for cleaning with hospital disinfectants.

F. Noise Criteria: NC 35 maximum in patient and treatment rooms at design air flow.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install outlets and inlets in coordination with ceiling grid and lighting layout; seal to ceiling.

B. Adjust deflection and dampers in accordance with Section 230593.

End of Section 23 37 13

SECTION 234100 – PARTICULATE AIR FILTRATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes panel and bag filters for fresh-air and supply-air systems.

1.3 SUBMITTALS

A. Product Data: Filter efficiency, initial and final pressure drop, dimensions and frame material.

1.4 EXTRA MATERIALS

A. Furnish one complete set of spare filters for each filter bank.

PART 2 – PRODUCTS

2.1 FILTERS

A. Pre-Filters: Pleated panel filters, ISO 16890 ePM10 50 percent (MERV 8) minimum, 50 mm deep.

B. Final Filters: Bag or rigid filters, ISO 16890 ePM1 55 percent (MERV 13) minimum, for supply air to treatment and clinical rooms, or as required by ASHRAE 170 for the space served.

C. Filter Housings: Galvanized steel, gasketed, with access doors and differential pressure gauge across each filter bank.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install filters with airtight seal between filter and frame; do not operate systems without filters.

B. Replace construction filters with clean filters before testing, adjusting and balancing and before handover.

End of Section 23 41 00

SECTION 238126 – SPLIT-SYSTEM AIR-CONDITIONERS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes split-system and ducted split air-conditioning units with outdoor condensing units, refrigerant copper piping, controls and condensate drain piping.

1.3 SUBMITTALS

A. Product Data: Cooling and heating capacities at the design conditions in Section 220500, power input, efficiency, sound levels, refrigerant, dimensions and weights.

B. Shop Drawings: Refrigerant piping layout and sizes, condensate drain routes and outdoor unit locations and supports.

1.4 QUALITY ASSURANCE

A. Capacities rated in accordance with AHRI 210/240 or EN 14511; refrigerant installation by technicians certified for handling refrigerants.

1.5 WARRANTY

A. Compressor warranty of five years and unit warranty of two years from Substantial Completion.

PART 2 – PRODUCTS

2.1 UNITS

A. Indoor Units: Ducted, ceiling cassette or wall-mounted type as indicated, with washable filters, condensate pump where gravity drain is not possible, and wired wall controller.

B. Outdoor Units: Air-cooled, inverter-driven scroll or rotary compressor, refrigerant R-410A or R-32, coated condenser coil suitable for the site conditions, weatherproof casing.

C. Electrical: Single or three phase as indicated, with isolating switch at each unit.

2.2 REFRIGERANT PIPING

A. Copper Tube: ASTM B280, seamless, deoxidized, cleaned and capped, ACR type; sizes as recommended by the unit manufacturer.

B. Fittings and Joints: Wrought copper fittings, brazed with silver alloy under nitrogen purge; flare joints only at unit connections.

C. Insulation: Closed-cell elastomeric insulation, minimum 13 mm thick on liquid lines and 19 mm on suction lines, UV-protected where exposed outdoors.

2.3 CONDENSATE DRAIN PIPING

A. uPVC pipe ASTM D2665 or PPR pipe, minimum 32 mm diameter, with trap at each unit and insulation where condensation may form, discharging to the drainage system through an air break as specified in Division 22.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install units level on supports or brackets with vibration isolators; provide clearances for maintenance.

B. Install refrigerant piping with minimum joints, slope suction lines toward compressor, support at maximum 1.5 m centers.

C. Pressure test refrigerant piping with dry nitrogen at the pressure recommended by the manufacturer for 24 hours; evacuate to 500 microns and charge with refrigerant.

D. Slope condensate drains at minimum 1 percent; test for free drainage.

E. Where refrigerant or condensate pipes penetrate the lead shielding of the PET-CT unit, provide lead sleeves or offsets as specified in Section 13 49 00.

3.2 FIELD QUALITY CONTROL

A. Start up units by manufacturer's representative; record operating data; demonstrate controls and train hospital staff.

End of Section 23 81 26

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SECTION 260000 – BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Divisions 07, 21, 23, 25, 26, 27 & 28.

1.2 SCOPE OF WORK

1.2.1 The scope of electrical work for the project will include but is not necessarily limited to:

A. Power Supply and Distribution consisting of:
1. Motor control center
2. Distribution, sub-distribution and final branch circuit panel boards,
3. Cables, wires and related accessories,
4. Conduits, wireways, supporting systems and related accessories,

B. Lighting and Power Installations including:
1. Functional indoor and outdoor lighting installations,
2. Electrification for the indoor and outdoor lighting installations,
3. Lighting control such as normal switches and lighting control system,
4. Wiring devices including all lighting switches, isolating switches, socket - outlets, plates,
5. Emergency Lighting System.

C. Life safety and low current systems consisting of:
1. Fire detection and alarm system (related to firefighting apparatus or building fire alarm)
2. Building Management Systems

1.2.2 Unless otherwise specified, includes the supply, installation, testing and commissioning of the complete electrical systems, equipment and materials shown on the Drawings and/or described in the Specification together with all associated ancillary work, support work and builder's work in connection.

1.2.3 Incoming power supply and connection will be provided by the building infrastructure for utility power and secondary generator supply. Electrical power shall be @ 220/380 Volts, 50 Hz (all equipment shall be able to operate continuously at full load under 230/400 V) to the location shown on the Drawings.

1.2.4 All mechanical vibration and noise isolation issues to be coordinated and approved by the acoustic consultant.

1.3 GENERAL REQUIREMENTS

1.3.1 INSTALLATIONS GENERALLY

A. Carry out electrical work in accordance with the Drawings, Specification and Regulations, ensuring compliance with design and performance requirements, to provide safe and protected systems with equipment readily accessible for operation, maintenance and repair.

B. Installations are to be complete, ready for operation and fully integrated and coordinated with all other work.

C. Installations are to be carried out by qualified personnel.

D. Provide accessories necessary to complete the installations, of the types specified or recommended for the purpose by the manufacturer of the equipment or accessories.

E. Any device, components or equipment to be installed in the floor area especially when critical case is important such operation rooms, ICU and CSSD area shall be specified with anti-bacterial resistant item.

1.3.2 EQUIPMENT SPACES AND ROOMS: check that dimensions, structure, ventilating and cooling arrangements and other provisions in equipment spaces and rooms are suitable for installation, operation and maintenance of proposed equipment. Note any discrepancies on the shop and construction drawings. The Contractor is responsible of planning the erection of the electrical equipment such that it is not interfering with any other trade in the building.

1.3.3 POWER SUPPLY: liaise with the building electrical installation engineer to confirm:

1. Characteristics of supply and system earthing
2. Location of incoming supply shown on the Drawings
3. Space requirements and associated builder's work for the Authority's installations.
4. Make necessary arrangements at the earliest opportunity to ensure connection as and when required, and inform the Engineer in the event of any foreseen delay.

1.3.4 KWH-METERING: Provide kWh metering and other electrical parameters and speci- fied and indicated on drawings.

1.3.5 Systems used before substantial completion for the benefit of the Contractor are to have all consumable elements, such as lamps etc. and defective equipment replaced by new, within 7 days prior to the date of substantial completion

1.4 DESIGN CONDITIONS

A. Nominal characteristics of power supply and distribution are as follows:

1. Low voltage : 380 V, 3 phase, 4 wire, solidly earthed neutral
2. Frequency : 50 Hz,
3. Earthing System : TN-S (solidly grounded neutral with separate grounding conductor)

B. DISTRIBUTION SYSTEMS are to be supplied or derived from the voltage system previously described, as shown on the Drawings, or as otherwise specified.

C. EQUIPMENT is to be designed for the system voltage and frequency previously described, unless otherwise specified. Special provisions are to be made for equipment sensitive to power supply frequency and voltage variations and for equipment operated at other voltages/frequencies or by direct current sources.

D. KWH-METERING: metering to as shown on the Drawings.

E. CLIMATIC CONDITIONS: equipment, including transformers, switchgear, cables, relays, lighting fixtures, motors etc., is to be designed and de-rated for continuous and trouble free service under the following climatic conditions:
1. Altitude: at sea level
2. Maximum ambient temperature: 37 C (in the shade)
3. Minimum ambient temperature: 5 C
4. Maximum relative humidity: 90 %
5. Atmospheric conditions: 1 bar

F. Where design and operating conditions, different from the above are required for particular equipment, they are described in the specification of the equipment concerned.

G. REGULATIONS: carry out electrical work in accordance with the current issue of the NFPA standards (for life safety) and IEC Regulations for Electrical Installations, where not in contradiction with the local codes of practice and regulations, herein referred to collectively as 'the Regulations'.

H. CONFLICT should an instance occur in this specification or on the drawings in which material or construction methods called for are less than minimum requirement of the Regulations, the Engineer shall be immediately informed in writing. Consequent to Engineers approval, supply the materials and perform the work as through called for to minimum code standards.

I. STANDARDS: unless otherwise specified, equipment and materials are to be manufactured and installed in compliance with the relevant recommendations of the following:

1.	IEC	:	The International Electro-technical Commission
2.	ISO	:	The International Standardization Organization
3.	BS	:	The British regulation
4.	NFPA	:	National Fire Protection Association
5.	EN	:	European Norm
6.	NF-USE	:	The French Regulation
7.	CCITT	:	The International Telephone & Telegraph Consultative Committee
8.	CCIR	:	The International Radio Consultative Committee
9.	CISPR	:	The International Special Committee on Radio Interference
10.	EIA/TIA	:	Electronics Industries association / Telecommunications Industries Associations.
11.	IEEE	:	Institute of Electrical and Electronics Engineers, Inc.
12.	UTI	:	Uptime Institute

Or other equal and approved standards, herein referred to as 'the Standards'. Local standards, where enforced and relevant, are to have precedence over the Standards.

1.5 THE DRAWINGS

A. EQUIPMENT LOCATIONS shown on the Drawings indicate the approximate locations and general layout of equipment. Exact and final locations and layouts together with dimensions, weights, mounting methods and accessories, where relevant are to be shown on the shop and construction drawings. All protecting device shall show: the short circuit current value for single and three phase current, the

voltage drop, the indirect protection function in case of a fault with respect the earthing system.

B. WIRING LAYOUTS shown on the Drawings are to be used as a guide only to defining basic positions, circuiting, loading and switching arrangements. Actual layouts and details of routing of circuits are to be shown on the shop and construction drawings.

C. WIRING LAYOUTS shown on the Drawings for work not included in the Electrical Work are shown for convenience and reference only.

D. SYMBOLS: in order to provide sufficient detail and a minimum degree of clarity on the drawings, the symbols used for the various electrical devices, particularly wall mounted devices, take up more space on the drawings than the device does on the wall. Because of drafting limitations these locations must be considered as being symbolic rather than exact physical locations of the devices.

E. The devices shall be installed with prime regard for convenience of operation and the best usage of the wall space for this and other purposes rather than string the devices out along the wall so as to coincide with the scaled locations of the symbols. In locating the outlets, follow the criteria provided on detail drawings where provided, and co-ordinate with furniture. Submittal of detail drawings is required for this purpose before execution. Do not scale from design drawings.

1.6 EQUIPMENT AND MATERIALS

A. AVAILABILITY: confirm availability of equipment and materials proposed for use in the work prior to submission for approval. If, after approval, equipment or materials cease to be available, submit alternative items of equal quality and type for approval.

B. ACCEPTANCE BY AUTHORITY: confirm that proposed equipment and material characteristics where required are compatible with the requirements of the Local Power Authority or other authorities having jurisdiction and are acceptable to them. Inform the Engineer of any modifications necessary to comply with the specifications.

C. MANUFACTURERS' STANDARDS: equipment is to be the latest standard product of the manufacturer. Component parts are to be the product of a single manufacturer, unless otherwise approved and provided that components made by other manufacturers are of a standard design and are interchangeable.

D. APPROVED MANUFACTURERS (Only western European, Japanese and North American are approved): listing of approved manufacturers does not necessarily constitute approval of their standard products as equal to those specified. As certain that listed manufacturers are able to supply equipment and material in conformity with the Specification.

E. FACTORY ASSEMBLY: equipment generally is to be supplied in complete factory assembled units ready for installation on site. Disassembly necessary for transportation or other purposes is to be arranged to limit site work to simple re-assembly and inter-wiring of control and power cabling.

F. STORAGE OF MATERIALS: equipment and materials are to be stored in an approved location, under cover, free from humidity, dust, debris and rodents. Equipment sensitive to heat and humidity is to be kept in climatically conditioned areas until installed and handed over.

G. DEFECTIVE EQUIPMENT: the Employer reserves the right to operate operable defective equipment during the Defects Liability Period until it can be removed from service for repair or replacement.

H. WARRANTY: where required by the Specification, provide a warranty, signed by the manufacturer (including his agreement to replace promptly, defective equipment or parts thereof, as instructed by the Engineer) covering materials and workmanship for the period stated in the Specification, starting at substantial completion. The Contractor is to assign the benefits of such warranty to the Employer.

I. SPARE PARTS: not later than the date of substantial completion, provide spare parts required by the Specification, together with suitable means of identifying, storing and securing same.

J. TOOLS AND INSTRUMENTS: not later than the date of substantial completion, provide sets of tools and instruments required by the Specification, together with suitable means of identifying, storing and securing same.

K. LABEL AND IDENTIFY all equipment, instruments, controls and electrical devices etc. to indicate duty service or function, to the satisfaction of the Engineer. Labels are to be anodized aluminum discs with black surface and white core with incised lettering in English or Arabic to the satisfaction of the Engineer. Alternative methods of labeling may be submitted for approval. Fix labels with non-corrodible screws to equipment, or to adjacent permanent surfaces or as approved by the Engineer.

L. EQUIPMENT NAMEPLATES are to be non-corroding, robust metal, inscribed in English, and firmly fixed to equipment at factory. Nameplates are to indicate name and address of manufacturer, model, serial number, basic characteristics and ratings of equipment and are to include elementary diagrams etc., all in accordance with the Standards.

M. FIREPROOFING: Where cables, cable trays or conduits pass through floors, raised (access) floors and fire rated walls, pack space between wiring and sleeve full with materials and seal with approved caulking compound.

1.7 SUBMITTALS

A. Approval of submittal: Approval of a submittal does not relieve the contractor from the specifications and contractual obligations. Each submittal should show a schedule of compliance sheet, addressing each point mentioned in the specifications and/or in the BOQ, these points should be numbered and each number should be highlighted with the relative number on the original certified catalogue. Any deviation or omission from the specifications shall be clearly stated in a compliance sheet.

B. Coordination: Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay, and allow for 2-week time for review.

C. Submit all required data in 4 copies minimum.

D. Submittal Preparation: Place a permanent label or title block on each submittal (including shop drawing) for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Include the following information on the label for processing and recording action taken:
   a. Project name.
   b. Date.
   c. Reference number for the submittal with revision number if the same submittal has been submitted before.
   d. Name and address of the Architect.
   e. Name and address of the Contractor.
   f. Name and address of the subcontractor.
   g. Name and address of the supplier.
   h. Name of the manufacturer.
   i. Number and title of appropriate Specification Section.
   j. Drawing number and detail references, as appropriate.

E. Product Data: Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
   a. Manufacturer's printed recommendations.
   b. Type of usage and location.
   c. Reference number in contract documents (Specifications, drawings)
   d. Compliance with recognized testing agency standards.
   e. Application of testing agency labels and seals.
   f. Notation of dimensions verified by field measurement.
   g. Notation of coordination requirements.

2. Provide complete original catalogues of product when relevant or when requested.

3. Include Installation and Operation manual with each applicable submittal.

F. SAMPLES: Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

G. Operation and Maintenance Manuals: Include Operation and Maintenance manual for each equipment. Identify each equipment and include the local supplier’s name and full address, the manufacturer’s manual, in addition to recommended spare parts.

H. Organize the Operation and Maintenance Manuals by system and sub-system. Describe for the whole system and each sub-system separately, the proper normal

operation, shut down, access, routine preventive maintenance and describe intervention needed in case of failure.

1.8 SHOP DRAWINGS

A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project will be rejected.

B. Submit Builder's Work drawings showing Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.

C. Shop drawings shall be prepared electronically editable on Autocad similar to the edition of the original drawing and not less than 2019 Edition. Layers, sizes and all other drawing requirements shall be followed as per instructions of the Architect/Engineer. These shall be made and presented to suit for the elaboration of *3D* composite drawings.

D. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include information as required by individual sections, in addition to the following information:
   a. Dimensions, distances, invert levels, operating clearances, location of access required.
   b. Identification of products and materials included by sheet and detail number.
   c. Accessories, connections to other services, electrical connections, etc.
   d. Notation of coordination requirements.
   e. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit general layouts on 1/50 scale, and details on 1/20.
   f. Submittal: Submit 4 blue- or black-line prints for the Architect's/Engineer review. The Architect/Engineer will return one print.
   g. Do not use Shop Drawings without an appropriate final stamp indicating action taken.
   h. Submit electronic copy after approval of drawing.

E. Shop drawings are to be checked thoroughly and coordinated to avoid interference with structural elements, finishing requirements and the work of other trades.

F. Shop drawings and redesign shall be prepared electronically editable on Autocad similar to the edition of the original drawing and not less than 2019 edition. Layers, sizes and all other drawing requirements shall be followed as per instructions of the Architect/Engineer. These shall be made and presented to suit for the elaboration of *3D* composite drawings. Shop drawings and redesign should be done even if changes on Architectural drawings are important and even if redesign of some parts of the areas is requested.

G. Submit Final Electrical calculation for Discrimination, Definition and settings of circuit breaker and other detailed calculations required.

1.9 COORDINATED COMPOSITE DRAWINGS

A. Participate in site meetings to coordinate shop drawings between all construction trades.

B. Submit coordinated composite drawings showing interference of all trades on one sheet, including composite sections and elevations.

C. Submit Composite drawings showing reflected ceiling plans to coordinate and integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers, drainage pipes, water supply and other ceiling-mounted items

1.10 AS BUILT DRAWINGS

A. As-Built Drawings: On completion of the works of each area, system or floor, submit four sets of prints of each applicable drawing for the electrical systems installation, showing the exact position of all apparatus, plant, duct and pipe work runs, valve positions, grille and diffuser locations, etc. with all appropriate labeling to the Architect/Engineer's requirements. As-built drawings shall be updated on each works milestone (first fix, second fix, etc.) and submitted for review. All as-built drawings must conform in all respects to the pattern of the Contract Drawings, and to the approval of the Architect/Engineer.

B. As-Built drawings shall be submitted directly after approval of the installation, and prior to testing and commissioning. A draft copy shall be submitted before closing shafts, ceiling or any obstructing element.

C. The words "As Built Drawing" shall be clearly indicated on all drawings adjacent to the title cover. As-built drawings will be subject to Architect/Engineer approval. Contractor to submit hard copies and also soft copies of all as built drawings on read-only USB memory devices to the Architect/ Engineer after the approval of the as built drawings.

1.11 OPERATION AND MAINTENANCE MANUAL

A. Before Final Handing over submit a draft copy of a complete Operation and Maintenance manual that include:
   1. A documentation Directory
   2. Emergency information
   3. Operating manual
   4. Maintenance Manual
   5. Test reports
   6. As built drawings

B. Documentation directory: Submit an index of all O&M documents in a well-organized manner identified to ease the access of information and reflecting the hierarchy of the project: System, sub-system, Equipment, component.

C. Emergency information: a document that should be readily available for emergency situation that include, for each system, information needed for type of emergency, with the notification activity and the responsibility of the personnel.

D. Operating manual: A document that contains all information needed for day-to-day operation and management of the building systems. Two parts required: one intended for the building manager focused on the systems and one for the building operators focused on the technical information of the equipment, with the normal operation, access and shut down of equipment.

E. Maintenance Manual: In addition to manufacturer supplied maintenance manuals, provide for each equipment:
1. Description of equipment
2. Recommended maintenance procedures and their frequency.
3. Recommended list of spare parts with their number and reference.
4. Original purchase order number, supplier’s name, address and phone number.
5. Intervention needed in case of failure and Installation information.

F. Testing reports: Include test results from the testing and commissioning process.

G. Construction documents include AS-built drawings, specifications, approved submittals, schedule of equipment, warranty certificates,

1.12 GENERAL SUBMISSIONS

A. GENERALLY: submit for approval, manufacturers' technical literature, shop and construction drawings and other information required by the Specification, before ordering equipment or materials and before executing any related work on site.

B. TECHNICAL LITERATURE is to include detailed manufacturers' specifications and original catalogues or catalogue cuts, characteristics, model number, application and operating criteria of all equipment and materials, together with other information necessary to satisfy the Engineer that proposed equipment and systems are suitable and adequate.

C. LIST OF PROPOSED MANUFACTURERS of all equipment and materials, including all items for which choice of manufacturer is at the discretion of the Contractor, is to be submitted for approval.

D. TEST CERTIFICATES AND REPORTS: where required by the Specification, submit manufacturer's type and routine test certificates and reports for equipment and devices. Complete test results are to be submitted in clearly identified and organized booklets, indicating item of equipment, make, model, type, date of tests, type of tests, descriptions and procedures.

E. LABORATORY TESTS: if manufacturer's test certificates are considered unsatisfactory, then independent laboratory tests are to be carried out on equipment in accordance with the Specification and the Standards, as required by the Engineer.

F. SPARE PARTS SCHEDULES: submit with the Tender itemized schedules of spare parts to be provided, as required by the Specification, and state against each item the manufacturer's unit price including packaging and delivery to site.

G. TOOLS AND INSTRUMENTS SCHEDULES: submit with the Tender itemized schedules of tools and instruments to be provided, as required by the Specification, and state against each item the manufacturer's unit price including packaging and delivery to site.

H. LABELLING SCHEDULE: submit for approval, prior to installation, a schedule of all equipment and devices to be labeled and the suggested details, lettering, position and fixing methods of each label indicating its application.

I. SAMPLES: submit samples of all equipment and materials for approval. Major items of equipment for which samples cannot be submitted are to be demonstrated in existing installations or by manufacturer's information, test certificates and reports.

PART 2 - SPECIAL REQUIREMENTS FOR ELECTRONIC EQUIPMENT

2.1 REQUIREMENTS

A. CONSTRUCTION: electronic components of communication systems, security systems and special systems and electronic components forming part of the power generation and distribution system are to be solid-state integrated construction, unless otherwise approved.

B. TEMPERATURE LIMITS: manufacturer is to indicate maximum and minimum ambient temperatures acceptable for the equipment to operate continuously and normally and beyond which electronic components may suffer permanent damage.

C. ALTERNATIVE ELECTRONIC EQUIPMENT may be submitted for approval, provided such equipment meets or exceeds the functional capabilities and/or performance parameters of the equipment specified. Proposals for alternative equipment will be considered only if accompanied by the following information:
1. List of operational characteristics and performance parameters.
2. List of differences in operation and performance between proposed and specified equipment.
3. List of changes required and resulting implications.
4. Drawings indicating changes required to system wiring.
5. Statement of advantages of proposed equipment over that specified.

D. PROTECTION: solid state equipment under normal conditions of operation is to withstand any surges which might be produced by sudden mains or standby power switching operations. Protective devices are to be provided to protect against surges, failure of output stages due to open circuit, short-circuit or impedance mis-match. In the absence of IEC or BS standards comply with IEEE standard 472 (ANSI/IEEE C37.90 "Guide for Surge Withstand Capability Tests". System/equipment which may be adversely affected by short duration power blackouts shall be capable of riding through such a disturbance by having an internal battery back-up to the memory / microprocessor, etc.

E. INDICATOR LIGHTS shall be Light Emitting Diodes (LEDs).

F. ELECTROMAGNETIC RELAYS and control/small power transformers are to be designed to withstand the 500 V a.c. test voltage between winding and winding or winding and core.

G. DUST COVERS, easily removable for inspection and servicing, are to be provided for all relays and sensitive elements.

H. OUTDOOR EQUIPMENT, electronic or other, is to be designed for maximum ambient temperature or direct sun and is to be protected/enclosed, as applicable, against dust and weather conditions.

I. EXTERNAL INTERFERENCE: carry out field investigations and tests to determine possible interference from outside sources. Design electronic equipment to ensure trouble-free operation.

J. SEGREGATION OF WIRING: design wiring so that low current circuits are segregated from power wiring, using different conduits and wireways for the purpose. Composite wiring is acceptable for the same system in accordance with the relevant codes. Cable insulation is to be same grade for all conductors in a common enclosure.

K. POWER SUPPLY UNITS for low current systems which are fed from the LV supply are to be independently fused on the live conductor and are to have front panel mains indicator light, on/off switch and standard cartridge type fuse holder. Blown fuse indicator lamp is to be provided when fuse does not have an indicator.

PART 3 - TESTS ON SITE, RECORDS, TRAINING AND MAINTENANCE

3.1 TESTS ON SITE

A. GENERALLY: carry out inspection and acceptance tests on site on each complete system, before final placement into service, in accordance with the Regulations and Standards, as described in the Specification and required by the Engineer.

B. TEST SCHEDULES AND PROCEDURES are to be submitted for approval and are to include details of testing equipment to be provided.

C. WITNESSING: inspection and acceptance tests are to be carried out in the presence of the Engineer and, when required, by an authorized representative of the Local Power Authority.

D. VISUAL INSPECTION: visually check proper installation, connections and nameplate data before testing.

E. INSULATION RESISTANCE: test the feeders and busducts, lighting and power circuits, motors and other power equipment of low voltage installations with a megger of not less than 500 V D.C for installations rated up to 500 V (R.M.S value of A.C supply) and 1000 V D.C for installations rated above 500 V up to 1000 V, and as required by the particular Section of the Specification.

F. INSULATION RESISTANCE: unless otherwise specified or approved, test the circuit insulation resistance related to communications and security systems with a megger of not less than 500 V operating voltage, with equipment disconnected.

G. CONTINUITY: test all feeders and circuits for continuity.

H. OPERATIONAL TESTS: carry out operational tests on all equipment and complete systems to verify proper performance in compliance with the Specification. Tests are to be carried out under normal operating conditions for not less than 3 days, and as required by the Engineer.

I. SPECIFIC TESTS: carry out specific tests required by the Specification and any other tests required by the Engineer to verify compliance of the installations with the Specification.

J. LOAD BALANCE: upon completion of the building and immediately prior to final inspection and take-over, check load balance on all feeders and at distribution centers, panels, etc. Conduct tests by turning on all possible loads in the building and checking the load current balance. If load unbalance exceeds 15%, rearrange and reconnect circuits to balance the load after Engineer's approval.

K. VOLTAGE CHECKS: perform voltage checks throughout the building and if directed by the Engineer, adjust the transformer tap settings where a transformer is provided on the supply end, or report to power authority for adjustment necessary.

L. CURRENT CHECKS: In cooperation with the mechanical sub-contractor, take clip-on ammeter readings on all phases of all mechanical equipment motors with motors operating under full load conditions. Test readings shall be submitted to the Consultant.

3.2 RECORDS

A. GENERALLY: not later than the date of substantial completion, provide the Engineer with four copies of all approved as-installed drawings, test records, manufacturers' guarantees and warranties, operating and maintenance manuals and other records required by the Specification.

B. PRESENTATION OF RECORDS is to be in A4 size plastic covered, loose-leaf ring binders or other approved binders with hard covers, each indexed, divided and appropriately cover titled. Drawings larger than A4 size are to be folded in the binders so that they may be unfolded without being detached.

C. AS-INSTALLED DRAWINGS are to contain the complete assembled information included on the construction drawings, prepared in the same manner, and up-dated to indicate the systems, labelling, referencing, mounting methods, routing etc. as installed. Submit complete drawings for approval. Provide the Engineer with one set of transparencies in addition to the four copies required.

D. TESTING COMMISSIONING: Include test results from the testing and commissioning process. Tests for all and each of the equipment and accessories should be done in presence of the manufacturer representative, the commissioning to be done by a specialized team with the knowhow of similar jobs. Schedules to be

performed for each type of equipment and accessories showing that performances during the test, meets the expected and specified one

E. TEST RECORDS are to include test certificates of type tests, routine tests, site tests, commissioning and performance tests and all other tests on equipment and installations described in the Specification and required by the Engineer. Information is to include test procedures and results, conditions under which tests were carried out including set points, temperatures and the like, dates, location and attendance by authorized representatives etc.

F. OPERATING AND MAINTENANCE MANUALS are to contain the following:
1. Technical description of each system and item of equipment installed, written to ensure that the Employer's staff fully understand the scope and facilities provided.
2. Diagrammatic drawings of each system indicating principle components and items of equipment.
3. Schedules (system by system) of equipment installed giving manufacturer, catalogue list numbers, model, rating, capacity and operating characteristics; each item is to have a unique code and number, cross- referenced to the diagrammatic drawings and layout drawings.
4. Name, address, telephone, telex and fax numbers of the manufacturer of every item of equipment.
5. Name, address, telephone and telex numbers of equipment agents' representatives for emergency services and procedures.
6. Manufacturer's service manual for each major item of equipment, assembled specifically for the project, including detailed drawings, illustrations, circuit details, operating and maintenance instructions, modes of operation, control provisions, sequences and interlocks and preventative maintenance program.
7. Schedules of all fixed and variable equipment settings established during commissioning.
8. Procedures for fault finding, where applicable.
9. Manufacturers' lists of recommended spare parts for items subject to wear and deterioration, giving expected running period and indicating specifically those items which may involve extended deliveries.

G. OPERATING AND MAINTENANCE MANUALS: prepare two temporary copies with provisional record drawings and preliminary performance data and make available at time of testing and commencement of commissioning to enable the Employer's staff to familiarize themselves with the installations. Temporary copies are to be in the same format as the final manuals with temporary insertions for items which cannot be finalized until installations are commissioned and performance tested.

3.3 TRAINING

A. OPERATION AND MAINTENANCE TRAINING: before the date of substantial completion, explain and demonstrate to the Employer's maintenance staff the purpose, function and operation of the installations including all items and procedures listed in the operating and maintenance manuals. Include for not less than thirty days for this purpose.

3.4 MAINTENANCE

A. MAINTENANCE CONTRACTS: where required by the Specification, submit supplementary proposals for annual maintenance contracts. The proposals are to:

1. Include for maintaining the installations in efficient working order including routine and emergency service checks, adjustments, lubrication and the supply and replacement of damaged parts etc.
2. Set out the terms of the offer, the work to be carried out, the guarantees of performance and the price of the work or part thereof for the first twelve months after substantial completion.

The proposals will not be considered as part of the Tender.

SECTION 260519 - WIRES, CABLES AND RELATED ACCESSORIES.

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and all general Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes cables and related splices, terminations, and accessories for low voltage electrical distribution systems.

1.3 STANDARD

A. LV single and three core cables, armoured or unarmoured, conforming to IEC EN 60502-1,: 2004, A1:2009.

B. Single core LV wires, Cu/PVC to IEC EN 60227,: 2007.

C. Fire resistant low smoke, flame retardant cables to IEC 331: 2018, IEC 332-1: 2004, BS6387: 2013, BS 8434-2: 2003, BS 8491: 2008, EN 50200: 2015.

D. Plain copper with concentric stranded conductors to IEC EN 60228: 2004.

E. Conductor screening conforming to the applicable requirements of IEC EN 60502-1,: 2004, A1:2009.

F. Cable insulating: conforming to the applicable requirements of IEC EN 60502-1,: 2004, A1:2009.

G. Insulation screening: conforming to the applicable requirements of IEC EN 60502-1,: 2004, A1:2009.

H. Armour: conforming to the applicable requirements of IEC EN 60502-1,: 2004, A1:2009.

I. Sheath: conforming to the applicable requirements of IEC EN 60502-1,: 2004, A1:2009.

1.4 SUBMITTALS

A. Product Data: Include electrical characteristics, dimensions, installation method, supports, materials, firestops, and weatherstops for each cable.

B. Shop Drawings: Installation details of LV cables including plans, elevations, sections, component details, and attachments to other construction elements. Detail connections to switchboards and transformers. Detail supports and connections to building.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

D. Field quality control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency with the experience and capability to conduct the cables testing.

B. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in IEC 60502-1, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

1.7 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: A written warranty, signed by Contractor and manufacturer, agreeing to replace any component of the LV cabling network that do not meet requirements or that fail within the specified warranty period.

C. Warranty Period: 10 years from date of Substantial Completion for any component of the system.

1.8 APPROVED MANUFACTURERS:

A. Refer to List of approved electrical manufacturers.

PART 2 - PRODUCTS

2.1 SINGLE CORE WIRES (NYA) Cu/PVC TO IEC EN 60227

A. This specification covers single core, PVC insulated wires, intended for internal wiring in dry locations, concealed in conduits.

B. Conductors shall be of high conductivity annealed plain copper with concentric stranded conductors, to IEC EN 60228: 2004.

C. Minimum conductor size used shall not be less than 2.5 mm^2.

D. All wires for lighting and power systems pulled inside conduits shall be single core, insulated with PVC compound, of grade not less than 300 / 500 volts, to IEC EN 60227: 2007.

2.2 MULTI CORE & SINGLE CORE POWER CABLES Cu/PVC/PVC & Cu/XLPE/PVC TO IEC EN 60502-1

A. Power cables shall be used for supply of power to main distribution boards, secondary

distribution boards, pumps, HVAC equipment and all external lighting and equipment.

B. This specification covers single, two, three or four core cables, PVC or XLPE insulated and PVC sheathed, rated at 600V/1000 V unarmored and armored type.

C. Conductor shall be plain, annealed electrolytic copper, circular or sectorial stranded, conforming to the applicable requirements of IEC EN 60228: 2004.

D. The insulation shall be PVC or XLPE based (as indicated on drawings) thermoplastic material conforming to the applicable requirements of IEC EN 60502-1: 2004, A1:2009.

E. The assembly shall consist of insulated conductors filled where necessary with non-hygroscopic material and covered with an additional layer of extruded thermoplastic material or non-hygroscopic binding tape.

F. The sheath shall be PVC based thermoplastic material, conforming to the applicable requirements of IEC EN 60502-1: 2004, A1:2009.

2.3 FLEXIBLE CORDS

A. The flexible cords used for the connection of fixtures to circuit wiring shall have finely stranded copper conductor with PVC insulation, type NYFAF, 500V grade.

B. Cords used for water heater connections shall be of high conductivity tinned copper wires, (4 mm^2 unless otherwise indicated) insulated with ethylene propylene rubber, three cores twisted together, filled and sheathed with chlorosulphonated polyethylene (EPR CSP), 300/500 V rated, and shall withstand an operating temperature of 85°C.

C. Cords used for pendant lighting points and between 220 V / 12 V transformers to lighting fixtures, shall be circular three core (1.5 mm^2) silicon rubber insulated, glass fiber braided 300/500 V rated and shall withstand an operating temperature of 170°C.

D. Cords used for extract fans and fan coil units shall be of plain annealed copper conductor (2.5 mm^2 unless otherwise indicated), PVC insulated, circular three cores twisted together, PVC overall sheeted 300 / 500 V rated and shall withstand an operating temperature of 70°C.

2.4 CONTROL CABLES

A. Control cables where used underground direct burial shall comprise stranded annealed copper conductor of minimum 2.5 mm^2 cross-section insulated with high dielectric polyvinyl chloride, nylon sheathed with a tape binder applied over the assembly, overall PVC jacketed Control cables shall comply with IEC EN 60502-1: 2004, A1:2009.

B. Number of conductors shall be equal to the maximum number of functions plus 20% spare.

C. Cable shall be 600 /1000V insulated and sheathed grade.

D. Junction boxes shall include all necessary terminal connector boards with proper labels.

E. Contractor shall make sure that the cross-sectional areas of the conductors are sufficient to cater for the voltage drop due to the long runs involved.

F. Control cables where used in ducts underground or in conduits above ground shall comprise stranded annealed copper conductor of minimum 1.5 mm^2 cross-section for cables in ducts and 0.75 mm^2 for cables in conduits insulated with high dielectric polyvinyl chloride, and PVC sheathed. Control cables shall comply with IEC EN 60502-1: 2004, A1:2009.

2.5 FIRE RESISTANT CABLES

A. Description

a. Fire resistant cable 600/1000 Volts rated, for use where fire resistance, flame retardant and low smoke and corrosive gas emission properties are required.

b. For power limited cables and emergency wiring terminal circuits, fire rated cables shall be 300/500 V rated. Fire rated cables for low current systems, shall be rated as a minimum as per the voltage they intended to carry or equal to the voltage rating of any cable they share any containment system with; whichever is greater.

c. It shall provide uninterrupted power supply and preserve circuit integrity in the event of fire.

d. "X" x CSA mm^2, plain or stranded Copper, Mica/Glass tape, cross-linked insulation and LSOH sheath overall; rated 600/1000V.

B. Fire Resistance/Low Smoke

a. The cable shall meet the requirements of IEC331: 2018 and BS6387: 2013 for categories C, W and Z (950°C for 3 hours, water spray test and mechanical shock test).

b. Compliant and certified to the integrated fire, shock and water test BS 8434-2: 2003 for 120 minutes for cables smaller than 20mm overall diameter and BS 8491 for cables with larger external diameter.

c. Compliant and certified to EN 50200: 2015 Class PH120 + Annex E

d. When the complete cable is tested in accordance with BS7622: 1993 Pt 2 (IEC1034-2) it shall meet the minimum light transmittance requirements as stated in BS7622: 1993 Pt 2 (IEC 1034-2).

e. When tested in accordance with BS6425: 1993 Pt 1 (IEC754-1), all nonmetallic components shall give a level of HCI not greater than 0.5%.

C. Flame Retardant

The cable shall meet the requirements of BS4066: 1994 Pt 1 (IEC332 -1) and comply with BS6387: 2013 categories “Flame Retardant”.

D. Certification
The cable shall be certified by an approved authority to comply with the standards and requirements listed herein.

E. Construction Conductors
1.0 mm2 to 630mm2. Plain copper stranded circular conductor complying with BS6360 Class 2.

F. Insulation
Mica/Glass Fire Resistant tape, covered by an extruded cross-linked insulation, com- plying with BS7655: 2006 type GP8 or type GP6, operating temperature 90°C. The cross-linked insulation shall prevent thermoplastic flow and give high short circuit withstand ratings.

G. Core identification
Cores shall be identified as follows:
Single core black or red
2 core black, red
3 core red, yellow, blue.
4 core red, yellow, blue, black.
7+ core white with black printed numbers. Sheath
Abrasion resistant extruded LSOH sheath complying with BS7655: 2006 type LTS4. Sheath color
Orange.
Sheath Marking
Marked as follows:
Fire Rated Cable LSOH “X” x CSA ELECTRIC CABLE 600/1000V

H. Installation
Cables should be installed in accordance with the appropriate regulations including IEC 364: 2005, IEE Wiring Regulations or any other national regulations.
Range and Availability Single core 1.0 - 630mm^2
2-core 1.0 - 300mm^2
3-core 1.0 - 300mm^2
4-core 1.0 - 300mm^2
7, 12, 19, 27 & 37-core 1.0 - 2.5mm^2
Temperature Limits
The cables shall be suitable for operation in the range of -25°C to +90°C.

I. Quality Assurance
The cables shall be manufactured under a strict Quality Management System that is certified to meet the requirements of ISO 9001: 2015.

N.B.: Unless otherwise mentioned on the drawings or in the specification, all equipment dedicated for life safety such as staircases air pressurization fans, parking smoke management fans, fire pumps, elevators, fire-fighting systems, voice evacuation systems, fire alarm and detection system, emergency lighting and emergency motors/pumps shall be wiring using fire rated cables.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES & CABLES

A. All wires shall be installed in accordance with the applicable provisions of the approved codes and as indicated on the Drawings.

B. The number of wires and sizes of conduits indicated on the Drawings is a guide only and are not necessarily the correct number and sizes necessary for actual equipment installed. 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.

C. Where more than one conductor is used per phase, each phase, neutral if any and ground wires shall be run in each metallic or non-metallic conduit.

D. Conductors shall be continuous from outlet to outlet and no splices shall be made except within outlet or junction boxes.

E. At every outlet and pull box, wires and cables passing through shall be left slack by an amount equivalent to 20 cm of cable length to allow inspection and connection to be made therein.

F. No cable bend shall have a radius of less than eight times its diameter.

G. The Contractor shall not change any circuit number, especially from a phase to a different phase. If such a change is necessary due to modification on site, the Contractor shall bring this matter to the attention of the engineer.

H. All conductors to be contained within a single conduit shall be drawn in at the same time.

I. A wire pulling compound shall be applied to conductors being drawn through conduit. Pulling compound shall be soap tone or other approved material.

J. Only cables forming part of a lift installation if any may be run in a lift shaft.

K. Wires and cables for feeders, sub-feeders, control, and branch circuit wiring shall be color coded as per IEC regulations.

L. Wire and cable sizes shall be as indicated on the Drawings; however, in no case shall their size be smaller than required by the approved Code.

M. Unless otherwise indicated, no conductor for lighting and power wires shall be smaller than 2.5 mm^2.

N. All branch circuits for internal lighting and appliances shall be single conductor cables run inside conduits, unless otherwise indicated.

O. Feeder and sub-feeders shall be multi-conductor cables run exposed on cable trays or in underground ducts as shown on the Drawings.

P. Single cables unless otherwise specified and shown on drawings, could be fixed directly to walls or ceilings. Where 2 or more cables are run in parallel, they shall be fixed on hot dip galvanized steel perforated trays or other approved special cable supporting and protecting arrangement.

Q. Cables shall be fixed to supporting structures with approved hot dip galvanized cast steel clamps at distances not exceeding 20 diameters.

R. Fire resistant cables shall either be directly clipped to the concrete shell using metallic clamps every 20 diameters, installed in metallic conduits or run on fire resistant cable trays certified and listed for such use.

S. Telecommunication system data cables (copper and fiber) shall be fixed on cable trays or trunks or basket trays with special tie wraps. Tie wraps shall be used at appropriate intervals to secure cable and to provide strain relief at termination points. These wraps shall not be over tightened to the point of deforming or crimping the cable sheath. Plastic tie wraps are not allowed to be used for Data cables, special tie similar to Velcro Tie wraps shall be used.

T. No joints or splices shall be accepted on main feeders.

3.2 FIRE STOPPING

A. Apply fire stopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section 078413 "Penetration Firestopping" or EN or NFPA standards.

3.3 IDENTIFICATION OF WIRES & CABLES

A. Generally, comply with section 260553 - Identification of Electrical Systems

B. Identification scheme shall be as required by IEC Standards as a minimum.

C. Individual conductor or circuit identification shall be carried throughout, with circuit numbers or other identification clearly installed on terminal boards and printed on directory cards in distribution cabinets and panel boards.

D. In junction boxes, cabinets, and terminal boxes where the total number of control, indicating, and metering wires is three or fewer and no terminal board is provided, each wire including all power wires, shall be properly identified by means of a plastic, wire marker.

E. Wires including motor leads and other power wires too large for connection to the terminal boards shall be identified by wire markers as specified above.

F. In manholes, hand holes, pull boxes, junction boxes and at both terminals each cable shall be properly identified by a plastic tag located so as to be easily seen. Wires and cables shall be identified by cable number indicated on the Drawings.

3.4 CONNECTORS AND TERMINAL BLOCKS

A. For the wiring of circuits consisting of wire sizes 35 mm^2 and smaller such as for lighting, branch circuits etc…, self-insulated pressure cage clamp type connectors shall be utilized for all splices or joints. Where flexible cables (NYFAF) are used from ceiling outlet box to recessed lighting fixtures, 3M caps shall be utilized.

B. For the wiring of circuits consisting of wire sizes 50 mm^2 and larger, connectors shall be of the bolted pressure type, with a pre-insulated sleeve shall be used.

C. For the wiring of circuits consisting of wire sizes 70 mm^2 and larger, connectors shall consist of rigid busbars from panel boards' manufacturer prefabricated terminal blocks.

D. Connectors shall be manufactured from high conductivity electrolytic copper with soft tin-lead plating (Sn60Pb40).

E. Connector bodies shall be manufactured from Polyamide (Nylon 6.6).

3.5 CABLE GLANDS

A. Cable glands shall be provided at the termination of all cables at the enclosure of a distribution board or any other equipment. Metallic cable glands shall be provided for cables greater than 70mm2.

B. Cable glands shall be indoor or outdoor type, ordinary or weatherproof according to the location of the termination and the installation standard and to the approval of the Engineer.

3.6 FIELD QUALITY CONTROL

A. Cables tests are to be carried out in accordance with the requirements of the Regulations and Standards and as specified in Division 1 specification section 017950.

B. Engage a qualified testing and inspecting agency to perform the field tests and inspections and prepare test reports.

C. Test Equipment: Provide megger testers of various ranges as applicable. Use 500 V megger on installations with nominal voltage up to 500 V and for control circuits to avoid over voltage injection, and 1000 V megger on installations with nominal voltage over 500 V up to 1000 V.

D. Insulation resistance for LV power and lighting installations is to be carried out in accordance with IEE Regulations 73-5 through 713-8 and 713-04.

E. Insulation resistance for control and signal cables is to be minimum 10000 Megohm-Km for PE insulated cables and 100 Megohm-Km for PVC insulated cables, all measured core-core and core-earth, in accordance with the Regulations.

F. Prior to energization of circuitry, check installed wires and cables with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled.

G. Prior to energization, test wires and cables for electrical continuity and for short circuit.

H. Subsequent to wire and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

SECTION 260533 - RACEWAYS, BOXES AND FITTINGS

PART 1 - GENERAL

1.1 ELECTRICAL WORK GENERALLY: is to be in accordance with the requirements of Section 260000 of the Specification.

1.2 DESCRIPTION OF WORK: raceways including conduits, wireways and related installations and accessories necessary to support and protect cables, feeders, branch circuit wiring and wiring of low current systems, communications and signal cables.

1.3 REGULATIONS AND STANDARDS: conduits, wireways, cables trays and fittings are to be designed, constructed and installed to give safe installation and reliable mechanical protection for wires and cables in accordance with the Regulations. Standards of Cable trunking system are to be as specified. Local production is prohibited.

1.4 TECHNICAL DATA: submit data for approval including, but not limited to, the following:

A. Manufacturer's catalogues with specifications of raceways including conduits, trunking etc… and related accessories.

B. Samples of each type of raceway and accessory.

1.5 SHOP AND CONSTRUCTION DRAWINGS: submit drawings for approval including, but not limited to, the followings:

A. Exact routing of conduits, trunking etc. With indication of boxes, accessories and expansion joints, size of conduits and boxes.

B. Typical assembly details of installation of trunking, trays etc…

C. Construction details of pull boxes.

D. Typical installation details including isometric trunking system, connection of conduits to metal enclosure. Connections of flexible conduits, vapor-tight installations in cold rooms, liquid tight flexible metallic outdoors etc. and earthing connections.

1.6 APPROVED MANUFACTURERS:

A. Refer to List of approved electrical manufacturers.

PART 2 - PRODUCT & SYSTEMS SYSTEM

2.1 CONDUITS AND ACCESSORIES

1. FLEXIBLE METAL CONDUIT: steel, cold rolled and annealed, non-threaded type, formed from continuous length of helically wound and

interlocked strip steel, with fused zinc coating on inside and outside. FMC Compliant to ANSI & UL listed.

2. RIGID METAL CONDUIT: Black enameled or hot dipped galvanized, L= 3m, with compression type connectors (for EMT) and couplings on both. Compliant to ANSI & UL listed.

3. LIQUID-TIGHT FLEXIBLE METALLIC CONDUIT: is to have PVC jacket extruded over core. LFMC Compliant to ANSI & UL listed.

4. FITTINGS GENERALLY: thread less for EMT & threaded for IMT & RSC, compression type, hot dipped galvanized or cadmium plated malleable cast iron. Fittings used in corrosive atmospheres are to be specially treated. Compliant to ANSI & UL listed.

5. STRAIGHT CONNECTORS: one-piece body, female type, hot dipped galvanized or cadmium plated malleable cast iron. Fittings used in corrosive atmospheres are to be specially treated. Compliant to ANSI & UL listed.

6. ANGLE CONNECTORS: of 45 or 90 degree and terminal connectors are to be as specified for straight connectors, except that body is to be two-piece with removable upper section. Compliant to ANSI & UL listed.

7. Standards:
   a. American National Standard for Electric Rigid Steel Conduit - ANSI C80.1-2015
   b. American National Standard for Electrical Metallic Tubing—Steel (EMT-S) - ANSI C80.3-2015
   c. American National Standard for Intermediate Metal Conduit (EIMC) - ANSI C80.6-2018
   d. Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit - NEMA RN 1-2018
   e. UL 360 for Flexible Metallic conduit - FMC & Liquid-tight Flexible Metallic conduit - LFMC

A. RIGID MEDIUM GAUGE PVC CONDUIT (Local production is prohibited).

1. MATERIAL: rigid un-plasticized, could form a bend with PVC accessories, polyvinyl chloride with high impact and high temperature resistance, flame retardant, non-hygroscopic and non- porous, compressive strength 750 N, to CEE 26, BS EN 61386: 2008, DIN 49026 or other equal and approved standards conforming to IEC 423.

2. FITTINGS GENERALLY: unbreakable, non-flammable, self-extinguishing, moulded plastic.

3. ASSEMBLY: conduits, boxes and accessories are to be assembled by cementing, using manufacturer's recommended produCable trunking system and appropriate connectors or spouts are available use smooth bore male PVC bushes and sockets.

B. FLEXIBLE MEDIUM GAUGE PVC CONDUIT (Local production is prohibited).

1. MATERIAL: flame retardant, heat resistant, non-hygroscopic PVC, high resistance to impact, plain non corrugated construction.

PART 3 - FIELD AND INSTALLATION WORK

3.1 CONDUIT AND WIREWAYS GENERALLY

A. USE: unless otherwise specifically indicated all light and power circuits, communications, signal and low current systems wiring are to be drawn inside conduits or wireways up to the various electric power consuming equipment as shown on the Drawings. Separate conduit and wireways installations are to be used for LV cables/wires normal lighting and power circuits, emergency lighting and power circuits and communication, signal and other low current systems wiring.

B. BOXES: junction, pull and splice boxes of ample capacity (with 30% spare at least) are to be provided as indicated or required. Boxes are to remain permanently accessible. Minimum outlet, junction or pull box depth to be 50mm clear. Boxes installed outdoors, unless fully embedded shall be metallic and painted to prevent corrosion.

C. TOOLS AND ACCESSORIES: for forming and installing conduit and wireway systems are to be purpose made for the particular application and used in accordance with manufacturer’s instructions.

D. FIXING: conduits and wireway installations are to be concealed as much as possible.

E. SIZES: Unless otherwise specified conduits and wireways sizes, not shown on the Drawings, are to be selected in accordance with the tables on design drawings and in relation to the number and size of conductors. Minimum size of conduit for all applications is to be 20 mm diameter, unless otherwise shown on the Drawings.

F. MECHANICAL CONTINUITY: conduits and wireways are to be effectively joined together (special cement) and connected to electrical boxes, fittings and cabinets (glands) to provide firm mechanical assembly. Earthing jumpers are to be installed on steel conduits where required to ensure effective electrical continuity irrespective of whether a protective earth conductor is required or not.

3.2 RACEWAY APPLICATIONS AND INSTALLATIONS GENERALLY

A. RIGID MEDIUM GAUGE PVC CONDUIT: unless otherwise specified or mentioned on drawings or contradictory to local codes; is to be used generally in underground, in screed, in duct banks installation for lighting, power and light current circuits.

B. FLEXIBLE MEDIUM GAUGE PVC CONDUIT: is to be used for lighting, power and light current circuits in under tiles and embedded in walls installation unless otherwise specified or mentioned on the drawings.

C. RIGID LIGHT DUTY (EMT) STEEL CONDUIT: is to be used in technical plant rooms (generator room, electrical rooms, UPS & batteries rooms, server rooms, telecommunication rooms, corridors, low current rooms, mechanical plant rooms,

fuel rooms…etc) and unless embedded under 5cm of concrete, for security systems (access control, CCTV) wiring including structured cabling connections.

D. RIGID INTERMEDIATE METAL CONDUIT (IMT): is to be used for all above ground (unburied) outdoor installations, for all systems; unless embedded under 5cm of concrete. All outdoor metallic conduits shall be painted to prevent corrosion.

E. FLEXIBLE STEEL CONDUIT: is to be used for connection to motors, vibrating and non-rigidly fixed equipment and fixtures installed in false ceiling or on server racks.

F. FLEXIBLE LIQUID-TIGHT STEEL CONDUIT: is to be used, in rooms subject to ingress and at the outdoor spaces, for connection vibrating and non-rigidly fixed equipment, lighting fixtures and where requested by IEC-364.

G. EXPOSURE TO DAMAGE: conduit considered being subject to undue risk of damage by shock or corrosion is to be brought to the attention of the Engineer.

H. CROSSINGS: conduits are not to cross pipe shafts, vents or openings.

I. CLEARANCES: install conduits at least 100 mm clear of and preferably above pipes of other non-electrical services.

J. SLEEVES: obtain approval for positioning sleeves where conduits pass through reinforced concrete. Additional openings may be allowed in finished slabs but are to be drilled and not broken. Fix sleeves rigidly to maintain position and alignment during construction work.

K. EXPANSION FITTINGS: provide in each conduit run over 30 mm in length and at crossing of expansion joint in structure.

L. WATERPROOF CONSTRUCTION: conduits are not to cross waterproof construction unless permitted by the Engineer. Specially designed and approved fittings are to be used.

M. MAKE GOOD all holes for conduits passing through walls, floors and ceilings with cement or similar fire-resisting material to full thickness.

N. BENDS: conduit runs between outlet, fitting and fitting or outlet and fitting are not to contain more than the equivalent of 2 quarter bends (180 degrees total).

O. BENDING is to be made without damaging conduit or tubing and without reducing internal diameter. Methods of field bending are to be approved.

P. CUT ENDS are to be reamed to remove burrs and sharp edges.

Q. CONDUITS ENTERING COLD STORES are to be made vapor tight, so that vapor from outside cannot enter conduit.

R. DRAINING: arrange conduits so that condensed moisture can drain to screwed plug at lowest point.

S. BEFORE WIRING, conduits are to be swabbed through. Do not draw cables into any section of system until conduit and draw boxes are fixed in position.

T. CAPPING: conduits are to be properly capped until wiring conductors are drawn in.

U. CONDUITS AND FITTINGS INSTALLED OUTDOORS are to be watertight and highly resistant to corrosion. Use appropriate fittings, threaded and hubbed boxes, gaskets with screw on covers and the like.

V. PENETRATIONS THROUGH RADIATION SHIELDING: where conduits, cable trays, boxes and cables of power, lighting, telecom, security and access control, CCTV and fire alarm systems penetrate or are recessed in the lead-lined walls and ceilings of the PET-CT unit, provide lead sleeves, offsets or lead back plates of the same lead equivalence as the shielding, extending minimum 25 mm beyond the box or opening, as specified in Section 13 49 00 "Radiation Protection" of the Civil and Architectural specifications. Coordinate all routes with the shielding installer before the lead lining is fixed, and do not cut or drill the lead lining after installation without approved shielding details.

V. TERMINATIONS: do not terminate or fasten rigid conduits to motor frame or base.

W. LENGTH AND RADIUS OF FLEXIBLE CONDUIT used for motors and vibrating equipment is to permit bending of feeder cables without damage to conductor or insulation.

X. FLEXIBLE CONDUIT FOR SLIDE RAIL MOUNTED MOTOR is to have sufficient slack to allow for movement of motor over entire slide rail length.

Y. PULLING WIRE: install 3 mm galvanized stranded steel wire or equivalent strength cord with wooden blocks fastened at ends, in empty service conduits (power, low current and signal).

Z. STANDARD ELBOWS are to be used for conduit sizes equal or greater than 20mm.

AA. TAGS: fit to conduits entering or leaving floors, walls or ceilings for identification of conduit and circuits. Tags are also to be placed at suitable intervals throughout the systems. Tags shall be approved by the engineer and have their durability at least equal to those used for power feeders.

3.3 PVC CONDUITS

A. COUPLING OF CONDUIT and/ or termination into spouted fittings is to be made watertight and permanent using special cement.

B. TERMINATION: connect conduits terminating in switchgear, panel boards, trunking, adaptable boxes or non-spouted enclosures etc, with smooth bore male PVC bushes and sockets.

C. ENDS OF CONDUIT end conduit fittings are to be cleaned and jointed using PVC cement recommended by manufacturer.

D. SEMI-PERMANENT ADHESIVE: use in joints requiring expansion couplers.

3.4 EMBEDDED CONDUITS

A. CONDUITS IN CONCRETE SLABS: place conduits parallel to main reinforcing steel.

B. CONDUITS IN PARTITIONS OR SIDE WALLS: horizontal or cross runs are to be avoided.

C. PULL-BOXES are not to be used. If unavoidable, pull-boxes may be approved if located inconspicuously.

D. CONDUITS IN FLOOR OF BEDS ON GRADE: encase in concrete, minimum thickness 50 mm or to thickness allowed by architectural detail.

E. PVC CONDUITS IN REINFORCED CONCRETE STRUCTURES are generally to be installed after placing reinforcement and before concreting, if protected against damage, or are to be placed in grooves in formed in the concrete, if approved.

3.5 EXPOSED CONDUITS

A. CONDUITS ON WALLS: run neatly, horizontally or vertically.

B. SUPPORTS: use approved clamps, hangers or clips fastened by machine screws to expansion sleeves in inserts or to lead anchors.

C. SPACING OF CLAMPS OR CLIPS for supporting steel conduits is not to be greater than:

Conduit Size mm (inches)	Maximum Spacing of Supports meters
20 (3/4)	1.0 m
25 (1)	1.0 m
32-38 (1-1/4-1-1/2)	1.25 m

D. SPACING OF CLAMPS OR CLIPS for supporting PVC conduits is not to be greater than.

Conduit Size mm (inches)	Maximum Spacing of Supports meters
20 (3/4)	0.50
25-50 (1-2)	0.50
63-75 (2-1/2-3)	0.75

E. BENDS AND FITTINGS: firmly fasten conduit at each side of bends and within 900 mm of each outlet box, junction box, cabinet or fitting.

F. OUTLETS: do not run more than one conduit to any surface wall outlet. Install junction box on home run near to ceiling level and tap-off vertical conduit to outlet box below.

G. Any device, components or equipment to be installed in the floor area especially when critical case is important such operation rooms, ICU and CSSD area shall be specified with anti-bacterial resistant item.

3.6 WIRING AND CABLE TRUNKING SYSTEM (CTS)

A. Components are to include wireway base, clip-on covers, couplings, end plates, wall flanges, panel to trunking rubber grommets, elbows, tees, adaptor plates and necessary hangers, supports and accessories.

B. Steel Trunking: To BS EN 50085-1: 2005, A1:2013 & 50085-2-1:2006, A1:2011,
galvanized sheet steel, minimum 1.5 mm thick, protected internally and externally with corrosion resistant finish such as zinc or cadmium with top coat of enamel.

1. Description:
   a. Multi-compartment metallic distribution trunking with pre-fitted coupling system, integrated shake-proof screws, a clip-on metallic lid and a smooth safety edge.
   b. A safety return edge steel surface trunking system with strength and rigidity Manufactured to BS EN 50085 2-1: 2006, A1:2011
   c. Each trunking length shall be supplied with coupler, lid and lid fixings (push-fit die-cast turnbuckle fixings).
2. Features:
   a. Cover with spring loaded die-cast turnbuckles screws: Push fit, quarter- turn release
   b. Pre-galvanized steel to BS EN 10327: 2004 grade DX51D, powder coated (color to be submitted for approval), minimum 1.5 mm thickness.
3. Distribution trunking classification to BS EN 50085-1: 2005, A1:2013 and BS EN 50085 2-1: 2006, A1:2011:
   a. Clause 6.2 Resistance to impact for installation and application: impact 20 Joules
   b. Clause 6.3 Application temperature: up to 60 °C
   c. Clause 6.4 Resistance to flame propagation: metallic non-flame propagating
   d. Clause 6.5 Electrical continuity characteristic: cable trunking system with electrical continuity (maximum linear impedance 1 milliohms per meter)
   e. Clause 6.6 Electrical insulating characteristic: cable trunking system without electrical insulating characteristic
   f. Clause 6.7 Degree of protection provided by enclosure according to BS EN 60529 –: 1992, A2:2013: IP30 – with cover straps
   g. Clause 6.9 System access cover retention: cable trunking system access cover which can only be opened with a tool
   h. Clause 6.10 Electrically protective separation: cable trunking system without internal protective partition (but multi-compartment where specified)
   i. Clause 6.101 Position when surface mounted: cable trunking system surface mounted on wall, surface mounted on ceiling (mounted away from the wall or ceiling using fixing devices)
   j. Clause 6.103 Functions provided: Type 2 Cable Trunking System (distribution)

4. Fittings (available for 1, 2 or 3 compartments trunking):
   a. Inside lid tees gusset
   b. Outside lid tees gusset
   c. Offset tees
   d. Offset crossovers
   e. Reducers

f. Crossovers (including those for multi-compartment systems)
g. Bellmouths
h. Change faces (both sides)

5. Accessories:
   a. Pin racks
   b. End caps
   c. Flanges
   d. Fitting to fitting adaptors
   e. Trunking couplers
   f. Cable retainers
   g. Earth Links
   h. Stirrup hangers
   i. separators

C. PVC Trunking: to BS EN 50085-2-1:2006, A1:2011 and BS EN 50085-1:2005, A1:2013, high impact, heavy duty, self-extinguishing, rigid PVC with grooved double locking action of the clip-on cover. Design is to be approved by the Engineer before ordering materials. Trunking is to be capable of receiving functional slot-in hangers and demountable separators to segregate wiring systems as needed.

D. Sizes: As required to accommodate number of conductors permitted by the Regulations and/or as shown on the Drawings.

3.7 WEATHERPROOF WIRING AND CABLE TRUNKING

A. Type: hot-dip galvanized sheet steel trunking of 1.5 mm thick (minimum) and cover, 1 mm thick, to BS EN 50085-1: 2005, A1:2013 and 50085-2-1: 2006, A1:2011, for
trunking and BS EN ISO 1461: 2009and BS EN ISO 11135: 2009 for galvanizing. For outdoor locations, cable trunking is to be painted to prevent corrosion.

B. Construction: Trunking is to have outwardly turned flanges to receive cover, and internal sleeve coupling between sections, permitting cutting of trunking on site.

C. Gaskets: Neoprene bonded cork gaskets are to be fitted throughout, between any two attached surfaces.

D. Screws: Removable flanged covers are to be secured with galvanized steel holding screw

END OF SECTION

SECTION 260575 - SHORT CIRCUIT & OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDIES

PART 1 – GENERAL

1.1 SUMMARY

Read this Section in conjunction with Drawings and general provisions of the Contract, including General and Supplementary Conditions. The Contractor shall become familiar with other sections of the Specifications affecting work of this trade.

1.2 SCOPE OF SERVICES

A. Provide a complete short-circuit study for the electrical equipment supplied for this project. The study shall include all portions of the normal supply network; normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.
B. Provide an equipment evaluation study for the protective electrical equipment supplied for this project. The study shall verify that all equipment is properly sized and recommend changes if necessary.
C. Provide a protective device coordination study for the protective electrical equipment supplied for this project. The study shall verify that all equipment is properly configured and recommend changes if necessary.

1.3 SUBMITTALS

A. The studies shall be submitted to the project electrical engineer prior to granting final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacture.

B. The version of the software used for each study, along with a description of the source of the data used to feed it shall be submitted.

C. The qualifications and credentials of the coordination-study specialist shall be submitted.

1.4 SHORT-CIRCUIT STUDY

A. The study shall be in accordance with applicable local and international Standards.
B. The study input data shall include the utility company's short-circuit single and three phase contribution, with the X/R ratio, the resistance and reactance components of each branch impedance, motor contributions, base quantities selected, and all other applicable circuit parameters.
C. Short-circuit momentary duties and interrupting duties shall be calculated on the basis of maximum available fault current at each panel board and other significant locations through the system.

1.5 EQUIPMENT EVALUATION STUDY

An equipment evaluation study shall be performed to determine the adequacy of circuit breakers, controllers, surge arresters (wherever applicable), busways, switches and fuses by tabulating and comparing the short-circuit ratings of these devices with the available fault currents. Any problem areas or inadequacies in the equipment shall be promptly brought to the Engineer's attention.

1.6 PROTECTIVE DEVICE COORDINATION STUDY

A. A protective device coordination study shall be performed to select or to check the selections of power fuse ratings, protective relay characteristics and settings, ratios and characteristics of associated voltage and current transformers, and low-voltage breaker trip characteristics and settings.

B. The coordination study shall include all voltage classes of equipment from the utility's incoming line protective device down to and including each panel board. The phase and ground overcurrent protection shall be included, as well as settings for all other adjustable protective devices.

C. The time-current characteristics of the specified protective devices shall be plotted on appropriate log-log paper.

1. The plots shall include complete titles, representative one-line diagram and legends, associated power company's relays or fuse characteristics, significant motor starting characteristics, complete parameters of transformers, complete operating bands of low voltage circuit breaker trip curves, and fuse curves.
2. The coordination plots shall indicate the types of protective devices selected, proposed relay taps, time dial and instantaneous trip settings, cable damage curves, symmetrical and asymmetrical fault currents.
3. Reasonable coordination intervals and separation of characteristic curves shall be maintained.
4. The coordination plots for phase and ground protective devices shall be provided on A complete system basis.
5. There shall be a maximum of eight protective devices per plot.

D. The selection and settings of the protective devices shall be provided separately in a tabulated form listing circuit identification, device number, current transformer ratios, manufacturer, type, range of adjustments, and recommended settings. Discrepancies, problem areas, or inadequacies shall be promptly brought to the Engineer's attention.

1.7 STUDY REPORT

A. The results of the power system study shall be summarized in a final report. Three (3) bound copies of the final report shall be submitted to the Engineer's representative.

B. The report shall include the following sections:

1. Description, purpose, basis, written scope, and a single-line diagram of the portion of the power system which is included within the scope of study.
2. Tabulations of circuit breakers and other equipment ratings versus calculated short-circuit duties, and commentary regarding same.
3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings and commentary regarding same.
4. Fault current tabulations include a definition of terms and a guide for interpretation.
5. Tabulation of appropriate tap settings for relay seal-in units.

1.8 IMPLEMENTATION

The agency performing the short circuit analysis and coordination study shall be responsible for setting, testing, and calibrating the protective relays, circuit breakers, fuses, and other applicable devices as recommended in the power system study report.

PART 2 – PRODUCTS

2.1 TESTING AGENCY

A. Coordination

1. The short-circuit analysis and coordination study must be done in accordance with the IEC 60909 and supervised by a Professional Engineer

PART 3 – EXECUTION

3.1 INSTALLATION

A. Testing must be done in such a manner that down time is kept to a minimum.
B. Coordinate all power outages with the Owner.
C. This contractor shall engage an independent testing firm for the purpose of inspection, setting, testing, and calibrating protective relays, circuit breakers, fuses, and all other applicable devices.

END OF SECTION

SECTION 260553 – IDENTIFICATION OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes electrical identification materials and devices.

1.2 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes and standards. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:
   1. Power Circuits: Black letters on an orange field.
   2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 50 mm (2 inches) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 50 mm (2 inches) wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 0.08 mm thick by 25 to 50 mm wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

C. Aluminum Wraparound Marker Labels: Cut from 0.35-mm thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

D. Metal Tags: Brass or aluminum, 50 by 50 by 1.3 mm with stamped legend, punched for use with self-locking nylon tie fastener.

E. Write-On Tags: Polyester tag, 0.38 mm thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
   1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
   1. Not less than 150 mm wide by 2 mm thick.
   2. Compounded for permanent direct-burial service.
   3. Embedded continuous metallic strip or core.
   4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

A. Comply with NFPA 70: 2017 & 101: 2018.

B. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose acetate butyrate signs with 1-mm galvanized-steel backing; and with colors, legend, and size required for application. 6.4-mm grommets in corners for mounting. Nominal size, 250 by 360 mm.

C. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 915 MM."

2.5 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1.6 mm thick for signs up to. 129 sq. cm and 3.2 mm thick for larger sizes.
   1. Engraved legend with [black letters on white face]
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 10 mm.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 10 mm. Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.

C. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 10 mm.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 10 mm.

E. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 25 mm.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
   1. Minimum Width: 5 mm.
   2. Tensile Strength: 22.6 kg, minimum.
   3. Temperature Range: Minus 40 to plus 85 deg C.
   4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
   1. Exterior Concrete, Stucco, and Masonry (Other Than Concrete Unit Masonry):
      a. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
         1) Primer: Exterior concrete and masonry primer.
         2) Finish Coats: Exterior semigloss acrylic enamel.
   2. Exterior Concrete Unit Masonry:
      a. Semigloss Acrylic-Enamel Finish: Two finish coats over a block filler.
         1) Block Filler: Concrete unit masonry block filler.
         2) Finish Coats: Exterior semigloss acrylic enamel.
   3. Exterior Ferrous Metal:
      a. Semigloss Alkyd-Enamel Finish: Two finish coats over a primer.
         1) Primer: Exterior ferrous-metal primer.
         2) Finish Coats: Exterior semigloss alkyd enamel.
   4. Exterior Zinc-Coated Metal (except Raceways):
      a. Semigloss Alkyd-Enamel Finish: Two finish coats over a primer.

1) Primer: Exterior zinc-coated metal primer.
2) Finish Coats: Exterior semigloss alkyd enamel.

5. Interior Concrete and Masonry (Other Than Concrete Unit Masonry):
   a. Semigloss Alkyd-Enamel Finish: Two finish coats over a primer.
      1) Primer: Interior concrete and masonry primer.
      2) Finish Coats: Interior semigloss alkyd enamel.
6. Interior Concrete Unit Masonry:
   a. Semigloss Acrylic-Enamel Finish: Two finish coats over a block filler.
      1) Block Filler: Concrete unit masonry block filler.
      2) Finish Coats: Interior semigloss acrylic enamel.
7. Interior Gypsum Board:
   a. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
      1) Primer: Interior gypsum board primer.
      2) Finish Coats: Interior semigloss acrylic enamel.
8. Interior Ferrous Metal:
   a. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
      1) Primer: Interior ferrous-metal primer.
      2) Finish Coats: Interior semigloss acrylic enamel.
9. Interior Zinc-Coated Metal (except Raceways):
   a. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
      1) Primer: Interior zinc-coated metal primer.
      2) Finish Coats: Interior semigloss acrylic enamel.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Raceways and Duct Banks More Than 600 V Concealed within Buildings: 100-mm wide black stripes on 250-mm centers over orange background that extends full length of raceway or duct and is 300 mm wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 75-mm high black letters on 500-mm centers. Stop stripes at legends. Apply to the following finished surfaces:
   1. Floor surface directly above conduits running beneath and within 300 mm of a floor that is in contact with earth or is framed above unexcavated space.
   2. Wall surfaces directly external to raceways concealed within wall.
   3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER HIGH VOLTAGE" in black letters at least 50 mm high, with snap-around labels. Repeat legend at 3-m maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange snap-around label.

D. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands, snap-around, color-coding bands:

1. Fire Alarm System: Red.
2. Fire-Suppression Supervisory and Control System: Red and yellow.
3. Combined Fire Alarm and Security System: Red and blue.
4. Security System: Blue and yellow.
5. Mechanical and Electrical Supervisory System: Green and blue.
6. Telecommunication System: Green and yellow.
7. Control Wiring: Green and red.

E. Power-Circuit Conductor Identification: For primary and secondary conductors $50mm^2$ and larger in vaults, pull and junction boxes, manholes, and handholes use metal tags. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

F. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use metal tags. Identify each ungrounded conductor according to source and circuit number.

G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

H. Cables shall be labeled at both ends with durable type label having a minimum lifetime of 15 years. Main power cables shall be labeled every 5 to 10m.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
   3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.
   2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

L. Instruction Signs:
   1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 10-mm high letters for emergency instructions at equipment used for power transfer and load shedding.

M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
   a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 13-mm high letters on 38-mm high label; where 2 lines of text are required, use labels 50 mm high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
2. Equipment to be Labeled (as applicable):
   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Transformers.
   e. Electrical substations.
   f. Emergency system boxes and enclosures.
   g. Motor-control centers.
   h. Disconnect switches.
   i. Enclosed circuit breakers.
   j. Motor starters.
   k. Push-button stations.
   l. Power transfer equipment.
   m. Contactors.
   n. Remote-controlled switches, dimmer modules, and control devices.
   o. Battery inverter units.
   p. Battery racks.
   q. Power-generating units.
   r. Voice and data cable terminal equipment.
   s. Master clock and program equipment.
   t. Intercommunication and call system master and staff stations.
   u. Television/audio components, racks, and controls.
   v. Fire-alarm control panel and annunciators.
   w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
   x. Monitoring and control equipment.
   y. Uninterruptible power supply equipment.
   z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Phase Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
   1. Color shall be factory applied.
   2. Colors for 220/380-V Circuits:
      a. Phase A: Brown.
      b. Phase B: Black.
      c. Phase C: Orange.
      d. Neutral: Light Blue.
      e. Ground (PE): Green-Yellow.
   3. Alternative colors for 220/380-V Circuits:
      a. Phase A: Red.
      b. Phase B:. Black
      c. Phase C: Blue.
      d. Neutral: Grey.
      e. Ground (PE): Green-Yellow f.
   4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 150 mm from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 150 to 200 mm below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 400 mm (16 inches) overall.

J. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

END OF SECTION

SECTION 262416 – PANEL BOARDS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including Conditions of Contract and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: Lighting and power panelboards SMDB's, MCC's and FDB's and associated auxiliary equipment rated 600 V and less.

B. Related Sections include the following:
   1. Section 260500, "Common Work Results for Electrical."
   2. Section 260519, "Low-Voltage Electrical Power Conductors and Cables."
   3. Section 260525, "Grounding and Bonding for Electrical Systems."

C. Contractor shall provide all Labor, Materials, Contractor's Equipment and Plant to fully execute the requirements to furnish, deliver, and install the Works as expressly described in the Contract Documents, or implied therefrom, and in accordance with the Contract. This Specification section intends that the work performed pursuant here to be complete and acceptable in every respect for its intended purpose. It is further required that the provisions of this Specification section shall be complementary to and shall be correlated with, the requirements of the Contract. Nothing in this specification section shall limit the scope of Work as required by the Contract.

D. Execute the Work in accordance with the intent and meaning of the Drawings and Specifications. Provide all accessories and other items essential for the proper performance and completion of the Work. Execute all Work, including the provision of necessary materials, which can be reasonably inferred, whether specifically shown or described in the Drawings and Specifications.

E. If this specification conflicts with any applicable local or international code or standards or conflict with any other requirements stated in the Contract Documents, then the stringent requirement shall prevail.

1.3 DEFINITIONS

A. IEC: The International Electro-Technical Commission.
B. MCB: Miniature circuit breaker.
C. MCCB: Molded case circuit breaker.
D. SMDB: Sub Main Distribution Board
E. DB: Final distribution board.
F. ELCB: Earth leakage circuit breaker.
G. RMS: Root mean square.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, accessory item, and component specified.

B. Shop Drawings: For panelboards. Include dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include the following
   1. Enclosure type with details.
   2. Bus configuration and current ratings.
   3. Short-circuit current rating of panelboard.

4. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
5. Wiring Diagrams: Details of schematic diagram including control wiring and differentiating between manufacturer-installed and field-installed wiring.

C. Panel-board Schedules: For installation in panelboards. Submit final versions after load balancing.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around panelboard where piping and ducts are prohibited. Show panelboard layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Identify field measurements.

B. Manufacturer Seismic Qualification Certification: Submit certification that panelboard, accessories, and components will withstand seismic forces. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the specified seismic forces.
   b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Qualification Data: For professional engineer and testing agency.

D. Source quality-control test reports.

E. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

Operation and Maintenance Data: For equipment to include in emergency, operation, and maintenance manuals, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.
3. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
4. Detail operating instructions for both normal and abnormal conditions.

1.7 QUALITY ASSURANCE

A. Unless otherwise specified, equipment and materials are to be designed, manufactured, installed and tested in compliance with the requirements of the LOCAL REGULATIONS, IEC 60439 and the following relevant codes and standards. In the event of any conflict arising between these documents, the more stringent of these are to be followed:
   1. IEC 61439 "Low Voltage Switchgear and Control Gear Assemblies".
   2. IEC 60947-2 "Molded case circuit breakers"
   3. IEC 60898 "Miniature circuit breakers"
   4. Other components where not specified are to comply with the relevant IEC standards.

B. Testing shall be carried out by the manufacturer's authorized qualified engineers.

C. Unless accepted otherwise by the Company, use manufacturers and installers that employ a Quality Management System complying with the program described in ISO 9001-2000, or similar system.

D. Compliance with Local Requirements: Comply with applicable local regulations/code requirements of authorities having jurisdiction. These will have precedence over other codes/standards nominated for the project, unless otherwise approved in writing.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for main distribution boards, including clearances between main distribution boards, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.8 COORDINATION

Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.9 PROJECT CONDITIONS

Environmental and Project Limitations
Refer to section 260500 Common Work Results for Electrical Systems

1.10 MAINTENANCE AND REPAIR

Where practicable, use suppliers of materials, products and equipment having an office and maintenance service based in Lebanon.

1.11 WARRANTY

A. Unless otherwise stated in this specification section all materials, assemblies, components parts and workmanship shall be guaranteed against defect, damage, or non-conformity for a period of one (1) year from testing and commissioning at site.

B. During the guarantee period the manufacturer shall make all necessary repairs or replacement to achieve conformity to the requirements of the Contract Documents.

1.12 EXTRA MATERIALS

A. Spare Parts: Provide manufacturer's recommended spare parts for emergency replacement and/or three years' maintenance along with a complete priced list of these spare parts, including, but not limited to, the following.
   1. 2% of each circuit breaker and switch type and rating installed. Furnish at least one of each type.
   2. Keys: 6 spares of each type for panelboard cabinet lock.

B. The contractor must provide spare parts for about 10% minimum from the total amount of the supplier components.

C. Tools and Instruments: Provide tools and instruments required for normal routine inspection and maintenance and testing of circuit breakers and protective devices as appropriate for type of panelboard supplied.

PART 2 – PRODUCTS

1.13 GENERAL REQUIREMENTS

A. Rated insulation voltage is to be in accordance with the respective standards.
B. Panelboards are to be totally enclosed, dead front type, protection code IP 42 for indoor installations and IP 55 for outdoor installations and are to be factory designed and assembled.
C. Earthing bar is to be half the size of busbars.
D. Neutral bars are to be sized as the phase bus bars.
E. Protection is to be fully rated throughout the system.
F. Circuit breakers are to be the non-fused type.
G. Arrangement: Panelboards are to have one main incoming molded case switch and the required number of branch circuit breakers, including spare circuit breakers and spaces for future expansion. Three-phase panelboards are designed for sequence phase connection of branch circuit devices.
H. Branch Circuit Numbering: On 3-phase panelboard schedules, circuits 1 is to be connected to red m(R) phase 2 to yellow (Y) phase, 3 to blue (B) phase etc., to conform with branch circuit numbering shown on the sample schedule.

1.14 LIGHTING AND APPLIANCE BRANCH-CIRCUIT FINAL DISTRIBUTION PANELBOARDS

A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units with integral RCBO.
B. Doors: In front board panel, with concealed hinges. Secure with flush catch and cylinder or tumbler lock, all keyed alike with two keys per cabinet.
C. Provide 15 percent future space for over-current protective devices.

1.15 FINAL DISTRIBUTION PANELBOARDS

A. Doors: In panelboard front, except omit in fusible-switch panelboard, unless otherwise indicated. Secure door with vault-type latch with cylinder or tumbler lock, all keyed alike with two keys per cabinet.
B. Branch-Circuit Breakers: Where overcurrent protective devices are indicated to be circuit breakers, use bolt-on circuit breakers.
C. Provide spare as per the below.
Spare circuit breaker quantity shall be calculated based on the following approach
a. No electrical loads associated with these spare breakers shall be considered in panel.
b. 20% minimum spare breakers are required

1.16 MOULDED CASE CIRCUIT-BREAKERS

A. All MCCB's shall be to IEC 60947 and of the current limiting type.
B. MCCB’s shall be of the quick-make and break, independent, trip-free type with mechanical ON/OFF/TRIPPED indication as well as for connection to the BMS.
C. For switchboard mounting MCCB's shall be the cubicle mounting type with door mounted padlock, rotary type operating handle (Form 4). They shall be of the fixed pattern with

fully shrouded fixed contacts. Interlocks shall be provided to prevent the opening of the front cover with the operating handle in the 'ON' position.

D. The operating mechanism shall operate all poles simultaneously during opening, closing and tripping operations.

E. All MCCB's above 250A (excluding 250A) shall have front adjustable electronic release with adjustment in the range 50 – 100% of nominal overloads and 2-10 times in for short-circuit faults.

F. Ensure that full discrimination is achieved between the up and downstream devices as per authority requirements. Selection of MCCB's on the cascade principle will not be accepted.

G. MCCB's shall be of a type suitable for the fitting of motorized operators or shut trip devices.

1.17 MINIATURE CIRCUIT BREAKERS (MCBs)

A. Type: Thermal magnetic non-adjustable type, tested in accordance with, IEC 60898.

B. Minimum short-circuit breaking capacities (to IEC 60898) are to be as follows: 1. 6-100 A MCB: 6, 10, 16, 25 or 50 kA at 240/415 v A.C.

C. Construction: MCBs are to be tropicalized for operation at ambient temperatures up to 70°C within panelboard enclosure and humidity up to 95%, and are to be constructed from high quality, high temperature, molded insulating materials. Guaranteed duties and characteristics are to be submitted for temperatures above 40°C.

D. MCBs and combination devices are to be modular, of unified profile and suitable for mounting to a plug-in system.

E. Operation: Under overload conditions, thermal tripping is to provide close protection of insulated conductors. Under short-circuit conditions, magnetic trip is to operate at 7 - 10 times normal rated current (type 3 characteristic). Magnetic operation is to be in the current limiting region and opening time is not to exceed 5 milliseconds.

F. Ratings: Preferred rated currents are to be 6, 10, 15, 20, 25, 30, 40, 50, 60, 80 and 100 A, calibrated at 40°C, available as 1, 2, 3 and 4-pole circuit breakers. Derating above 40°C is not to exceed 1% per degree C and loading is not to exceed 70% of circuit breaker rating.

G. Residual current devices for earth leakage protective circuit breakers are to be add-on devices, or built-in and integral with the standard circuit breaker. Non-adjustable sensitivities of 30 mA, 100 mA and 300 mA are to be available for all ratings of 2-pole and 4-pole circuit breakers.

H. Auxiliaries are to include alarm switch, auxiliary switch, shunt trip, under voltage trip and similar units which are to be modular additions to the circuit breakers.

1.18 RESIDUAL CURRENT CIRCUIT DEVICES

A. Residual current circuit devices (RCCD) shall comply with IEC 61008 (RCCD) and IEC 61009 (RCBO). General Power outlets for maintenance used in service rooms shall be provided with safety 30 mA RCD residual current devices or RCCB termed as residual current circuit breaker. The RCD/RCCB shall be integral to the distribution board. The circuit breakers associated with these circuits shall be single or three pole.

B. The units shall be double or four - pole as required and mounted enclosed within the distribution board panels or purpose made enclosure.

C. The RCCD/RCBO shall automatically open the protected circuit on an earth leakage fault between phase and earth equal to or greater than the fault current sensitivity rating of the device.

D. The sensitivity ratings of the RCCD/RCBO shall be as indicated on the schematic diagrams and where specified shall be adjustable between the ranges stated.

E. The operating mechanism shall be independent trip-free and shall not be able to be held closed against an earth fault. The units shall be complete with a test button and trip re-set device.

F. The RCCD/RCBO shall have positive contact indication whereby the opening of the device is clearly indicated by a mechanical indicator. This indicator shall be linked to the device main contacts to show the positive opening of all poles.

1.19 ELECTRICITY METERS

A. Each incomer feeder section on a final distribution board shall be provided with an electronic metering system that measures and records at least.
   1. Line current.
   2. Instantaneous and maximum of each phase
   3. Line and phase voltages
   4. Active, reactive and apparent power
   5. Harmonics.

B. The meter shall be of a type with a clear display and easy to operate, cycle through controls. The display shall be backlit for easing reading. The meter shall be provided with an integral battery backup that will maintain the recorded data memory for at least forty-eight hours.

C. The meter should be capable of being connected to a BMS system for remote interrogation, monitoring and recording and have the facility to download its data records to the BMS system computer.

D. The meter should be installed at a convenient location in the switchboard section, suitable for easy reading and be complete with all CT's selector switches etc.

E. Electricity meters shall comply with BS EN 61036, of the whole current type.

F. Meter boards, where required, shall be of 20mm thick resin bonded wood chipboard.

1.20 INSTRUMENTATION

A. Unless specified elsewhere, the SMDB shall be provided with the following minimum instrumentation on the main incoming switch:
   1. One voltmeter with line voltage and phase voltage selector switch.
   2. One ammeter with line selector switch.

B. The instrumentation shall be flush mounted within the panel front of the switchboard, located immediately above the switches with which it is associated.

C. Current and voltage transformers shall be mounted within separate chambers within the switchboard. Transformers shall conform to BS EN 60044.

D. All instruments shall conform to BS 89, accuracy Class 1.5 (min) and to DIN 43700 style, minimum size 72mm square.

E. Ancillary fuses shall be labeled with the functions and operating details including fuse type and rating. All auxiliary wiring shall be labeled by permanent slip-on numbered ferrules. Terminal blocks and terminations shall be similarly identified.

1.21 METERING INSTRUMENTS

A. Generally: Instruments are to be housed in enameled, square, cases for flush installation. Scales and markings are to be protected and sealed. Accuracy of instruments is to be within 2% unless otherwise specified. All metering instruments shall be with low glare windows and potential terminals shall be covered against accidental contact and consequent damage.

B. The following metering devices are to be provided:
   1. 3 ammeters 144 by 144 mm or 96 by 96 required with compressed seal.
   2. Incomers are to have 3 phase sensors to provide switching in case of phase loss, phase reversal or under voltage and automatic restoration on normalization to prevent loss of supply.
   3. All incomer meters shall be 144 x 144 mm size and all outgoing meters shall be of 96 x 96 mm size

C. Voltmeters: Moving iron type, with center zero adjuster, range 1.25 times nominal system voltage, 90degree angle, size 96 x 96 mm.
D. Voltmeter Selector Switch: 7-position rotary type.
E. Ammeters: Moving iron type, with center zero adjuster, range 2-times nominal circuit amperage, 90degree angle, size 144 by 144 mm.
F. Current Transformer (CT) shall comply to BS EN 60044, Indoor dry type, rated secondary current 5A. Rated primary current, core size and accuracy are to be determined in accordance with nominal current of plant protected, short-circuit level and burden.
G. Voltage Transformer (VT) shall comply to BS EN 61869, provided where required, complete with primary and secondary fuses and disconnecting device.
H. Microprocessor Based Monitoring Device: Provide complete electrical metering (kW, kVA, kVAR, power factor, frequency, Amp. per phase, single phase and composite phase voltage, etc.) and is to be connected with PMCS for monitoring.

1.22 WIRING

A. Arrangement: Wiring is to be modularly and neatly arranged on master terminal boards with suitable numbering strips and appropriate cartridge type fuses where required. All control wiring is to be neatly enclosed in special trunking and secured in place.
B. Connections are to be made at front of the terminal board and with no live metal exposed. All terminations to be carried out with end-lugs / ferrules.
C. Metal cases of instruments, control switches, relays etc. are to be connected, by bare copper conductors not less than 2.5 mm 2 section, to the nearest Earthing bar. Multi-core cables. Finely stranded copper conductor, silicon rubber insulated cables are to be used in proximity to higher temperature components and as flexible cable.
E. Ferrules: Wires are to be fitted with numbered ferules of approved type at each termination.

1.23 ACCESSORY COMPONENTS AND FEATURES

Accessory Set: Include tools and miscellaneous items as required for overcurrent protective, inspection, maintenance, and operation.

PART 3 – EXECUTION

1.24 INSTALLATION

A. Install panelboards and accessory items according to IEC 60439.
B. Mounting Heights: Top of trim 1880 mm above finished floor, for functional units, unless otherwise indicated.
C. Mounting: Plumb and rigid without distortion of box. Mount flush panelboards uniformly.
D. Circuit Directory: Type directory to indicate installed circuit loads after balancing panelboard loads. Obtain approval before installation.
E. Install filler plates in unused spaces.
F. Wiring in Panelboard Gutters: Arrange conductors into groups, and bundle and wrap with wire ties after completing load balancing.
G. Connecting conduits shall not be used as support.

1.25 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs.
B. Panelboard Nameplates: Label each panelboard with engraved laminated-plastic or metal nameplates mounted with corrosion-resistant screws.
C. Labels and diagrams All switchgear/ fuse gear / disconnectors and distribution units, etc., shall be clearly marked with engraved laminated plastic labels, secured by screws to

the cases, clearly indicating the service, voltage and phase of the circuit or apparatus controlled.

D. A diagram showing the details, rating and function of each switch, size and number of cores of all outgoing cables, location, size and rating of all distribution boards fed from that switchboard and the phase of each outgoing circuit shall be provided at each switchboard.

E. These diagrams shall be mounted in glazed frames or similar of an approved design and the layout and mounting shall be approved by the Company prior to installation.

1.26 GROUNDING

A. Make equipment grounding connections for panelboards as indicated.
B. Provide ground continuity to the main electrical ground bus as indicated.

1.27 CONNECTIONS

Tighten electrical connectors and terminals including grounding connections, according to manufacturer's published torque-tightening values.

1.28 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
1. Make insulation resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuit.
2. Make continuity test of each circuit.

B. Testing Agency: Provide the services of a qualified engineer / representative of the manufacturer to perform specified testing.

1.29 ADJUSTING

Set field-adjustable switches and circuit-breaker trip ranges as indicated.

1.30 FIELD QUALITY CONTROL

A. Generally: Carry out all tests required by the governing codes and by the Company, on panelboards after installation, to verify compliance with the specifications and standards. Inspect conditions within panelboards and verify insulation conditions by use of a megger.

B. Circuit Breakers: Tests are to include operation of every circuit breaker manually. Check automatic operation of selected circuit breakers, as required by Company, by applying necessary short-circuit, overload and earth leakage current for tripping circuit breakers as applicable and compare with manufacturer's data/characteristic curves. Measure and report ambient temperature inside enclosure.

C. Insulation Check Tests: Carry out insulation tests on all busbars, between phases and between phases and earth/cabinet, and between neutral and earth. Record all readings, using 500 V megger for equipment on 240 V systems, and 1000 V megger for equipment on systems up to 600 V, for 1-minute, with circuit breakers in open position.

D. Type Tests:
1. Evidence shall be given that the proposed LV AC distribution board components to be supplied under this Contract have been subject to all type tests at a locally recognized testing agency. If deemed necessary.
2. An internationally recognized laboratory shall certify the type test reports.

3. The Contractor shall submit certified copies of type test certificates covering the proposed LV AC distribution board components.

E. Routine Tests:

1. LV AC distribution boards, circuit breakers, instrument transformers, relays, meters etc., shall comply with the type test requirements and subject to routine tests as per the relevant IEC recommendations.
2. The following tests shall be performed as a minimum requirement.

a. Check of All Meters and Instruments.

In order to ensure correctness of the connections between the associated incoming blocks and the instruments and meters, it is required that three-phase voltage and current be applied at the terminal blocks with the proper phase angle relationship to check the direction of rotation.

b. Complete Functional Test

1) This test is intended to completely check the functional operation of the board. The test shall be a check of all the tripping, closing, changeover switching, auxiliary circuits, interlocking, etc., for each panel or unit.
2) Interlocking Tests
3) Primary injection test for all circuit breakers and meters
4) Secondary test for all protection relays
5) Insulation test. Visual inspection of the entire board, in order to ensure that all components are mechanically assembled and fixed properly and that there are no imperfections shall be performed.

1.31 SITE TESTS

A. General Checks:

1. Check that the AC distribution panel is properly assembled.
2. Check for possible damages.
3. Check the AC panel for cleanliness including interior.
4. Check the frame earthings.
5. Check apparatus earthings.
6. Check earthing devices and earth terminals.
7. Check the gland plates.
8. Check the cable support.
9. Check the terminal arrangement.
10. Check painting.
11. Check rating plates, manufacturer plate.
12. Check keys.
13. Check conductor cross-sections.
14. Check air gaps.
15. Check lifting rings
16. Check the cable arrangement
17. Check the internal components as per the approved drawing.

B. Operational Checks:

1. Mechanical Operating Tests:
a. Circuit-breakers.
b. Isolators.
c. MCBs.
d. Switches.
e. Operating devices.
f. Door, cover plates and their locks
g. Torque test for bus bar joints
h. Phase sequence & loss of phase.

C. Electrical Operating Tests:

1. Phase sequence.

2. Main and auxiliary voltage.
3. Local control.
4. Remote control.
5. Inter lockings.
6. Releases.
7. Operating change-over automation.

D. Measurements:

1. Voltage Test 2000 V, 50 Hz, 1 min (IEC 60255-4)
a. R+Y+B+N/ framework.
b. R/Y+B+N+ framework.
c. Y/R+B+N+ framework.
d. B/R+Y+N+ framework.
e. N/R+Y+B+ framework.
2. Insulation Resistance 500 VDC, R > 50 Mohm (IEC 60255-5)
a. R+Y+B+N/ framework.
b. R/Y+B+N+ framework.
c. Y/R+B+N+ framework.
d. B/R+Y+N+ framework.
e. N/R+Y+B+ framework.
f. Current Transformer testing
3. Voltage transformer testing
4. Protection relays testing
5. Ammeters, Voltammeter and Energy meter (KWH) calibration test.
6. Air Circuit breaker test
7. Current and Voltage transducer testing
8. Bus Bar contact resistance test.
9. AC high voltage test (2 KV AC / 1 min.) for bus bar and control wiring.
10. Tripping of CB through protection relay.

1.32 ADJUSTING

Set field-adjustable switches and circuit breaker trip ranges.

1.33 DEMONSTRATION

Train Company maintenance personnel to adjust, operate, and maintain the system installation. Refer to Division 1.

END OF SECTION

SECTION 262726 – WIRING DEVICES AND DISCONNECTS

PART 1 - GENERAL

1.1 GENERAL WORK GENERALLY is to be in accordance with the requirements of Section 260000 of the Specification.

1.2 DESCRIPTION OF WORK: wiring devices, lighting switches, socket outlets, cord outlets, automatic and manual lighting control equipment, dimmers, outlet boxes and plates, disconnect switches etc…

1.3 STANDARDS: components are to be standard manufactured items, uniform and modular, complying with one set of approved Standards.

1.4 EQUIPMENT DATA: submit data for approval, including catalogues, detailed literature, manufacturer's name, catalogue number, rating, specification, overall dimensions and special features, as applicable for each item.

1.5 SHOP AND CONSTRUCTION DRAWINGS: submit drawings for approval including, but not limited to, the following:

A. Exact indication of position of each item and outlet box and fitting on layout drawings, with box and equipment types and sizes.

B. Installation details of special items including LV transformers, isolating switches, fans etc…

C. Wiring diagrams of special items.

1.6 SAMPLES: submit samples of each type of device for approval, unless otherwise agreed in writing by the Engineer.

1.7 SPARE PARTS:

A. provide manufacturer's recommended spare parts for replacement and one year's maintenance including, but not limited to, the followings:

1. Wiring Devices Faceplates: Quantity equal to 3 percent of amount of each type installed, but not less than two units of each type.
2. Lighting Switch: Quantity equal to 3 percent of amount of each type installed, but not less than five units of each type.
3. Socket Outlet: Quantity equal to 3 percent of amount of each type installed, but not less than five units of each type.
4. Lighting Contactor: Quantity equal to 3 percent of amount of each type installed, but not less than one unit of each type.
5. Dry-type transformer: Quantity equal to 3 percent of amount of each type installed, but not less than one unit of each type.

6. Switch Disconnector: Quantity equal to 3 percent of amount of each type installed, but not less than one unit of each type.
7. Push-Button: Quantity equal to 3 percent of amount of each type installed, but not less than five units of each type.
8. Manual Switch: Quantity equal to 3 percent of amount of each type installed, but not less than five units of each type.
9. Surface Mounted Outlet Boxes: Quantity equal to 3 percent of amount of each type installed, but not less than one unit of each type.

1.8 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Special Warranty: A written warranty, signed by Contractor and manufacturer, agreeing to replace any wiring devices component that do not meet requirements or that fail within the specified warranty period.
   1. Warranty Period: 3-year from date of Substantial Completion for any component of the system.

PART 2 - PRODUCT AND SYSTEMS

2.1 FITTINGS

A. OUTLET BOXES AND PLATES GENERALLY
   1. SURFACE OR RECESSED BOXES are to be suitable for type of related conduit or cable system. Shapes and sizes of boxes are to be compatible standards as switches, socket outlets and lighting fixtures selected and of various types and mounting methods required.
   2. UNUSED OPENINGS in outlet boxes are to be closed with knock-out closers manufactured for the purpose.
   3. BLANK PLATES: blank plates are to be installed on outlet boxes on which no apparatus is installed or where apparatus installed does not have suitable cover for box. Blanks plates for wall outlets are to be attached by a bridge with slots for horizontal and vertical adjustment.
   4. FLOOR OUTLETS AND PLATES are to be water-tight and impact resistant.

B. METALLIC OUTLET BOXES
   1. RECESSED AND CONCEALED BOXES: galvanized pressed steel, with knock- outs for easy field installation. Special boxes are to be punched as required on Site. Minimum depth to be 5cm.
   2. EXPOSED SURFACE MOUNTED BOXES: galvanized cast iron with threaded hubs.
   3. OUTDOOR SURFACE OR RECESSED BOXES: galvanized cast iron with threaded hubs and PVC gaskets to ensure water tightness and with stainless steel or non-ferrous, corrosion resistant screws.
   4. FLOOR BOXES: watertight, cast iron or cast metal alloy with corrosion resistant finish, adjustable mounting, standard duty, round or square, factory drilled and tapped for required conduit sizes, and with brass cover and flange with brushed finish free from markings other than required for mounting screws.

5. FLAME- PROOF BOXES: malleable iron or cast iron, with gas threaded hubs, special covers with silicon rubber gaskets, gas tight, and water- tight. Boxes are to comply with the Regulations for explosive areas.
6. MANUFACTURERS: obtain metallic outlet boxes from same manufacturer as conduit or other approved, and to the satisfaction of the Engineer.

C. MOULDED PLASTIC OUTLET BOXES
1. TYPE: boxes and covers used with PVC conduit systems are to be heavy gauge pressure molded plastic, minimum 2 mm thick, self-extinguishing, with softening point not less than 85°C. Boxes are to have provision for securely terminating conduits and are to be manufacturer's standard for required application. Minimum depth to be 5cm.
2. FITTINGS: boxes are to have brass inset threads to receive cover screws and for mounting devices or accessories, push- fit brass earth terminals, and steel insert clips to provide additional support for pendants or for heat conduction. Neoprene gaskets are to be provided for weatherproof installations.

D. PLATES AND CORD- OUTLETS
1. DESIGN: square, rectangular or round, designed to cover outlet box and to closely fit electrical device, and with polished chromium plated recessed head fixing screws. Combination plates are to be used for grouped outlets and devices.
2. CORD EXTENSION PLATES are to have threaded cord grip bushings of same material and finish as plates.
    a. Technical Spaces and areas subject to ingress (electrical, mechanical plant rooms, storage rooms and similar): Heavy gauge, break resistant, pressure molded plastic, grey color, IP557
        1) Manufacturers: Refer to List of approved electrical manufacturers.
    b. Outdoor locations: Heavy gauge, break resistant, anti-bacterial metal construction wiring devices. IK10 for dry areas and IP55- IK10 (IP55-10) for wet areas.
        1) Manufacturers: Legrand Sagane Roc or Soliroc or approved equal

3. CABLE/ CORD OUTLET are to be used for up to 45 A, 250 V rating for connection of power/ control cable of fixed appliances. Plate is to have threaded cord grip to anchor cable securely to cover. Box is to include fixed terminal block and cable clamp for termination of cable/cord within.

E. SWITCHES
1. GENERALLY: quick- make, quick- break type with silver alloy contacts in arc resisting molded base, with toggle, rocker or push- button as specified, for inductive or resistive loads up to full rated capacity, and arranged for side and/or back connection.
2. TYPES: single, two- way or intermediate, single pole or double pole, as shown on the Drawings.
3. GENERAL LIGHTING SWITCH: 10 A 250 V A.C, rocker operated, grid-switch with plate, for indoor installations in general, unless otherwise indicated. The switches shall be available in single or multi-gang, one-way, two-way and intermediate configurations.

a. Technical Spaces and areas subject to ingress (electrical, mechanical plant rooms, storage rooms and similar): Heavy gauge, break resistant, pressure molded plastic, grey color, IP557
   1) Manufacturers: Refer to List of approved electrical manufacturers
b. Outdoor locations: Heavy gauge, break resistant, anti-bacterial metal construction wiring devices. IK10 for dry areas and IP55- IK10 (IP55-10) for wet areas.
   1) Manufacturers: Refer to List of approved electrical manufacturers

F. PUSH BUTTON SWITCH: 10 A 250 V A.C, push-button operated, grid-mounted with plate, for indoor installations in general, unless otherwise indicated. The push-buttons shall be available in single or multi-gang:
   a. Technical Spaces and areas subject to ingress (electrical, mechanical plant rooms, storage rooms and similar): Heavy gauge, break resistant, pressure molded plastic, grey color, IP557
      1) Manufacturers: Refer to List of approved electrical manufacturers
   b. Outdoor locations: Heavy gauge, break resistant, anti-bacterial metal construction wiring devices. IK10 for dry areas and IP55- IK10 (IP55-10) for wet areas.
      1) Manufacturers: Refer to List of approved electrical manufacturers

G. MANUAL SWITCH: 2 pole, for fractional single and three phase motors and appliances, to interrupt motor and induction loads, rated 20 A at 415 VAC, toggle operated, with positive and luminous indication of on/off position of contacts.
   a. General Use (non-decorated area): Heavy gauge, break resistant, pressure molded plastic, white color.
   b. Technical Spaces and areas subject to ingress: Heavy gauge, break resistant, pressure molded plastic, grey color, IP56
      Refer to List of approved electrical manufacturers

2.2 SOCKET OUTLETS

A. GENERALLY: to have injection moulded plastic base with self- adjusting, non-expanding contacts to prevent permanent distortion, arranged for side and/or back connection and with screw terminals accepting at least three parallel branch- circuit wires.

B. TYPES: general-purpose socket outlets are to conform to German standard practice concerning layout & rating).

C. DUPLEX SOCKETS are to be mounted in parallel under one common plate with break- off feature for two-circuit connection.

D. WEATHERPROOF SOCKET OUTLETS are to be any of the types indicated, enclosed in surface mounted cast metal box and with cover comprising spring-retained gasketted hinged flap. Enclosure is to be pre- designed box and cover for type of socket outlet specified.

E. GERMAN STANDARD SOCKET: single phase, three wires, for plug with round pins, with grounding in accordance with German Standard practice and rated 16 A, 250 V

A.C. UPS sockets shall be by construction (red color, engraving…etc) distinguishable from standard supply sockets. Power sockets individually wired shall be by construction (green color, engraving…etc) distinguishable from standard supply sockets

a. Technical Spaces and areas subject to ingress (electrical, mechanical plant rooms, storage rooms and similar): Heavy gauge, break resistant, pressure molded plastic, grey color, IP557
   1) Manufacturers: Refer to List of approved electrical manufacturers
b. Outdoor locations: Heavy gauge, break resistant, anti-bacterial metal construction wiring devices. IK10 for dry areas and IP55- IK10 (IP55-10) for wet areas.
   1) Manufacturers: Refer to List of approved electrical manufacturers

F. INDUSTRIAL SOCKETS & RELATED PLUGS

1. Are to comply to the following standards:
   a. IEC 60309-1&2: 1999, A2:2012
   b. IEC 529 for IP as indicated on drawings (Ingress Protection)
   c. UL Standards 1682: 2017; 1686-C2: 2012 Pin and Sleeve Type; UL to CSA 22.2 No. 182.2: 1987
   d. Flame Class Rating per UL94: 2013; V0 for Contact Carriers (insulators), HB or better for Housings (UV Stabilized)
2. Current, Voltage, IP & housing material to be as indicated on drawings and/or BOQ
3. Approved Manufacturers: Refer to List of approved electrical manufacturers

2.3 PLUGS

A. TYPE: compatible with type of socket outlet specified, break resistant, of impact resistant moulded insulating material (separable construction), with solid brass pins and cord grip and of shape providing easy hand- grip for removal.

B. QUANTITY: supply number equal to 20% of total number of each type of socket outlet supplied.

2.4 SWITCH DISCONNECTOR (DISCONNECTING SWITCH)

A. RATING: 440 V, 2,3 or 4 pole, load break, short- circuit make, in accordance with IEC 947-3: 2015, unless otherwise mentioned, utilization category 22 for heating and lighting loads, category 23 for motor circuits, and with ampere rating shown on the Drawings.

B. DESIGN: non-fusible, air-break switch disconnect, single throw, safety type, housed in separate metallic enclosure with arc quenching devices on each pole.

C. OPERATING MECHANISM: quick-make, quick-break, independent of operator, with external operating handle mechanically interlocked to prevent opening door unless switch is in open position. Switch disconnect is to have provision for by-passing interlock. Position of handle is to be positive and clearly indicated on cover.

D. ENCLOSURE: General purpose injected polycarbonate for indoor use IP42 (as a minimum unless otherwise specified on drawings), robust thermoplastic enclosure, IP54, for indoor areas subject to ingress (like technical rooms) and weather-proof type aluminum alloy enclosure, IP64 and IK08, for outdoor locations, unless otherwise

required or shown on drawings. Locking of operating handle is to be possible in open and closed positions.

E. MANUFACTURERS: obtain switch disconnect from one of the following of the following or other equal and approved: Refer to List of approved electrical manufacturers

2.5 SPECIAL DEVICES

A. LIGHTING CONTACTORS

1. TYPE: unless otherwise indicated single pole for single phase and neutral circuits, and three pole for three phase circuits, mechanically held electrically operated or with local built-in bypass for locking in OFF or ON positions, rated 500 V, of current ratings shown on drawings and complying with IEC-60287-3-: 2012 category AC7a.
2. CONTACTS: copper alloy, with silver cadmium alloy double break contacts designed for switching inductive ballast loads and switching of tungsten lamp loads.
3. AUXILIARY CONTACTS: as required to provide specified interlocks and signals as shown on the Drawings.
4. ENCLOSURE: unless forming part of system housed in sheet steel panel, contractor is to be provided with IP 42 enclosure for indoor use or IP 65 enclosure for outdoor use or locations subject to ingress (like technical rooms).
5. CONTROL: each contractor whether part of a system or separately enclosed is to have on/off pilot lights and set of on/off/ automatic toggle switch mounted on cover.

B. CONTROL PANELS IN CONNECTION WITH AUTOMATION SYSTEMS

1. GENERAL: control panels are to be of equivalent construction to panel boards with respect to cabinet and interior standards of manufacture, and are to be surface mounted with see- through door and lock.
2. CONSTRUCTION: non- standard modular, factory assembled cabinets, designed to receive appropriate, relays transformers and the like as required in conformity with the Drawings for operation of system locally and remotely from central control and monitoring system console.
3. CONTROL: switching relays controlled remotely by the automation system are to be provided with over- riding manual local individual controls. Appropriate interface components are to be provided and coordinated with the system described.
4. RELAYS, SWITCHING COMPONENTS, PILOT LIGHTS, CONTROL TRANSFORMERS, FUSES ETC. are to be neatly arranged and mounted inside dust- tight and, where necessary, water- tight cabinets. Control and indication devices are to be continuously visible and accessible for monitoring and control.
5. EQUIPMENT is to be electrically front shielded and enclosed by sheet metal barriers, readily accessible and demountable. Wiring is to be neatly arranged, clipped and terminated in pressure type terminals. Hardware is to be non-corroding and robust material, approved by the Engineer.
6. CURRENT TRANSFORMERS are to have auxiliaries to enable connection to automation system.

7. OVERCURRENT RELAY is to be provided with all other accessories. Upon detecting fault on monitored control panel, corresponding bolt-on breaker unit is to trip, and fault signal is to be sent to the automation system.
8. INSTRUMENT AND INSTRUMENT TRANSFORMERS are to be provided as required and/or as indicated on the Drawings.
9. CURRENT TRANSFORMERS: bar primary type to IEC 61869-2: 2012 class
   0.5 for metering. Current rating is to be the next higher standard value above maximum demand load current.
10. TEST BLOCKS AND PLUGS are to be provided for testing all instruments and instrument transformers.

PART 3 - FIELD AND INSTALLATION WORK

3.1 INSTALLATION

A. LOCATIONS: the Drawings generally show approximate locations of outlets and equipment. Exact locations are to be determined from interior finishing and detail drawings. Any condition that would place an outlet in an unsuitable location is to be referred to the Engineer. Locate switches at strike sides of doors, whether shown on the Drawings or not. In locating outlets allow for overhead pipes, ducts, variations in arrangement, thickness of finishing, window trim, paneling and other architectural features.

B. MOUNTING HEIGHTS for outlet boxes and similar equipment are to be uniform within the same or similar areas. Mounting is to be as shown on the Drawings or as approved by the Engineer. Unless otherwise shown or instructed, mount lighting switches and socket outlets generally at 1200 mm and 300 mm from finished floor level respectively. Mount switches with long dimension vertical and operating handle, if of the toggle type, up when in the on position.

C. SINGLE POLE SWITCHES are to switch the phase wire. Do not run neutral wire through switches having neutral shunt or bridge.

D. ADDITIONAL OUTLETS to those shown on the Drawings are to be provided as required by equipment manufacturers for control or other wiring.

E. EXPOSED OUTLET BOXES: securely fasten to wall with machine screws to permanent inserts or lead anchors.

F. RECESSED OUTLET BOXES: make neat openings, to the satisfaction of the Engineer, allowing for thickness of finishing and use extension rings if required. Repair damaged finishing to original condition before installation of fittings or plates.

G. APPEARANCE: install exposed boxes and plates plumb, square and parallel to finished wall surface. Exposed plates covering recessed boxes are to rest neatly on wall surface without gaps, and fully covering the box.

H. GROUPED OUTLETS: arrange neatly so that use of fittings is convenient and clear.

I. WATERPROOF AND EXPLOSION- PROOF FITTINGS: follow manufacturer’s instructions for installation and connection to conduit system to fully achieve required degree of protection.

J. DAMAGED FITTINGS: reject damaged fittings or plates with damaged finish. Protect fittings and plates against damage after installation and handed over.

K. CONNECTION OF APPLIANCE:

1. Where appliance is designed to adapt directly to outlet box, extend electrical wiring to incoming terminals inside appliance.
2. Where appliance is not designed to adapt to outlet box, install connecting wiring in flexible conduit firmly fixed to outlet box cover plate and to terminal box on appliance.

L. Any device, components or equipment to be installed in the floor area especially when critical case is important such operation rooms, ICU and CSSD area shall be specified with anti-bacterial resistant item.

3.2 INSPECTION AND TEST ON SITE

A. VISUAL INSPECTION: fittings and equipment are to be inspected for fixing and workmanship.

B. MEGGER TESTS are to include switch and socket outlet tests together with insulation resistance of wiring installations.

C. OPERATION: devices are to be tested for operation and are to perform as intended at full load without any signs of heating.

D. EQUIPMENT is to be insulation tested and observed, under full- load for not less than 3 days operation, with respect to undue heating and performance in general.

END OF SECTION

SECTION 265113 - LIGHTING SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORKS

A. A Lighting system will be provided in accordance with international standards and as shown on drawings.
B. This section includes:
   1. Interior lighting fixtures and accessories
   2. Emergency lighting units
   3. Emergency exit signs
   4. Lamps
   5. Ballasts/Drivers
   6. Refer to Section 260925 for Lighting controls and accessories.
C. Construction safety is the responsibility of the contractor in accordance with local regulations.
D. The work covered under this section of specifications consists of furnishing labor, materials and services required for the completion of a functional and inconspicuous lighting system approved by the architect and engineer.

1.2 CODES AND STANDARDS

The lighting system shall be in accordance with IEC 60598-1 and IEC 60598-2, and other applicable standards, as shown in the drawings.

1.3 QUALITY ASSURANCE

A. Provide testing and inspections in accordance with the General Requirements of this specification.
B. Submit reports of independent tests demonstrating that the products and systems proposed are in accordance with the specified performance requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver lighting fixtures individually wrapped in factory-fabricated fiberboard type containers. Parabolic louvers shall be shipped in thermally sealed polyethylene wrappers.
B. Handle lighting fixtures carefully to prevent breakage, denting and scoring the fixture finish. Do not install damaged lighting fixtures.
C. Store lighting fixtures in a clean, dry space and protected from the weather.

1.5 SUBMITTALS

A. Shop Drawings: Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
B. Detail Lighting system showing the type, size and, including locations, cabling, conductors, conductor routing and connections, include indications for use of raceway and data on how concealment requirements will be met.
C. Product Data: Include dimensions and manufacturer’s technical data on features, performance, electrical characteristics, ratings, and finishes.
D. Lamps: Catalog cuts showing voltages, colors, approximate hour-life, approximate initial lumens, lumen maintenance curve, lamp type and base, lamp life cycle.
E. Ballasts: Catalog cuts showing type, wiring diagram, nominal watts, input voltage, starting current, input watts, sound rating, power factor and low temperature characteristics.

F. Site lighting pole data and catalog cuts, including wind loading, complete dimensions, and finish.

G. Controls: Catalog cuts and/or shop drawings showing dimensions, voltage capacity, contact ratings, wiring diagrams, operating levels, and temperature ratings.

H. Certifications: Prior to final inspection, deliver to the Consultant Engineer four copies of the following:
   1. Certification by the manufacturer that the lighting system shall conform to the requirements of the drawings and specifications.
   2. Certification that the equipment has been properly installed, adjusted, and tested.

I. Samples: Submit fully equipped sample of each fixture type, modified if required, together with color and texture samples of each fixture.

J. Dimming Ballast Compatibility Certificates: Signed by manufacturer of ballast certifying that Ballasts are compatible with dimming systems and equipment with which they are used.

K. Addressable Ballast Compatibility Certificates: Signed by manufacturer of ballast certifying that ballasts are compatible with the central battery systems and equipment with which they are used.

L. Compatibility Confirmation: Signed by manufacturers of lighting fixture, lamp and control gear/driver respectively clearly assuring compatibility with each other's equipment.

M. Product Data describing fixtures and lamps. Arrange Product Data for fixtures in order of fixture designation. Include data on features and accessories and the following:
   1. Outline drawings indicating dimensions and principal features of fixtures.
   2. Electrical Ratings and Photometric Data: Certified results of independent laboratory tests for fixtures and lamps.

N. Photometric data for lighting calculations provided as IES or LDT format including polar light distribution curves, coefficient of utilization, glare classification, efficiency, depreciation factors etc.

O. Certified results of accredited manufacturers' laboratory tests for fixtures and lamps for photometric performance.

P. For LEDs: Photometric test reports from accredited manufacturer's laboratories shall be submitted verifying the luminaire photometric characteristic Report shall include laboratory name, report number, date, luminaire catalogue number, luminaire, light source specifications, etc.
   1. Life, output (lumens, Color temperature, and CRI) and energy efficiency data for lamps.
   2. Battery and Charger Data: For self-contained emergency lighting fixtures.
   3. Photo biological risk assessment for LED fixtures.
   4. Product certificates signed by manufacturers of lighting fixtures certifying that their products comply with specified requirements.

Q. Warranty: provide a 5-year warranty certificate for all interior light fittings from date of taking over.

R. Where the Contractor wishes to deviate from specified equipment on an Equal and Approved basis, the Contractor shall submit a report and technical data to support the alternative solution. The report should include the following:
   1. Full lux level calculation of the affected spaces
   2. Full photometric data for the luminaire(s) being offered includes a comparison with the specified luminaire(s).
   3. Compliance Statement and evidence that the proposed luminaire(s) are of equal quality, durability and robustness to the specified luminaire(s). This shall include, but not be limited to: IP rating, ambient temperature operating conditions, enclosure type and finish, manufacturer's warranty. Such elements shall the casing, components, lamps, control equipment, fixings, supports, hangers, hinges etc.
   4. Statement and evidence of the country of origin of the proposed luminaire(s) and compliance with relevant Standards.

5. Statement and calculation of any variance in annual energy consumption of the proposed design compared to the existing design.
6. Statement of the electrical performance characteristics of the proposed luminaires in relation to the specified luminaires (e.g. in rush current, full load current, losses, power factor and harmonic current generation).
7. Update and revisions to the electrical distribution design, including distribution boards and cabling.

1.6 APPROVED MANUFACTURERS

A. Acceptable manufacturers are listed in the Contract Documents and within these Specifications. The listing of a manufacturer as "acceptable" does not imply automatic approval".

1.7 PROJECT CONDITIONS

A. Project Conditions
1. Some rooms are special for prison presence.
2. All apparatus and equipment in these areas shall therefore be anti-bacterial designed and constructed to operate satisfactorily and without any effects as per the mentioned conditions

B. Civil Work Coordination
Take into account all of the Civil/ Mechanical Work performed by other Subcontractors associated with installation of electrical, mechanical, plumbing and other facilities.

PART 2 – PRODUCTS

2.1 LUMINARIES

A. All luminaires shall be manufactured to IEC 60598-1 and 60598-2.
B. All luminaires supplied by the contractor shall be photometrically tested.
C. The contractors shall produce upon request photometric data for any luminaire specified or supplied.
D. All luminaires shall be provided with a lamp compatible with the control gear used.
E. All luminaires drivers shall be compatible with Dali lighting control systems as per the contract drawings.
F. Luminaires shall not be suspended by their flexible cord. A separate means of suspension shall be provided.
G. All flexible cords shall be anchored at both ends such that the cord is free from strain.
H. Any plastics used in the luminaire shall be light and UV stable and shall be suitable for their application.
I. All sheet steel components shall be suitably pre-treated and electrostatically spray-painted using acrylic polyester or epoxy powders.
J. Non-compatible materials shall not be used in contact with each other.
K. Louvers shall be restrained to prevent them from falling out of the body of the luminaires under normal conditions and when re-lamping. Metal louvers shall be earthed to the body of the luminaire or the earth terminal.
L. Diffusers shall be restrained to prevent them from falling out of the body of the luminaires under normal conditions and when re-lamping.
M. All luminaires designed for internal use shall be constructed to IP 20 and be Class 1 unless otherwise stated.
N. Any device, components or equipment to be installed in the floor area especially when critical case is important such operation rooms, ICU and CSSD area shall be specified with anti-bacterial resistant item.

2.2 LIGHTING FIXTURES

A. Light Emitting Diode (LED)

1) Manufacturer

Discrete light emitting diodes (LEDs) shall be manufactured by a reputable manufacturer as listed in the Approved List of Vendors, with proven experience in LED production. The luminaire manufacturers shall meet any certification available by the LED manufacturer. Failure to comply with manufacturer recommendations shall impact upon LED lifetime and reliability.

2) Thermal Parameters

a. LED module mounting shall be designed to ensure the junction temperature of any LED does not exceed the manufacturer's recommended maximum operating temperature. Thermal dissipating of the module shall be designed for the operating temperature and wattage of the unit.

b. LED luminaries shall be thermally tested to ensure the maximum junction temperature is not exceeded whilst operating in any environment between -10°C to +38°C.

c. Anti-bacterial resistant type where indicated on drawings

3) Optical Parameters: LED suppliers shall provide LED batch bin number, recording luminous flux, wavelength/ color and forward voltage of LED. Batch information to be included as part of the Operations and Maintenance (O+M) Manual or as part of the fixture's order/ serial number.

4) Color Rendering Index: White LEDs shall have a CRI greater than 80.

B. LED Lamp Life: LED minimum lamp life shall meet the following standards:

a. L70 at 40,000hrs.

b. LM79 standards for the luminaire

c. LM80 standards for LED chip.

C. IP Rating: Luminaires shall be IP rated as indicated on the design drawings and luminaires schedule. In addition,

a. In ground LED luminaries where provided shall be in IP67 enclosures with IP6 cable glands.

b. Wall LED luminaries where provided shall be in Min. IP65 enclosures with IP68 cable glands.

D. Converter

1) Generally, convertors shall match optimum and maximum current to suit the LED over the whole range of input voltages.

2) Dedicated converters shall be provided with the following features as a minimum:

a. Automatic reset in the event of a fault.

b. Isolation between the primary and secondary sides.

c. Dimming with linear characteristics.

d. Operation in ambient temperatures of -20°C to +50°C.

e. Storing ambient temperature of -40°C to +70°C.

f. Low power loss.

g. Integral electronic overload protection circuitry.

h. Integral electronic over temperature protection circuitry.

i. Integral electronic short circuit protection circuitry.

E. Minimum Luminous Efficacy

1. Manufacturer luminous efficacy is stated for a 25°C (77°F) ambient with a current of 20mA in an environment that does not build up heat around the LED.

2. Refer to detailed design drawings for luminaire selection.

2.3 EMERGENCY LIGHTING

A. Exit signs should be manufactured to meet the appropriate requirements of IEC standards.
B. All "Exit" signs and fire safety signs shall be of the pictogram type utilizing the pictograms as given in IEC. Where wording is incorporated on the signs it shall be in accordance with the latest civil defense requirements.
C. Sizes of lettering shall comply with the latest Civil Defense.
D. The housing shall be designed to maintain an internal ambient temperature below that of the lowest temperature rating of any piece of equipment installed therein.

2.4 PARTICULAR REQUIREMENTS

A. GENERAL

The Contractor shall be responsible for ensuring that the design and installation of all lighting within the buildings complies with the latest edition of IEC 60598.
All layouts shall be developed in conjunction with the Owner's Authorized Representative.
In general, all lighting shall be wired in a minimum of 2.5 mm² single core cables and protected by 16A MCB.

B. PLANT AREAS

The contractor shall ensure luminaires are positioned such that lighting levels are not significantly affected by adjacent services such as pipework or ductwork. Where necessary luminaires shall be installed on chains.

C. LIGHTING POWER DENSITIES

The contractor shall verify and validate the figures for the interior lighting based on the final luminaires selection.

PART 3 – EXECUTION

3.1 INSPECTION

A. Prior to ordering lighting fixture, check the building electrical system requirements, architectural finishes, and the type of ceilings where the lighting fixture will be installed. Any discrepancies of compatibility pertaining trim, frames, color, mounting, ballast, voltage, etc…. shall be brought to the attention of the Architect and Engineer by written notice. Do not proceed with procurement until discrepancies are resolved in a satisfactory manner.
B. Installer shall examine the areas and conditions that light fixtures 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.

3.2 INSTALLATION OF LIGHTING FIXTURES

A. Install lighting fixtures as indicated, in accordance with lighting fixture manufacturer's written instructions, requirements of applicable Standards and in accordance with recognized industry practices to ensure that installation complies with requirements and fulfills the intended function.
B. Coordinate as necessary to properly interface installation of lighting fixtures with other works.
C. Install each fixture properly and safely. Furnish and erect hangers, rods, mounting brackets, supports, bases, cables, canopies, channels, frames, and other equipment required.
D. Furnish lighting fixtures complete with accessories required for the proper, safe and distortion-free installation in the various surfaces in which they appear

E. Obtain each lighting fixture packaged with complete instructions and illustrations showing how to install. Install lighting fixtures in strict conformance with manufacturer's recommendations and instructions.
F. Install lighting fixtures at a height from the floor and leveled as specified. In cases where conditions make this impractical, refer to the consultant for a decision. Use ball aligners, hang straights and canopies on pendant fixtures.
G. Do not install fixtures and/or parts such as finishing plates and trims for recessed fixtures until all plastering and painting that may mark fixtures finish has been completed.
H. Lighting fixture locations in mechanical and technical rooms is approximate. Coordinate mounting height and location of lighting fixtures to clear equipment and to illuminate equipment adequately.
I. Support all lighting fixtures independently.
J. Whenever a fixture or its hanger canopy is applied to a surface mounted outlet box, utilize a finishing ring to conceal the outlet box.
K. Make splices in internal wiring with approved insulated "wire nut" type mechanical connectors, suitable for the temperature and voltage conditions to which they are subjected.
L. Use wire suitable for temperature, current, and voltage conditions to which it is subjected where utilized for connections to or between individual lamp sockets and lamp auxiliaries (i.e., wires which do not constitute "through circuit" wiring).
M. Replace blemished, damaged, or unsatisfactory fixtures as directed.
N. Install all lighting units set true and free of light leaks, bends, dents, and other irregularities.
O. Install all lighting units free of dust and dirt.
P. Do not scale electrical drawings for the exact location of the lighting fixtures. In general, the approved coordinated reflected ceiling workshop plans shall indicate the proper locations of lighting fixtures.
Q. Rigidly align continuous rows of lighting fixtures for true in-line appearance.
R. Do not install recessed fixtures weighing more than 18 kilograms directly on a concealed or exposed ceiling spline of a lightweight acoustic ceiling system. Support such fixtures from the building structure.
S. Do not mount surface or pendant type fixtures regardless of their weight directly on the concealed or exposed ceiling spline of a lightweight, acoustical ceiling system. Support such fixtures from the building structure.
T. Install reflector cones, baffles, aperture plates, light controlling element for air handling fixtures, visible trim, and decorative elements after completion of ceiling tiles, painting and general cleanup. Carefully handle to avoid scratching or fingerprinting and provide completely cleanliness to the Owner at the time of acceptance.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of lighting fixtures and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at the site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
B. Certify that the equipment has been properly installed, adjusted, and tested.

END OF SECTION

SECTION 27 00 05 – TELECOMMUNICATION NETWORK AND ICT CABLING

PART 1 – GENERAL

1.1 GENERAL CONDITIONS

A. Comply with all applicable governmental regulations and Local Telecommunication Service Providers' guidelines.
B. Work called for in this specification includes work to be performed by the Contractor, and any Sub-Contractors under the employ of the Contractor or others who work on behalf of the Contractor.
C. always Maintain a current copy of this bid specification at the job site.
D. This division of the specifications covers the Communications Systems general for development.
E. Contractor shall coordinate with ELV, ICT, Telecommunication contractors for installation, final locations and integration requirements.

1.2 WORK INCLUDED

A. All installation, testing and commission reports are as defined in Telecom Service provider latest guidelines and design approvals.
B. All services in the Telecom rooms shall be coordinated by the contractor and approval shall be obtained from the Engineer prior to commencement of any installation.

1.3 CODES, REGULATIONS AND STANDARDS

A. Comply with the most recently issued requirements, standards, recommendations, rules, and regulations of the Telecom service provider latest design guidelines
B. Follow the most restrictive code or recommendations. Where there are ambiguities, refer to the engineer for interpretation.

1.4 WARRANTY AND CERTIFICATION

The Contractor shall provide a letter from the Manufacturer confirming certification and trained engineers under the employ of the company. The Contractor is to provide the Manufacturer's Warranty, including the Manufacturers Performance Guarantee & Test Data and all applications supported under the warranty. The period of the warranty shall not be less than twenty (20) years from date of handover (Development operation date) in accordance with the manufacturer's extended warranty program.

1.5 SPECIAL CONDITIONS

The requirements and recommendations of the following are included herein and made a part of these contract documents:

1. Electrical Specifications Sections
2. Local country laws and codes, as well as local country Telecommunications Regulations Authority regulations.
3. Telecom service provider latest design guidelines.

PART 2 – PRODUCTS

1.6 GENERAL

All products shall be International Standards Compliant. Any device, components or equipment to be installed in the floor area especially when critical case is important such operation rooms, ICU and CSSD area shall be specified with anti-bacterial resistant item.

1.7 CATEGORY 6A UTP

A. Furnish and install, complete with all accessories, a Category 6A/ Class EA Unshielded Twisted Pair (UTP) Structured Cabling System (SCS). The SCS shall serve as the transport infrastructure for data, video and voice telephony signals throughout the network from designated demarcation points to outlets located at various locations.
B. The contractor shall provide printed and electronic independent 3rd Party certification certificates (such as ETL Laboratories) for performance in a 4-connector configuration up to 100 meters and exceeds international code Category 6A standards at swept frequencies up to 600 MHz.
C. Flame rating: International code
D. PoE and PoE+ compliance: International code for PoE applications
E. The cable shall be tested by an independent laboratory and comply with the electrical channel requirements of the following standards: International code standards
F. 10 GBASE-T (10Gigabit Ethernet)
G. 155 Mb/s ATM, 622 Mb/s ATM, 1.2 Gb/s ATM
H. The cables shall be UTP Category 6A cables and shall meet the international code requirements for Class EA.
I. The cables jacket must be low smoke zero halogen (LSZH).
J. Horizontal cabling shall be 4-pair independently verified for compliance.
K. Each cable must be clearly labeled at both ends.
L. The maximum allowable distance for each horizontal cable must not exceed 90m. Contractor shall coordinate to choose the shortest routing and verify path length before installation.
M. The cable must be suitable for different high-speed applications using simultaneous.
N. Horizontal cables shall be terminated according to the international code wiring pattern requirements.
O. Sequential meter marking is required with illustration of the aggregating length, cable category and the AWG.
P. The contractor shall provide, in writing, a full list of tested and guaranteed copper applications that are supported under the warranty, including the distances and number of connectors supported.
Q. Face Plate
    1. A faceplate kit (sloped & shuttered) for wall mounted outlets shall be used with number of ports as indicated on the drawings.
    2. Colors of items specified in this section must be verified with the Architect prior to purchase. Faceplates match electrical faceplates.
    3. Shuttered module snaps into standard floor box mounting plates, faceplates and patches panels and holds a single Module. Compatible with standard floor box opening dimensions (refer to the electric specification floor boxes).
    4. Face plates shall be provided with appropriate labeling (refer to the Labeling Section).
R. Data Outlets
    1. RJ45 jacks will be housed into the outlet; those jacks must be UTP Cat 6A and accept termination wiring according to international code standards.
    2. Modular jacks shall be Color coded.
    3. Modular jacks shall be 4-pair and shall meet the Category 6A performance requirements.
    4. Outdoor type outlets shall have the same characteristics of indoor type but with IP67.

PART 3 – EXECUTION

1.8 CABLE DISTRIBUTION

A. Furnish and install all communications cables per the drawings and specifications and in accordance with manufacturers' directions.
B. Comply with International code.
C. Install each backbone cable as an uninterrupted conductor section from its point of origination to its point of termination, as indicated on the drawings, splicing only at the points of final termination.
D. Utilize the shortest practical cable run length within the designated pathways. The Contractor may be required to re-pull or re-dress cable runs that are circuitously routed or installed with excess slack.

1.9 CABLE INSTALLATION

A. Furnish and install communications cables per the drawings and specifications and recommendations.
B. Cable Pulling

1. Pulling tension on optical fiber shall not exceed the fiber's rated maximum tensile load.
2. Do not exceed the manufacturer's minimum loaded and unloaded bending radius factors for each cable type pulled.
3. To limit the incidence of micro-bending of the individual fiber strands, mesh-type, swivel-eye pulling grips shall be employed for all fiber optic cable pulling.
4. Place a break away swivel between the grip and the puller and monitor tension with a dynamometer for each cable being pulled.
5. Utilize cable pulling lubricant where indicated to minimize stress to all cables pulled through duct or conduits.

1.10 FIRE STOPPING

A. Seal all penetrations through fire-rated walls, floors and walls created by or made on behalf of the contractor so that the original fire rating of the floor or wall is maintained as required by Article300-21 of the National Electric Code.
B. The sealant material shall have been subjected to fire exposure in accordance with the standard time temperature curve in the international code. The fire-stop material shall have also been subjected to the hose stream test in accordance with international code.

1.11 CABLE TESTING

A. Test all cables installed under the contract.
B. Pre-installation Inspection
   a. Visually inspect all cables, cable reels and shipping cartons for shipping damage. Return visibly damaged items to the manufacturer.
   b. Prior to testing, submit for review and approval copies of test report forms proposed for use. Forms shall, at minimum, contain: Project name; Contractor's name; Date of test; Media type and description; Make, model and serial number of the test equipment used and date of last calibration.
C. Post Installation Testing
   a. Test only completed systems. Partial or statistically sampled testing is not acceptable, except by prior, written approval from the Engineer.
   b. Calculate the total expected link loss based on the number of mated connector pairs, the connector's published loss per mated pair, and the cable's published loss based on distance. Demonstrate that the measured link loss does not exceed calculated link loss by more than 5%.

c. Correct any faults related to connectorization and re-test fiber as stated above until acceptable attenuation results are received.
d. Remove all defective cables from cable pathways. Do not abandon cables in place.
e. The Owner and Engineer reserve the right to observe the conduct of any or all portions of the testing process and to conduct, using the contractor's equipment and labor, a random re-test of up to five (5) percent of the cable plant to confirm documented test results.
f. Document all test results and corrective procedures and submit them to the Engineer within ten (10) working days of test completion.
g. In addition to the actions specified above, the contractor may be required to be present while the Owner or Owner's designated representatives conduct performance tests of the transport electronics connected to the cabling system.

1.12 ACCEPTANCE

Once the testing has been completed, as-built and testing documentation delivered to the Engineer, and the Engineer is satisfied that all work is in accordance with the contract documents, the Engineer shall notify the contractor in writing of the acceptance of the work performed. The date of this acceptance shall constitute the commencement of the warranty period. The Final approvals subject to the service providers approvals of structured cabling system by the Telecom Service Provider

END OF SECTION

SECTION 27 52 23 – IP NURSE CALL SYSTEM

PART - 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions and all related Specification sections shall supply to work in this section.

1.02 SUMMARY

A. This section includes real IP nurse call systems and requirements for system components including, but not limited to the following:

1. Nurse master stations
2. Patient stations
3. Emergency stations
4. Water-resistant bath / shower stations
5. Code blue stations
6. Staff stations
7. Dome lights
8. Flexible Wiring

1.03 SCOPE OF WORK

A. Provide labor, materials, equipment, and services to perform operations required for the complete installation and related work.

B. A nurse call system shall be provided to the locations illustrated on the drawings & where ever applicable according to local codes & standards.

1.04 SUBMITTALS

A. Provide submittals for the entire system including:

1. Complete equipment list
2. Catalog descriptive literature for equipment
3. Riser wiring diagram showing devices, wire quantities, and sizes
4. Typical termination wiring diagram for each type of device including nurse stations, power supplies, and external system interface gateways
5. Complete description of system operation
6. Name, address, and telephone number of nearest authorized service center.

1.05 STANDARDS

The nurse call system described in this specification must carry a complete and current Underwriters Laboratories listing, in conformance with the latest Hospital Signaling and Nurse Call Equipment, according to the CE, VDE and RoHS.

All wiring and equipment associated with the code blue capability shall be electrically supervised in accordance with the latest Hospital Signaling and Nurse Call Equipment, according to the CE, VDE and RoHS standard.

1.06 GENERAL REQUIREMENTS

A. The contractor shall furnish and install all equipment, accessories, and materials necessary for a complete system in accordance with specifications and applicable drawings.

1.07 SYSTEM DESCRIPTION

A. The nurse call system shall be based upon a distributed network architecture that consists of intelligent devices ("Nodes") that share status and event information over a common communications channel. For safety and service purposes, the system shall run completely without controlling units, gateways or dedicated servers and software.

B. Other non-intelligent system devices may be connected to the network for the purpose of initiating and annunciating calls and other system events using voltage coded inputs on any offered room unit

C. System devices shall be "hot swappable" and may be connected to or disconnected from the system without removing power to other system devices.

D. Each Node shall contain non-volatile memory that contains its individual operational programming, configuration, and status information. It shall be programmable individually and remotely via any browser.

E. The system shall provide an IP audio bus [VoIP], the audio bus shall permit both inter and intra-unit voice communication,

F. The system shall provide a gateway through which ancillary system interfaces such as pocket pagers may be connected to the communications network. This gateway shall electrically isolate the ancillary interfaces so that any damage or electrical problems with them shall not affect the operation of the main system network.

G. The nurse call system shall allow sub-division into smaller Units and it shall further allow the programming of Zones according to facility requirement to increase ease of use for staff members. The system shall also be capable of vectoring Calls and system events to specific nurse stations, staff stations, pocket pagers, and corridor displays based on the Unit, Zone, and Room Set membership of the originating device. Units, Zones, and Room Sets shall be logical definitions programmed into individual nodes using a system configuration software utility.

H. The system shall provide programmable Shifts that shall allow staff members to change call coverage and annunciation patterns within the system to accommodate operation under reduced staffing conditions (overnight hours) and allow for rooms to be operationally shifted from one care area to another.

Shifts may be a combination of one or more Units or Zones and shall be logical, software-configurable groupings not determined by the wiring or physical layout of the system. .

I. The system shall support staff presence registration and identification. Staff Presence Registration stations shall have integrated sounders to allow audible

signaling of calls when a staff member has registered as present.

J. System power supplies shall include the following capabilities:
   1. Normally open and normally closed contact outputs to signal low battery and loss of power
   2. Integrated battery charging circuitry
   3. Backup batteries.
   4. Short circuit and thermal overload protection

K. Any device, components or equipment to be installed in the floor area especially when critical case is important such operation rooms, ICU and CSSD area shall be specified with anti-bacterial resistant item.

1.08 FAULT TOLERANCE, SUPERVISION, AND SYSTEM SURVIVABILITY

A. Fault tolerance shall be a key requirement of the nurse call system. 24/7 supervised, Intelligence and system control functions shall be distributed throughout the networked devices and shall not reside in a central control cabinet, processing unit, or communications exchange whose failure shall disable all or part of the system.

B. In the event of a communications network disconnection or failure / IP-String, IP nodes shall continue to operate in a localized stand-alone mode. Once communication with the rest of the system is restored the IP node shall again begin operating normally.

C. Intelligent node program software, status information, and system configuration parameters shall be stored in the node using non-volatile RAM so that it shall not be lost during power failure and disconnection. The device shall resume operation in exactly the same state that it was in prior to power removal and any calls or faults that were in progress shall be re-asserted when power is restored.

D. All units are permanently supervised, without any additional controlling units and can be (re-)programed individually and accessed remotely. They will send out an immediate and automatic alarm to a device of choice in case of failure.

E. Call origination devices (call cords) connected to Patient Stations shall be supervised for both connections to the station and cord damage (breakage or electrical short). Disconnection of the call device from the station shall produce a "Cord Out" alarm at the nurse stations and other call annunciation devices covering the patient station. Cord out alarms may be silenced by re-attaching the call cord or by pressing the "Cancel" button integrated into the patient station. Systems that use dummy plugs to simulate a call cord connection in order to silence a cord out call shall not be acceptable.

1.09 NETWORK INTERFACING AND PROGRAMMABILITY

A. The nurse call system shall provide a method of interfacing non-intelligent devices to the system network via I/O or mini-DIN ("Call Lines").

B. Each Call Line shall detect separate voltage levels. It shall support call placement through either momentary or latched switches providing either a normally open dry contact.

C. The system shall allow more than one device to be connected to each Call Line. If the voltage levels from each device are distinct, then the node shall be able to distinguish between them and allow individual call properties to be programmed for each. If multiple devices using the same voltage level are used, then the room

controller shall treat them as calls from a single device and only one set of programmable call properties shall be available.

1.10 CALL AND SYSTEM EVENT ORIGINATION

A. Calls for assistance shall be originated within the nurse call system using any of the following devices:

- Patient Stations; Call Cords (attached to Patient Stations); Code Blue Stations, Emergency Stations, Bath / Shower Stations (attached anywhere

B. "Cord-Out" calls shall be automatically initiated by the Patient Station whenever a call cord is disconnected from its socket. If the call cord is shorted or severely damaged, the Patient Station shall automatically initiate a Fault to alert users that the cord has been damaged.

C. Staff presence shall be registered in the system using Staff Presence Terminals, Patient Stations, and Nurse Control Stations.

D. The nurse call system shall have several layers of supervision to detect device failure or disconnection. The failure of any device, or its disconnection from ~~either~~ the real IP network shall be detected and automatically reported as a Fault.

1.11 CALL CANCELLATION

A. The method used to cancel each system Call shall be programmable for each Call so that the system operation may be tailored to the different needs. Available options shall include:

1. Local cancellation only: The call can only be cancelled at its point of origination.
2. Staff Presence: The call will be cancelled when staff members register as present within the area from which the call originated.
3. Remote Service Assignment: Shall cancel the original call and initiate a Staff Service Request to the calling location from a Nurse or Staff Station.

1.12 CALL AND SYSTEM EVENT ANNUNCIATION

A. Calls for assistance within a patient room shall be visually announced to staff members using a multi-color corridor dome lamp. The lamp colors and flashing pattern shall be fixed

B. Calls for assistance within Zone, or Room Set shall be visually announced using a multi-color Zone Lamp. The facilities areas announced by each Zone lamp shall be fully software configurable. In addition, each zone lamp shall have a programmable filter that allows the definition of which calls and events are and are not annunciated by the Zone lamp.

C. The nurse call system shall also support the use of multiple Nurse and Staff stations throughout the facility. Each Station shall provide audible and visual announcement of calls via an integrated, backlit LED with software adjustable contrast level. The LED shall display the highest priority call or event in the system. If multiple calls of the same priority level are in progress, the display shall show the oldest call. Staff members shall be able to scroll through the list of pending calls, sorted by priority level and age. The following additional functions shall also be provided:

1. Service assignment: Staff members shall be able to respond to a patient call by initiating a Staff Service Request using a button integrated into the Station. Assignment shall cause a lamp at the patient room to flash, indicating a staff member

is required. The system shall provide software configurable parameters that allow the definition of the calls to be responded to using a Staff assignment. The system shall also allow disabling the feature completely if desired. The system should provide an internal timer to track the length of time each call to which a service request has been assigned, has been waiting for a staff member to respond.

2. Staff presence locations: Staff members shall be able to access a listing of all the areas in which staff members are currently registered as present.

3. Shift control: Staff members shall be able to view the current shift setting and initiate a change to another shift. The system shall provide the ability to configure which Nurse and Staff Stations are allowed to initiate shift changes.

1.13 CALL FORWARDING

A. The nurse call system shall maintain one countdown timer for each active call. If the call is not answered, the IP system shall escalate and forward to another stations

1.14 CALL FOLLOWING

A. The nurse call system shall provide Call Following (Nurse Follower or Staff Follower) functionality.

1. Call Following shall allow mobile staff members to receive audible notification of patient calls while they are away from the Nurse or Staff station. This feature shall be enabled or disabled within the system configurations settings.

2. Annunciation shall be accomplished using a buzzer module integrated into the Presence Station. When the staff member is registered as present in the room and a call is initiated from another area, the presence station shall sound tones that are indicative of the new call priority level. The tones shall continue until the call responsible has been responded to or the staff members cancel their presence registration in the room. If multiple calls are initiated, the presence station shall signal the highest priority level call.

3. The system shall provide a call following signal filter for each area in which the following call is supported

1.15 EXTERNAL SYSTEM INTERFACES

A. The nurse call system shall have the capability of interfacing with the following external, ancillary systems and support the features listed with each interface:

1. Computers: A USB interface that allows a Windows Compatible PC to connect to the nurse call system network for the purposes of installation and configuration.

2. RF Pagers: An RS-232 serial, interface between the nurse call system and

the pocket pager system transmitter. This interface allow transmission of system events, calls and faults to and display on pocket pagers worn by mobile staff members in the facility. The system shall allow set up of filters for each pager to define which calls and events are displayed on it. Filter parameters shall include Unit, Zone, Room Set, and Call Type.

3. Corridor Displays: An RS-232 serial communications interface between the nurse call system and the Corridor Display. This interface shall allow system events, calls and faults to be shown on the Corridor Display. The system shall allow setting up filters to define which calls and events are shown on each Corridor Display. Filter parameters shall include Unit, Zone, Room Set, and Call Type.

4. bed lamps: The nurse call system shall provide pass-through connections to allow the control of room lighting and over-bed reading lamps.

B. External devices that Initiate alarms (through voltage-coded inputs): The system shall also accommodate the attachment of other external systems via the I/O or mini-DIN ("Call Lines").

PART - 2 PRODUCTS

2.01 GENERAL

A. All devices listed below shall be "hot swappable" to allow connection to or disconnect from the system without having to remove power or data communications from any other portion of the system when either installing or servicing the system

B. System devices shall be fault tolerant and designed to withstand wiring and termination errors without damage (as long as voltage is not extreme)

2.02 NURSE CALL STATION CONSOLE

A. The station shall be, network-enabled device that provides audible and visual call and system event notification

B. Shall be configured for use as either a nurse or staff station during installation using system configuration software package

C. Shall include an integrated buzzer and LED with the following features
1. Buzzer volume level shall be software-adjustable
2. LED shall display at least 2 lines of information each 16 characters in length
3. LED shall be backlit for easy viewing in low-light conditions
4. LED contrast level shall be adjustable using software controls included in the station

D. Shall include the following color-coded, integrated feature buttons and associated reassurance LEDs. The buttons shall provide the following functions:
1. Nurse level staff presence registration / registration cancellation
2. To provide access to interactive information menus
3. Acknowledge to initiate a staff service request in response to a patient call
4. Up / Down Arrows - Scroll. To allow users to step through the list of active patient calls and interactive menu options

E. Shall be capable of being equipped with an audio handset to form a nurse master or audio staff station. When answering calls, scrolling to the desired call and lifting the handset shall initiate a full-duplex VoIP communication to the calling audio patient station.

2.03 AUDIO PATIENT STATION & AUDIO STAFF STATION

A. This unit shall be used to initiate and cancel calls for assistance

B. Shall be fully supervised and programmable individually and remotely via browser.

C. Shall include one or two sockets with quick-disconnect design for the connection of call cords, call pendants and offer the following features:

1. Call initiation devices connected to the socket shall be automatically supervised for cord removal from the socket and for cord wire short or breakage between the socket and the call button
2. "Breakaway" design of the socket shall allow cords to detach from the station when pulled without causing damage to either the cord or the station

D. Shall include color-coded, integrated buttons with field reassurance and finding LEDs, labeled for functions such as:
1. Nurse level staff presence registration / registration cancellation
2. Emergency button to allow staff members to initiate an emergency call for assistance.
3. Call button to allow staff members to initiate a call for assistance.
4. Reassurance and finding LEDs shall visually signal the status condition of each button.

E. Shall feature an independent speaker and microphone. After a call has been placed, a nurse station operator shall be able to initiate a full-duplex, hands-free VoIP communication with the Audio Patient Station. A nurse station operator shall also be able to initiate one-way page announcements to the Audio Patient Station.

F. Audio sensitivity shall be capable of being individually adjusted at each Audio Patient Station to compensate for room acoustics.

2.04 PULL STATION

Those units will be used as emergency & code blue & bath/shower stations with the follows:

A. Shall be a wall mounted, splash-proof station used to signal emergency level calls from within a shower or other high-moisture environment

B. Shall include a large, easy to activate pull switch and integrated call reassurance and finding LED
1. Pull switch shall be color-coded a pull cord shall be attachable to allow patients unable to reach the station to initiate calls
2. Calls shall be reset via a green Button
3. Integral LED shall illuminate when the station is activated to reassure the user that the call has been successfully placed.
4. The pull station shall be 24/7 supervised

2.05 DIRECTION LAMP

A. Shall be network-enabled 4 light dome lamp used to visually signal patient calls and other system events within designated areas & shall have the following features
1. The number of lights used and their color configuration shall be flexible and individually configurable for each installation
2. Lights shall be protected by a single piece, frosted plastic lens that promotes light diffusion and increases visibility
3. The hardware for each of these light types shall be identical. The functioning of the unit shall be determined during installation using system configuration software. The

area being monitored by the lamp shall also be designated using software and not be a function of the system wiring configuration

4. Each lamp shall contain a software-configurable "filter" that allows to select what system call and event types will be annunciated by the unit.

B. When used in the Direction Lamp configuration the unit shall signal calls and system events occurring in selected areas. Each light in the lamp shall be configurable to either flash or steadily illuminate when calls are placed from its assigned areas.

2.06 AUDIO SIP-UNITS

A. Shall provide an audio voice channel between audio enabled stations. This voice channel shall also allow nurse station users to speak to one another in hand free, full-duplex VoIP.

B. The amount of voice channels for inter-unit communication is unlimited a staff member at a nurse station in one unit wants to speak to another audio device in another unit, the audio shall be switchable across one of the inter-unit channels to the appropriate unit and then onto the local unit audio bus to the desired station.

2.07 NURSE STATION

A. Shall be a desktop format, microprocessor-controlled nurse control station (NCS) with integral graphical display, telephone, speaker, microphone, and keyboard.

B. Shall be capable of managing all calls, presences, and other events within the unit(s), without limitation and individually.

C. Shall enable voice contact to be initiated to audio stations located across the entire system, unit, or zone groupings, as well as individual rooms or beds.

D. Shall enable button-activated, hands-free operation.

E. Shall include a resistive touch screen.

F. Shall include a backlit, OLED Graphic Display. Shall be capable of displaying information in single and dual height characters

G. Shall feature an on-screen function menu activated by keys. Patient calls shall be shown on the Incoming Call Display/Function Menu. Each call shall be clearly identified by room number, bed number, location name and call level. The call levels (according to priority) shall be: Code Blue, Emergency, and Routine Patient Call. Call level nomenclature shall be programmable in system programming.

H. Shall feature a keyboard with numeric keypad, & programmable keys for initiating frequently performed tasks, & keys for operators to navigate the display, contrast and volume keys, as well as icon-based feature keys for: Present levels, Answer/Audio, Shift, and Enter.

I. Shall include an integral microphone separate from the speaker for voice pick-up during push to talk communications

J. Desktop audio nurse station tone signaling shall continue until a call is answered or cancelled.

K. Power supply should be either POE, powered or power injected. The Nurse Station should be Normal Open and/or Normal Closed.

2.08 CALL BUS

A. Shall maintain the boost data signal strength to provide increased cabling distances up to 1 KM without using repeaters and to allow the data network to support additional devices

2.09 PROGRAMMING VIA IP

A. Shall be network enabled gateway and support programming, and configuration via IP

2.10 CORRIDOR DISPLAY INTERFACE

A. Shall be network enabled gateway that allows system call and event information to be communicated to and displayed by LED scrolling displays

B. One interface shall be required for each corridor display. The physical interface to the corridor display shall be RS-232

C. Each gateway shall contain a software-configurable "filter" that allows the service person to select what system call and event types will be annunciated by the unit. Also the feature of being able to use software to select the area or areas of the facility whose events will be shown on the corridor display. The correlation between the interface and the area(s) announced it shall be logical and shall not be determined by the system wiring

2.11 RF PAGER INTERFACE

A. Shall be network enabled gateway that allows system call and event information to be communicated to staff members via wireless pocket pagers

B. The physical interface to the paging system transmitter shall be RS-232

C. The system shall support Multiple Pager Interfaces to increase the overall system pager capacity

D. The ability of being able to use system configuration software to configure the individual pager properties including the area(s) covered. The correlation between the pagers and the area(s) whose events are annunciated on them shall be logical and shall not be determined by the system wiring

E. The call and system event types that will be sent to the pager

2.12 CALL CORDS AND HANDSET

A. The following call initiation devices shall be available for use with the system as following:

1. Call cords including single button, pneumatic press bulb, and breath activated models
2. Handset Callroom light, and bed lamp functions

2.13 POWER SUPPLIES

A. Shall be a wall mounted, locking cabinet enclosure and current limited, 3A power supply used to provide 24V DC power to the nurse call system

B. The power supply shall have the following features:

1. Include batteries for backup power in the event main AC power fails
2. Integrated battery charger circuitry

3. Short circuit and thermal overload protection
4. Normally open and normally closed contacts to signal low battery and AC power loss.

2.14 TRACKING AND REPORTING SOFTWARE

A. Shall be a complete solution for logging and reporting all events that occur on the nurse call system and include an event logger, a database, and a report generator

B. Shall track and capture events in real-time

C. Shall be capable of generating both standard and custom reports based upon logged network activity

D. Events shall be captured by room, zone, nurse, …etc. or entire system, and include metrics like "number of calls", "call duration", "emergency calls", "staff presence …. etc. Event overview will be unlimited in time.

E. Shall be capable of exporting data to a variety of common software applications, including Microsoft products such as Excel and Word, as well as Adobe products.

PART - 3 INSTALLATION

3.01 GENERAL

A. Installation shall conform to the general installation requirements specified in Section.

B. Stations, devices and lights shall be coordinated with the back boxes. Provide any trim plates as may be required.

END OF SECTION

SECTION 282000 - CLOSED CIRCUIT TELEVISION SURVEILLANCE

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

Conditions and Specification, apply to this Section.

1.2 CODES AND STANDARDS

A. Work shall be performed in accordance with the applicable national and local codes or standards current at the commencement of installation.
B. Where more than one code or regulation is applicable, the more stringent regulation shall apply.

1.3 SUMMARY

A. The section includes a video surveillance system consisting of IP-CCTV cameras, video recorder /servers, data transmission wiring, and a control station with its associated equipment.
B. Video surveillance systems should be integrated with Security Access Control, which specifies systems integration.
C. The IP video management system shall be an IP network-based, fully distributed digital video system. The security video system will utilize local area networks (LAN) as a transmission medium for video configuration, as well as storage of all data.
D. The system offered shall follow the latest international codes guidelines and its amendments. Any subsequent update of this regulation shall be followed in full during the time of implementation.
E. The security video system should provide full video control at the security control room, with additional full selection capability at any point within the network from a workstation. The security video system shall provide unlimited expansion capability for the addition or modification of video inputs.
F. The contractor shall furnish and install all security video cameras, pan/tilt/zoom (PTZ) cameras, mounts, housing, power supply systems, network cables, connectors, equipment racks, monitor sand consoles, workstations, recording servers, storage servers, keyboards, and all other hardware and software to provide a fully operational system.
G. Contractor to ensure that the existing IP video management system permits normal and event monitoring of all secured areas on digital monitors as to be coordinated with the team who operate and monitor the CCTV network.
H. Video monitoring of all cameras should be possible at the control room and at the localized control room. Review capabilities for the digitally recorded video via the secure network specified without interruption to recording capabilities.
I. The intent of this specification is to provide the owner a networked digital security system supplied by the Contractor and shall be a complete and operational system as per the performance requirements and objectives of these specifications. The contractor shall be responsible for the coordination of related work with other trades affecting his work or the work of others and with the existing team of the project.
J. All cameras shall feature intelligent analytic behaviors to reduce false alarms. Refer camera specifications for required analytic behaviors per camera. The analytics available with the camera should be integrated with the provided video management system. It shall be possible to define a cause-effect scenario upon trigger of analytics.
K. Any device, components or equipment to be installed in the floor area especially when critical case is important such operation rooms, ICU and CSSD area shall be specified with anti-bacterial resistant item.

1.4 SCOPE OF WORK

A. This section establishes a Video Surveillance System for the project in accordance with the international standards and international codes requirements.
B. Contractor shall comply with all project Specifications documents and the following requirements for complete and fully operational system installation.
   1. Provide an open platform-based Video Surveillance System as described hereafter that includes, but is not limited to, supplying, installing, labeling, and testing of.
      a) IP CCTV Cameras
      b) Software
      c) Storage
      d) Workstation / Matrix if needed according to the existing situation and as per client requirements
      e) Monitors/ Display system if required
   2. Provide the CCTV system which shall be fully compatible with the dedicated security network
   3. Furnish all labor, materials, tools, equipment, and services for the installation described herein. All requirements and specifications will be enforced.
   4. Cable pathways and runs to individual cameras are not shown in their entirety but shall be provided as if shown in their entirety.
   5. Verify that conduit routing does not cause cabling to exceed specified length.
   6. Follow industry standard installation procedures to ensure that the functional, electrical, and mechanical characteristics of the system and equipment are maintained.
   7. Provide the necessary quantities of cameras as per international codes latest regulations at the time of project execution.
   8. Provide the storage calculation as required by international codes latest regulations.
   9. Provide, install, terminate, test, label and document all components of the system.
   10. Provide complete documentation and demonstration of work.
   11. Conduct a final document handover meeting with Employer and Engineer to review, discuss and educate the Employer on the test results and As-Built Drawings.
   12. Provide Manufacturer's Warranty and AMC for the project

1.5 SUBMITTALS

A. Manufacturer's Certification Submit a certified statement, for each product proposed for this work, including the following:
   a. Manufacturers Name:
   b. Address of the proposed Manufacturer:
   c. Name, address and telephone number of the local representative, a general sales and engineering bulletin covering the full line of products manufactured; a certification that the products proposed have been in continuous and successful use for not less than 5 years (where applicable); general catalogue information covering the characteristics of the systems proposed; a statement that the components and systems proposed will be warranted and supported by the manufacturer for parts and labor for not less than 20 years.
B. Specialist: Installation and commissioning of the Security technology shall be performed under the direct supervision of a specialist trained and authorized by the manufacturer. Submit the following:
   a. Field supervisors name.
   b. A list of three projects of comparable size and complexity to that of this project, which were directly supervised by the proposed specialist supervisor.
   c. For each project list: the name of the project, location, project description, name and telephone number of the Owner's representative, date installation started, and date installation was completed.

C. Product Data:
   a. Submit manufacturer's product data sheets for all materials and equipment proposed for use on the project.
   b. Mark each product data sheet to show applicable choices and options. Where product data includes information on several products, some of which are not required, mark to indicate the applicable information.
   c. Submit example "As Installed" detail and workshop drawings.

D. Pre-fabrication Submittals

1) General Description and Requirements
   a. Submit pre-fabrication submittals in accordance with the Owner's construction schedule.
   b. Pre-fabrication submittals shall consist of product data, shop drawings, samples, and a detailed completion schedule. Partial submittals will not be accepted without prior written approval from the Architect.
   c. Pre-fabrication submittals shall be furnished in electronic formats as defined by the General Conditions under the Project Specifications.
   d. No portion of the Work shall commence, nor shall any equipment be procured until the Architect has approved the pre-fabrication submittals in writing.
   e. A letter of transmittal identifying the name of the Project, Contractor's name, date submitted for review, shall accompany pre-fabrication submittals and a list of items transmitted.

2) Product data required as part of the pre-fabrication submittal shall include the following:
   a) Equipment schedule listing all System components, manufacturer, model number and the quantity of each.
   b) General functional descriptions for the System
   c) Manufacturer's data specification sheets for all System components, including any warranty information (sheets containing more than one device or component model number shall be clearly marked to delineate items included in the Work)
   d) A complete list of cable and wiring types, sizes, manufacturer, and model number
   e) A complete list of finishes and sample graphics, including custom artwork and custom graphics (if applicable)

3) Shop Drawings shall include the following:
   a) Floor plan drawings indicating device locations with device legends
   b) System riser diagram with all devices, wire runs, and wire designations
   c) The Contractor shall submit samples of any equipment components upon request of the Owner.
   d) Samples submitted shall be the latest version of equipment.
   e) It is the responsibility of the Contractor to confirm all dimensions, quantities, and the coordination of materials and products supplied by the Contractor with other trades. Approval of shop drawings containing errors does not relieve the Contractor from making corrections at their expense

E. Equipment List: Include every piece of equipment by model number, manufacturer, serial number, location, and date of original installation. Add pretesting record of each piece of equipment, listing name of person testing, date of test, set points of adjustments, name and description of the view of preset positions, description of alarms, and description of unit output responses to an alarm.

F. Material Submittal

The contractor shall submit three (3) specified manufacturers' products for the approval during construction administration as part of client procedure. client/consultants shall select the product suitable for the intended application

1.6 ELECTRICAL POWER REQUIREMENTS

A. Provide power supplies as required at each camera location as designated on the power riser drawing.

B. All source voltage shall be conditioned to protect from environmental conditions, power surge, power sag, under-voltage, over-voltage, line noise, frequency (variation of the waveform), transients and harmonic distortion.

C. The circuit breakers adequate for the system load shall not draw over 80% of the rated capacity under normal operating conditions.

1.7 QUALITY ASSURANCE

A. New equipment and materials shall:
   a) Be International codes Compliant where specifically called for; or where normally subject to such international codes labelling and/or an equivalent listing service.
   b) Be clearly labelled identifying make, model, and manufacturer.
   c) Be without blemish or defect.
   d) Be products that meet with the acceptance of the agency inspecting the security Systems work.

B. All materials and equipment supplied by the Contractor shall be new and shall meet or exceed the latest published specification of the manufacturer in all respects.

C. All equipment and materials for permanent installation shall be the products of recognized manufacturers. The Contractor shall supply the latest products available at the time of order placement for each piece of equipment/material. If a newer version becomes available within thirty (30) days of the issuance of a purchase order by the Owner or if a new technology becomes available that offers an alternative to selected equipment or materials the Contractor shall offer to substitute such new equipment or materials for the selected equipment and materials. The Owner shall decide whether or not such substitutions are appropriate, and prices shall be adjusted to reflect increases or decreases in cost to Owner.

D. Within the Specifications, certain manufacturers have been listed. These manufacturers are listed for example purposes (unless followed by “No Exceptions”). The Contractor may substitute manufacturers and models that may be more cost effective or readily available than that specified. However, all substitutions shall meet or exceed the specified functional and technical requirements. Acceptance of such substitutions is at the discretion of the Consultant and/or Owner.

E. All products/materials shall be international codes Compliant.

1.8 WARRANTY

A. Warranty shall be 2 years from the date of provisional handover of all the works.

B. Warranty shall include all parts, labor, and the service technician’s travel and living expenses for the entire 2-year period.

C. Contractor shall warrant that the Work shall be free of defects in material and workmanship for a period of two years from the date of Taking-over. The contractor shall promptly and at its own cost and expense correct Work that is rejected by Engineer or Work that fails to conform to the requirements of the Specification.

D. Contractor shall assign to Engineer all manufacturers' warranties relating to any of the equipment and materials, specifically the respective manufacturers' extended warranties. The contractor shall deliver copies of all such warranties to the engineers.

E. Contractor shall warrant that it has obtained all applicable licenses for Employer to use the Materials and has paid all required royalties for use of the system for its expected useful life.

PART 2 – PRODUCTS

1.9 PREFERRED MANUFACTURERS

A. Preferred Manufacturers: Subject to compliance with the requirements of the Contract Documents and client preferences.

1.10 GENERAL

A. Camera type, location, enclosure, and mounting requirements shall be as indicated on the Documents and as specified herein.
B. Anti-bacterial resistant camera type with all accessories and fixation shall be selected where indicated on drawings
C. The Scope of Works is to undertake supply, commission and install without limitation all equipment, apparatus, appliances, services, and documentation as a comprehensive turnkey solution not limited to below.
D. All Civil work related to the project including Conduits, driveway, Chipping, Plastering, and filling, Power distribution and design, Electrical work, and mounting.
E. Single integrator for full setup (network, camera, servers, storage, UTP pulling/patching/termination/labelling, Fiber pulling/patching/termination/labelling, etc.)
F. Complete Network design including Cabling not limited to Power, CAT6A, Fiber Optic, Ethernet, etc.
G. Any requirements of the vendor from client should be clearly stated in the proposal, such as an internet connection, etc.
H. All hardware requirements should be included in the proposal with breakdown and summary.
I. The Service Provider to ensure proper site survey is performed before proposing any system.

1.11 VIDEO SURVEILLANCE CAMERAS SPECIFICATIONS

A. Cameras shall be supplied of the type shown in locations as per the layout drawings.
B. Contractor shall be responsible for selecting the correct lens to achieve the intended field of view (FOV)
C. In compliance with International codes regulations, camera type / locations shall be as follows:
1. All equipment and materials used shall be standard anti-bacterial resistant components that are regularly manufactured and used in the manufacturer's system.
2. All systems and components shall have been thoroughly tested and proven in actual use.
3. All systems and components shall be provided with the availability of an authorized local distributor.
4. Cameras shall be supplied of the type shown in locations as per the layout drawings.
5. All the cameras shall be anti-bacterial resistant with IK10 when installed at 2.5m height or lower.
6. The network camera shall feature up to 5 Mega Pixel resolutions.
7. The camera shall be able to support H.264 and H.265 compression.
8. The camera shall feature a day / night mode that incorporates an infrared cut filter removal mechanism for true color reproduction and the best possible low light performance.
9. The camera shall feature integrated IR with a viewable length of up to 20mts.
10. The camera shall feature a motorized varifocal lens of 3.2~10mm.
11. The camera shall feature integrated motion detection, tampering, defocus detection analytics, enter/exit, virtual line, and direction detection analytics.
12. The camera shall run on POE power.

D. CAMERA
1. Imaging Device 1/2.9" 2.19 MP CMOS
2. Total Pixels 2000 (H) x 1121(V) total; 1984 (H) x 1105 (V) effective
3. Scanning System Progressive
4. Min. Illumination: Color 0.2 Lux & B/W 0.0 Lux (IR LED ON)
5. S / N Ratio 50dB

E. LENS TYPE
1. Lens Type DC Auto Iris,
2. Mount Type Board-in type

3. Focal Length (Zoom Ratio) 3.0~ 12mm (remote focus and motorized lens)
4. Max. Aperture Ratio F1.6
5. Angular Field of View H: 103.8˚ (Wide) ~ 31.2˚ (Tele); V: 53.7˚ (Wide) ~ 17.5˚ (Tele)
6. Min. Object Distance 0.5M (1.64ft)

F. OPERATION

1 Camera Title Off / On (Displayed up to 40 characters)
2 Day & Night Auto (ICR) / Color / B/W
3 Backlight Compensation Off, BLC
4 Wide Dynamic Range 110Db

G. NETWORK PROTOCOL

1. Ethernet RJ-45 (10/100Base-T)
2. Video Compression Format H.264 (MPEG-4 part 10/AVC), H.254, MJPEG
3. Max. Framerate: H.264/H.265 Max 30fps for all resolutions.
4. Intelligent Codec Dynamic GOV & ROI shall be available for both H.265 & H.264
5. Video Quality Adjustment
   a. H.264/H.265 Compression level, Target bit rate level control
   b. MJPEG Quality level control
6. Bitrate Control Method
   a. H.264/H.265 CBR or VBR
   b. MJPEG VBR
7. Streaming Capability Multiple Streaming (Up to 3 Streams minimum)
8. IP IPv4, IPv6
9. Protocol TCP/IP, UDP/IP, RTP(UDP), RTP(TCP), RTCP, RTSP, NTP, HTTP, HTTPS, SSL, DHCP, PPPoE, FTP, SMTP, ICMP, IGMP, SNMPv1/v2c/v3(MIB-2), ARP, DNS, DDNS, QoS, PIM-SM, UPnP, Bonjour

H. ELECTRICAL

a. Voltage POE
b. Consumption Max. 5.4W

I. ENVIRONMENTAL SPECIFICATIONS

1. Operating Temperature -10°C ~ +40°C
2. Storage Temperature -30°C ~ +60°C (-22°F ~ +140°F)
3. Operating Humidity Less than 90% RH

J. WARRANTY

2 years, parts, and labor.

PART 3 – EXECUTION

1.12 GENERAL

A. Comply with the most current edition of international codes regulations.
B. Comply with the International codes.
C. Shall be international codes Compliant
D. All work shall be installed in a neat, workmanlike manner in accordance with international codes.
E. All equipment of the same type and capacity shall be by the same manufacturer.
F. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounted items.
G. Working clearance around equipment shall not be less than that specified in the international codes.
H. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

I. Fire stopping shall be applied to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of the assembly according to Division 07 and 09 Sections.

1.13 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerance, hazards to camera installation, and other conditions affecting installation.
B. Examine roughing-in for LAN, WAN, and IP network before device installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.
D. Verification of Conditions: Examine the areas to receive the Works and the conditions under which the Works will be performed. The contractor shall remedy conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.
E. Before construction works commence, visit the site and identify the exact routing for all cable pathways and equipment placement. Verify all dimensions, locating the works and their relation to existing works, all existing conditions and their relation to the works and all obstructions and conditions, etc. affecting the completion and proper execution of the works as indicated in the project drawings and specifications.
F. All equipment locations should be coordinated with Engineer, other trades and existing conditions to eliminate interference with required clearances for equipment maintenance and inspections.
G. Install cabling and equipment to facilitate maintenance and repair or replacement of equipment components. Coordinate with the Engineer the exact location and mounting height of all equipment in finished areas.

1.14 WIRING

A. Comply with requirements in "Raceways and Boxes."
B. Wiring Method: Install cables in raceways unless otherwise indicated.
   1. Except raceways are not required in accessible indoor ceiling spaces and attics.
   2. Except raceways are not required in hollow gypsum board partitions.
   3. Conceal raceways and wiring except in unfinished spaces.
C. Wiring Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.
D. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in international codes.

1.15 VIDEO SURVEILLANCE SYSTEM INSTALLATION

A. Install cameras with adequate clear space below cameras and their mountings.
B. Install power supplies and other auxiliary components at control stations unless otherwise indicated.
C. Identify system components, wiring, cabling, and terminals according to Division 26 Section “Electrical Identification."

1.16 SUBSTANTIAL COMPLETION

A. To qualify for the Architect's consideration of Substantial Completion, the Work must, at a minimum, meet the following requirement that All alarm points and cameras must be installed and fully operational.
B. Substantial Completion shall NOT be construed as final acceptance of the Work.

1.17 SYSTEM ACCEPTANCE

A. Final acceptance testing of the Work will be conducted by the Architect, Consultant, and/or Owner.
B. The Contractor shall submit a report matrix indicating completion or delinquency for each item included in the Specification and all subsequent addenda and bulletins as part of the Work. Should work on any item be under way, but not yet fully complete, indicate the extent (or lack thereof) of completion to date, and the proposed date of completion.
C. Conduct a complete test of the entire System and provide the Architect with a written report on the results of that test. During this test, place the integrated System in service and calibrate and test all equipment.

END OF SECTION

LIST OF APPROVED MANUFACTURERS

ITEM	APPROVED MANUFACTURERS OR APPROVED EQUAL
Wires, Cables and Related accessories	Liban Cables
	Prysmian Cables
	Legrand
	3M
	Wago
	Phoenix Contact
Control / Signal Transmission Media Penetration Firestopping	Belden Cables
	Prysmian Cables
	Draka
	B3 Cables
	West Penn Wire
	Datwyler
Control / Signal Transmission Media Accessories	3M
	Legrand
	Wago
	Phoenix Contact
Raceways, Boxes and Fittings	Liban Cables
	Prysmian Cables
	Legrand
	3M
	Wago
	Phoenix Contact
Cable trays and Ladder Systems	Tolmega
	Cablofil
	Vergokan
	Legrand
	Defem
	MK
	OBO Betterman
	Panduit
	FEMI-CZ
	OB Profils

ITEM	APPROVED MANUFACTURERS OR APPROVED EQUAL
Motors Control Centers Switchgear & control gear	Schneider Electric
	Eaton
	Siemens
	ABB
	Danfoss
Motors Control Centers Enclosure and Busbar system	Schneider Electric
	Eaton-Moeller
	Siemens
	Eaton-Holec
	Logstrup
	ABB System Pro E
Wiring devices: Switch disconnector	Schneider Electric
	Legrand
	ABB
	Katko
	Eaton
Lighting	Philips
	General Electric
	Tridonic
	CREE
	Radium
	Schneider Electric
	Siemens
	Legrand
	ABB System Pro E