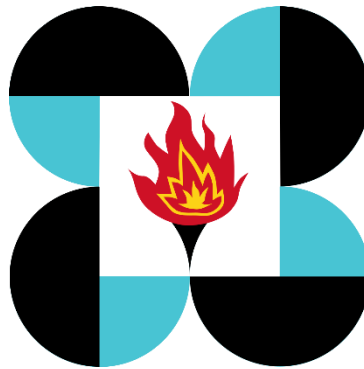


# CONSULTING SERVICES FOR THE ARCHITECTURAL AND DETAILED ENGINEERING DESIGN FOR THE CONSTRUCTION OF ACADEMIC BUILDING II

PHILIPPINE SCIENCE HIGH SCHOOL – MIMAROPA REGION CAMPUS  
Barangay Rizal, Odiongan, Romblon

## *TECHNICAL SPECIFICATION ARCHITECTURAL WORKS*

### CONTRACT DOCUMENTS



PREPARED BY:



IN JOINT  
VENTURE  
WITH



**HENRY STEVE R. OLONAN  
ARCHITECT**

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DATE : January 11, 2021  
PLACE : Quezon City

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**SECTION 011000**

**SUMMARY**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. Section Includes:

- 1. Project information.
- 2. Work covered by Contract Documents.
- 3. Phased construction.
- 4. Future work.
- 5. Access to site.
- 6. Coordination with occupants.
- 7. Work restrictions.

B. Related Requirements:

- 1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3. PROJECT INFORMATION

- A. Project Identifications: CONSTRUCTION OF THE PHILIPPINE SCIENCE HIGHSCHOOL (PSHS), MIMAROPA REGIONAL CAMPUS ACADEMIC BUILDING II. The proposed "new" PSHS Academic Building is to be built on an approximately 3,700 sqm square meter lot at Brgy. Rizal, Odiongan, Romblon. The Project consists of a 1-level basement & 4-level school building. Construction of the building shall include incidental related works to complete the building, ready for occupancy and use.

- 1. Project Location : Brgy. Rizal, Odiongan, Romblon.

- B. Owner: Philippine Science Highschool (PSHS), Mimaropa regional campus

- C. Architect-of-Record: Detailed Architectural Drawings and Documents dated May 2021 were prepared for the Project by Arch Henry Steve R. Olonan of Enrique O. Olonan and Associates (EOOA).

- D. Architect's Consultants: As part of EOOA's design group, the following design professionals were part of the preparation of the Detailed Engineering Drawings and Documents as part of the Contract Documents dated May 2021;

- |                                    |                            |
|------------------------------------|----------------------------|
| 1. Structural:                     | Engr. Arnel Nixon Tanazana |
| 2. Sanitary/Plumbing:              | Engr. Victoria Adecer      |
| 3. Electrical:                     | Engr. Manuel Panis         |
| 4. Mechanical & Fire Protection:   | Engr. Meliton Nague        |
| 5. Electronics and Communications: | Engr. Efren Pineda         |
| 6. Landscape:                      | L. Arch. Eric Estonido     |

1.4. WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and consists of the following:



1. The Work includes complete Architectural, Structural, Electrical, Mechanical, Fire Protection, Plumbing/Sanitary, Landscape Works, and other site related construction or as defined in the Contract Documents and Specification Documents.
2. Workmanship: Only personnel skilled in the operations of each trade required under any and all part of these Specifications shall undertake the works called for in the manner specified herewith.

#### 1.5. ACCESS TO SITE

- A. General: Contractor shall have full use of the Project Site for construction operations during the construction period. Contractor's use of the Project site is limited only by the Owner's/ Client's right to perform work or to retain other contractors on portions of the Project.
- B. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  1. Limits: Confine construction operations to the site premises
  2. Driveways, Walkways and Entrances: Keep driveways, parking, garage, loading areas, and entrances serving premises clear and available to Owner/Client, its employees and representatives and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

#### 1.6. SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:
  1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

1.7. MISCELLANEOUS PROVISIONS

- A. The Contractor shall comply with all laws, City Ordinances, and all Government Regulation and with the following regulatory requirements, in so far as they are binding upon or affect the portion of the work thereto. The Contractor of those engaged shall obtain all necessary licenses and permits and shall be responsible for all damages to persons or property, which may occur in connection with the execution of the work.

1. National Building Code of the Philippines
2. Architectural Code of the Philippines
3. National Structural Code of the Philippines (Latest Ed.)
4. Handicapped Law to Enhance Mobility of Disabled Persons /Accessibility Law
5. Philippine Electrical Code (National Electrical Code)
6. Philippine Electronics and Communications Code
7. Philippine Plumbing Code (Uniform Plumbing Code)
8. Philippine Society of Mechanical Engineers Code (Uniform Mechanical Code)
9. NFPA, Fire Protection Code

- B. RA 9266: All drawings and specifications acting as an instrument of service is the property of Enrique Olonan & Associates, and cannot be reproduced without their written consent.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

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**SECTION 012100**

**ALLOWANCES**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Section Includes administrative and procedural requirements governing allowances:
1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
1. Quantity allowances.
  2. Contingency allowances.
  3. Testing and inspecting allowances.
- C. Related Requirements:
1. Section 014000 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.3. SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by Architect from the designated supplier.

1.4. ACTION SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.5. INFORMATIONAL SUBMITTALS

- A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.
- B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

- C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.
- 1.6. COORDINATION
- A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation
- 1.7. QUANTITY ALLOWANCES
- A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
  - B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner under allowance shall be included as part of the Contract Sum and not part of the allowance.
- 1.8. CONTINGENCY ALLOWANCES
- A. Use the contingency allowance only as directed by Architect for Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
  - B. Contractor's overhead, profit, and related costs for products and equipment ordered by Owner under the contingency allowance are included in the allowance and are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
  - C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
  - D. At Project closeout, credit unused amounts remaining in the contingency allowance to Owner by Change Order.
- 1.9. TESTING AND INSPECTING ALLOWANCES
- A. Testing and inspecting allowances include the cost of engaging testing agencies, actual tests and inspections, and reporting results.
  - B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting if previous tests and inspections result in failure. The cost for incidental labor to assist the testing agency shall be included in the Contract Sum.
  - C. Costs of services not required by the Contract Documents are not included in the allowance.
  - D. At Project closeout, credit unused amounts remaining in the testing and inspecting allowance to Owner by Change Order.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1. EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2. PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

END OF SECTION 012100

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**SECTION 012300**

**ALTERNATES**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.3. DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.

2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4. PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

- C. Execute accepted alternates under the same conditions as other work of the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

END OF SECTION 012300

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**SECTION 013300**

**SUBMITTAL PROCEDURES**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

- B. Related Requirements:

- 1. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
- 2. "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3. DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4. ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

1.5. SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will not be provided by Architect for Contractor's use in preparing submittals.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space on label or beside title block to record Contractor's review and approval markings and action taken by Architect and Construction Manager.
  3. Include the following information for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Construction Manager.
    - e. Name of Contractor.
    - f. Name of subcontractor.
    - g. Name of supplier.
    - h. Name of manufacturer.
    - i. Submittal number or other unique identifier, including revision identifier.
      - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
    - j. Number and title of appropriate Specification Section.
    - k. Drawing number and detail references, as appropriate.
    - l. Location(s) where product is to be installed, as appropriate.
    - m. Other necessary identification.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.



2. Name file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
  3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
  4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner, containing the following information:
    - a. Project name.
    - b. Date.
    - c. Name of Contractor.
    - d. Name of firm or entity that prepared submittal.
    - e. Names of subcontractor, manufacturer, and supplier.
    - f. Category and type of submittal.
    - g. Submittal purpose and description.
    - h. Specification Section number and title.
    - i. Specification paragraph number or drawing designation and generic name for each of multiple items.
    - j. Drawing number and detail references, as appropriate.
    - k. Location(s) where product is to be installed, as appropriate.
    - l. Related physical samples submitted directly.
    - m. Indication of full or partial submittal.
    - n. Transmittal number.
    - o. Other necessary identification.
    - p. Remarks.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect and Construction Manager on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval notation from Architect's and Construction Manager's action stamp.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## PART 2 – PRODUCTS

### 2.1. SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Submit electronic submittals via email as PDF electronic files.
  2. Action Submittals: Submit (3) paper copies of each submittal unless otherwise indicated. Architect will return (2) copies.
  3. Informational Submittals: Submit (2) paper copies of each submittal unless otherwise indicated. Architect will not return copies.
  4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
    - i. PDF electronic file.
    - j. (5) Paper copies of Product Data unless otherwise indicated. Architect will return (4) copies.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Submit Shop Drawings in the following format:
    - a. PDF electronic file.

- 
- b. (3) Opaque copies of each submittal. Architect will retain (2) copies; remainder will be returned.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
- 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  - 2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
  - 3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  - 4. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
    - a. Number of Samples: Submit (3) sets of Samples. Architect will retain (1) Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
      - 1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least (3) sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
- 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
  - 2. Manufacturer and product name, and model number if applicable.
  - 3. Number and name of room or space.
  - 4. Location within room or space.
  - 5. Submit product schedule in the following format:
    - a. Three (3) paper copies of product schedule or list unless otherwise indicated. Architect will return (2) copies.
- F. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."
- G. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

- H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."
- I. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."
- J. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- L. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- M. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents
- P. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- Q. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- R. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
- S. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- T. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

- U. Field Test Reports: Submit written reports indicating and interpreting results of field tests either performed during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- V. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions, other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

### PART 3 – EXECUTION

#### 3.1. CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

#### 3.2. ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals, not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

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**SECTION 014000**

**QUALITY REQUIREMENTS**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specified tests, inspections, and related actions do not limit Contractor's other quality- assurance and control procedures that facilitate compliance with the Contract Document requirements.
  - 2. Requirements for Contractor to provide quality-assurance and control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Requirements:
  - 1. Section 012100 "Allowances" for testing and inspecting allowances.

1.3. DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having

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jurisdiction, to establish product performance and compliance with specified requirements.

- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five (5) previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.4. CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

#### 1.5. INFORMATIONAL SUBMITTALS

- A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

#### 1.6. REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  - 1. Date of issue.

2. Project title and number.
  3. Name, address, and telephone number of testing agency.
  4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and re-inspecting.
- B. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

#### 1.7. QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. 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 the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.



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- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
  - H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
    - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
    - 2. Notify Architect seven (7) days in advance of dates and times when mockups will be constructed.
    - 3. Demonstrate the proposed range of aesthetic effects and workmanship.
    - 4. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - 5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
    - 6. Demolish and remove mockups when directed, unless otherwise indicated.
  - I. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

#### 1.8. QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  - 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
  - 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
  - 1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  - 2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  - 3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

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- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- E. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform any duties of Contractor.
- F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  6. Security and protection for samples and for testing and inspecting equipment at Project site.
- G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and - control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- 1.9. SPECIAL TESTS AND INSPECTIONS
- A. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections and in Statement of Special Inspections attached to this Section, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.

2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and re-inspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1. SPECIAL TESTS AND INSPECTIONS

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

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**SECTION 016000**

**PRODUCT REQUIREMENTS**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

- B. Related Requirements:

1. Section 13300 "Submittal Procedures"

1.3. DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4. ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one (1) week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven (17) days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

#### 1.5. QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

#### 1.6. PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from spilling.

#### 1.7. PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and

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limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

## PART 2 – PRODUCTS

### 2.1. PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
  6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  3. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers.

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Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section "Substitution Procedures" for proposal of product.
  
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2. COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
  - 1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - 3. Evidence that proposed product provides specified warranty.
  - 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  - 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

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**SECTION 017300**

**EXECUTION**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

- B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting surveys.
2. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3. INFORMATIONAL SUBMITTALS

- A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

- B. Certified Surveys: Submit two (2) copies signed by land surveyor.

- C. Final Property Survey: Submit two (2) copies showing the Work performed and record

1.4. QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

1.5. WARRANTY

- A. Existing warranties: Remove, replace, patch and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.



PART 2 – PRODUCTS (Not used)

PART 3 - EXECUTION (Not Used)

3.1. WARRANTY

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2. PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

### 3.3. CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect and Construction Manager promptly.
  
- B. General: Engage a professional engineer to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish limits on use of Project site.
  - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 4. Inform installers of lines and levels to which they must comply.
  - 5. Check the location, level and plumb, of every major element as the Work progresses.
  - 6. Notify Architect and Construction Manager when deviations from required lines and levels exceed allowable tolerances.
  - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
  
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
  
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
  
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect and Construction Manager.

### 3.4. FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
  
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect or Construction Manager. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect and Construction Manager before proceeding.
  
- C. Benchmarks: Establish and maintain a minimum of two (2) permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a land surveyor to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  2. 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5. INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

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- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  2. Allow for building movement, including thermal expansion and contraction.
  3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6. PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven (7) days during normal weather or three (3) days if the temperature is expected to rise above 27 degrees C.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways.
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.7. STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

### 3.8. STARTING AND ADJUSTING

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

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**SECTION 017300**  
**CLOSEOUT PROCEDURES**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final completion procedures.
3. Warranties.
4. Final cleaning.

- B. Related Requirements:

1. Section 017300 "Execution" for progress cleaning of Project site.
2. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3. SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.

- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.

- a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item

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and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.

5. Submit test/adjust/balance records.
  6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Advise Owner of changeover in heat and other utilities.
  6. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
  7. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  8. Complete final cleaning requirements, including touchup painting.
  9. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
  2. Results of completed inspection will form the basis of requirements for final completion.
- 1.4. FINAL COMPLETION PROCEDURES
- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to "Payment Procedures."
  2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Submit pest-control final inspection report.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection

or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5. LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.

1.6. SUBMITTAL OF PROJECT WARRANTIE

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 215 mm x 280 mm paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

- C. Provide additional copies of each warranty to include in operation and maintenance manuals.



PART 2 – PRODUCTS (Not used)

2.1. MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

1. Use cleaning products that comply with the relevant code for regulations in maximum allowable VOC levels.

PART 3 - EXECUTION

3.1. FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
  - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
  - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
  - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
  - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e. Remove snow and ice to provide safe access to building.
  - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - h. Sweep concrete floors broom clean in unoccupied spaces.
  - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

- m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
  - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
- p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
- q. Leave Project clean and ready for occupancy.

### 3.2. REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

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**SECTION 017823**

**OPERATION AND MAINTENANCE DATA**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

- B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
2. Section 017700 "Closeout Procedures".

1.3. CLOSEOUT SUBMITTALS

- A. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
  - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
  - b. Enable inserted reviewer comments on draft submittals.
2. Three (3) paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two (2) copies.

- B. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.

- C. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.

1. Correct or revise each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

## PART 2 – PRODUCTS

### 2.1. OPERATION AND MAINTENANCE DOCUMENTARY DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
  - 1. Use List of documents.
  - 2. List of systems.
  - 3. List of equipment.
  - 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### 2.2. REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- B. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.
  - 6. Name and contact information for Architect.
  - 7. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

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- E. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 215 mm x 280 mm paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
  2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
  4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

### 2.3. EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
1. Type of emergency.
  2. Emergency instructions.
  3. Emergency procedures.
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
  2. Flood.
  3. Gas leak.
  4. Water leak.
  5. Power failure.
  6. Water outage.
  7. System, subsystem, or equipment failure.
  8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

#### 2.4. OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Operating standards.
3. Operating procedures.
4. Operating logs.
5. Wiring diagrams.
6. Control diagrams.
7. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.5. PRODUCT MAINTENANCE MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
  - 1. Product name and model number.
  - 2. Manufacturer's name.
  - 3. Color, pattern, and texture.
  - 4. Material and chemical composition.
  - 5. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures.
  - 2. Types of cleaning agents to be used and methods of cleaning.
  - 3. List of cleaning agents and methods of cleaning detrimental to product.
  - 4. Schedule for routine cleaning and maintenance.
  - 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

2.6. SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins.

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2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  3. Identification and nomenclature of parts and components.
  4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
  2. Troubleshooting guide.
  3. Precautions against improper maintenance.
  4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  5. Aligning, adjusting, and checking instructions.
  6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

### PART 3 - EXECUTION

#### 3.1. MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.



1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
1. Do not use original project record documents as part of operation and maintenance manuals.
- G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

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**SECTION 017839**

**PROJECT RECORD DOCUMENTS**

**PART 1 – GENERAL**

**1.1. RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

**1.2. SUMMARY**

- A. Section includes administrative and procedural requirements for project record documents, including the following:

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.

- B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

**1.3. CLOSEOUT SUBMITTALS**

- A. Record Drawings: Comply with the following:

1. Number of Copies: Submit 1 set(s) of marked-up record prints.

- B. Record Specifications: Submit one paper copy annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.

- C. Record Product Data: Submit one paper copy annotated PDF electronic files and directories of each submittal.

**PART 2 – PRODUCTS**

**2.1. RECORD DRAWINGS**

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.

b. Record data as soon as possible after obtaining it.

2. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  3. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  4. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Mark Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
  4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  3. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor
- 2.2. RECORD SPECIFICATIONS
- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Table Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders and record Drawings where applicable.

#### 2.3. RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  3. Note related Change Orders, record Specifications, and record Drawings where applicable.

#### 2.4. MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

### PART 3 - EXECUTION

#### 3.1. RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 017839

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**SECTION 017900**

**DEMONSTRATION AND TRAINING**

PART 1 – GENERAL

1.1. RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
  - 3. Demonstration and training video recordings.

1.3. INFORMATION SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4. CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two (2) copies within seven (7) days of end of each training module.

1.5. QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

- C. Pre-instruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
    - 1. Inspect and discuss locations and other facilities required for instruction.
    - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
    - 3. Review required content of instruction.
    - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.
- 1.6. COORDINATION
- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
  - B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
  - C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

## PART 2 – PRODUCTS

- 2.1. INSTRUCTION PROGRAM
- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
  - B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
    - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
      - a. System, subsystem, and equipment descriptions.
      - b. Performance and design criteria if Contractor is delegated design responsibility.
      - c. Operating standards.
      - d. Regulatory requirements.
      - e. Equipment function.
      - f. Operating characteristics.
      - g. Limiting conditions.
      - h. Performance curves.

2. Documentation: Review the following items in detail:
  - a. Emergency manuals.
  - b. Operations manuals.
  - c. Maintenance manuals.
  - d. Project record documents.
  - e. Identification systems.
  - f. Warranties and bonds.
  - g. Maintenance service agreements and similar continuing commitments
  
3. Emergencies: Include the following, as applicable:
  - a. Instructions on meaning of warnings, trouble indications, and error messages.
  - b. Instructions on stopping.
  - c. Shutdown instructions for each type of emergency.
  - d. Operating instructions for conditions outside of normal operating limits.
  - e. Sequences for electric or electronic systems.
  - f. Special operating instructions and procedures.
  
4. Operations: Include the following, as applicable
  - a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures
  
5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
  
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
  
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.

8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

### PART 3 - EXECUTION

#### 3.1. INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
  2. Owner will furnish an instructor to describe Owner's operational philosophy.
  3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  1. Schedule training with Owner with at least seven (7) days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

#### 3.2. DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Video: Provide minimum format type acceptable to Owner.
- C. Narration: Describe scenes on video recording by audio narration off-site after video recording is recorded. Include description of items being viewed.
- D. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

END OF SECTION 017900



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**SECTION 022113**

**SITE SURVEYS**

PART 1 – GENERAL

1.1. DESCRIPTION

- A. This section specifies the gathering of research documents, performance of a topographic survey and preparation of a topographic survey map.

1.2. MATERIALS (not used)

PART 2 – EXECUTION

- A. The surveyor shall research available public records for all mapping, plats, governmental surveys etc. that may pertain to the subject property. Research all applicable public utilities for substructure data such as sewers, storm drains, water lines, electrical conduits etc.
- B. The surveyor, when applicable, shall consult with the Project Architect / Engineer to determine the scale of plat or map and sizes of drawings.
- C. The surveyor shall furnish two sets of prints of the plat or map of survey and an electronic CADD file. If the plat or map of survey consists of more than one sheet, the sheets shall be numbered, the total number of sheets indicated and the match lines shown on each sheet.
- D. On the plat or map, the survey boundary shall be drawn to a convenient scale, or the scale designated by the Architect, with the scale clearly indicated. A graphic scale, shown in meters shall be included. A north arrow shall be shown and when applicable, the plat or map of survey shall be oriented so that north is at the top of the drawing. Symbols or abbreviations used shall be identified on the face of the plat or map of survey by use of a legend or other means. Supplementary or exaggerated diagrams shall be presented accurately on the plat or map where dimensional data is too small to be shown clearly at full scale. The plat or map shall be 30 by 42 inches.
- E. The survey shall contain the following applicable information:
1. The name, address, telephone number, and signature of the Professional Land Surveyor who made the survey, his or her official seal and registration number, the date the survey was completed and the dates of all revisions.
  2. The survey drawing(s) submitted shall bear the following certification adjacent to the Engineer's official seal: "I hereby certify that all information indicated on this drawing was obtained and verified by actual measurements in the field and that every effort has been made to furnish complete and accurate information."
  3. Vicinity map showing the property surveyed in reference to nearby highways or major street intersections.
  4. Land area as defined by the boundaries of the legal description of the surveyed premises.

5. All data necessary to indicate the mathematical dimensions and relationships of the boundary represented by bearings and distances, and the length and radius of each curve, together with elements necessary to mathematically define each curve. The point of beginning of the surveyor's description and the basis of bearings shall also be shown.
6. When record bearings or angles or distances differ from measured bearings, angles or distances, both record and measured bearings, angles, and distances shall be clearly indicated. If the record description fails to form a mathematically closed figure, the surveyor shall so indicate.
7. Measured and record distances from corners of parcels surveyed to the nearest right-of-way lines of streets in urban or suburban areas, together with recovered lot corners and evidence of lot corners, shall be noted. The distances to the nearest intersecting street shall be indicated and verified. Names and widths of the streets and highways abutting the property surveyed and widths of right-of-way shall be given. Observable evidence of access (or lack thereof) to such abutting streets or highways shall be indicated. Observable evidence of private roads shall be so indicated. Streets abutting the premises, which have been described in record Documents, but not physically opened, shall be shown and so noted.
8. The identifying titles of all recorded plats, filed maps, right-of-way maps, or similar documents which the survey represents, wholly or in part, with their appropriate recording data. The survey shall indicate platted setback or building restriction lines which have been recorded in subdivision plats or which appear in a Record Document which have been delivered to the surveyor. Contiguity, gores, and overlaps along the exterior boundaries of the survey premises, where ascertainable from field evidence or Record Documents, or interior to those exterior boundaries, shall be clearly indicated or noted. Where only a part of a recorded lot or parcel is included in the survey, the balance of the lot or parcel shall be indicated.
9. The location of all buildings upon the plot or parcel shall be shown and their locations defined by measurements perpendicular to the boundaries. State if there is no building. Proper street numbers shall be shown where available.
10. All easements evidenced by a Record Document which have been delivered to the surveyor shall be shown, both those burdening and those benefiting the property surveyed, indicating recording information. If such an easement cannot be located, a note to this effect shall be included. Observable evidence of easements and/or servitudes of all kinds, such as those created by roads, right-of-ways, water courses, drains, telephone, or electric lines, water, sewer, oil or gas pipelines on or across the surveyed property and on adjoining properties if they appear to affect the surveyed property, shall be located and noted. Surface indications, if any, or of underground easements and/or servitudes shall also be shown.
11. The character and location of all walls, buildings, fences, and other visible improvements within five feet of each side of the boundary lines shall be noted. Without expressing a legal opinion, physical evidence of encroaching structural appurtenances and projections by or on adjoining property or on abutting streets, on any easement or over setback lines shown by Record Documents shall be indicated with the extent of such encroachment or projection.

12. Location, alignment and dimensions of all roads, curbs, walks, parking and paved areas abutting the subject land. Indicate road centerlines with true bearings and lengths by 50 foot stationing. Describe curves by designating the points of curvature and tangency by station. Include all curve data as well as a location of radius and vertex points.
13. Location of utilities existing on or serving the surveyed property as determined by observing evidence together with plans and markings provided by utility companies, and other appropriate resources (with reference as to the source of information). Locate and show all fire hydrants located within 500 feet of the project property.
14. Indicate location of manholes, catch basins, valve vaults or other surface indications of subterranean uses.
15. Wires and cables (including their function) crossing the survey premises, all poles on or within ten feet of the surveyed premises, and the dimensions of all cross-wires or overhangs affecting the surveyed premises.
16. Utility company installations on the surveyed premises.
17. Names of adjoining owners of platted lands.
18. Observable evidence of earth moving work, building construction or building additions within recent months.
19. Any changes in street right-of-way lines either completed or proposed, and available from the controlling jurisdiction. Any observable evidence of recent street or sidewalk construction or repairs shall be indicated.

END OF SECTION 022113

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**SECTION 024119**

**SELECTIVE/COMPREHENSIVE DEMOLITION**

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. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of existing building/s or structure/s.
3. Demolition and removal of selected site elements.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition or whole demolition.
3. Section 017300 "Execution" for cutting and patching procedures.
4. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

1.3. DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4. PRE-INSTALLATION MEETINGS

- A. Pre-demolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
  2. Review structural load limitations of existing structure.
  3. Review and finalize demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  4. Review areas where existing construction is to remain and requires protection.

1.5. INFORMATIONAL SUBMITTALS

- A. Qualification Data: Submit third-party Training Certificates of Heavy equipment operators and erectors.
- B. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
  2. Interruption of utility services. Indicate how long utility services will be interrupted (if applicable).

- 3. Coordination for shutoff, capping, and continuation of utility services (if applicable).
  - C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
  - D. Pre-demolition Photographs or Video: Submit before Work begins.
  - E. Warranties: Documentation indicated that existing warranties are still in effect after completion of demolition.
- 1.6. CLOSEOUT SUBMITTALS
- A. Inventory: Submit a list of items that have been removed and salvaged.
- 1.7. FIELD CONDITIONS
- A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with demolition.
  - B. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
    - 1. Hazardous materials will be removed by Owner before start of the Work.
    - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
  - C. Hazardous Materials: Hazardous materials may be present in buildings and structures to be demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
    - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
    - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
    - 3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
  - D. Storage or sale of removed items or materials on-site is not permitted.
  - E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.

## PART 2 – PRODUCTS

### 2.1. PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241

### PART 3 – EXECUTIONS

#### 3.1. EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- F. Survey of Existing Conditions: Record existing conditions by use of as built drawings and preconstruction photographs.
  - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
  - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
  - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

#### 3.2. UTILITY SERVICES AND MECHANICAL / ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
  - 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  - 2. Arrange to shut off indicated utilities with utility companies.
  - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3. PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

3.4. SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.

3.5. SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.6. COMPREHENSIVE DEMOLITION PROCEDURES

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures, and then remove concrete.
- B. Masonry: Demolish in sections. Cut masonry at junctures then remove masonry.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.7. CLEANING

- A. Clean dust, dirt, and debris caused by selective/comprehensive demolition operations. Return adjacent areas that have been damaged to condition existing before selective/comprehensive demolition operations began.

END OF SECTION 024119



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**SECTION 030130**

**MAINTENANCE OF CAST-IN-PLACE CONCRETE**

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. Polymer hardener / sealer.

1.3. PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.4. ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.
- B. Samples for Verification: Cured samples for each exposed product and for each color and texture specified.
  - 1. Include Samples of each required type, color, and texture of patching material in the form of patches in drilled holes or sawed joints in sample concrete representative of the range of concrete colors on the building.

1.5. INFORMATIONAL SUBMITTALS

- A. Product List: List manufacturer name and product name for each product proposed for use as concrete admixture and surface treatment.
- B. Manufacturer's Certificate: Indicating products listed on Contractor's Product List are compatible and suitable for the specified application.

1.6. QUALITY ASSURANCE

- A. Manufacturer: ISO 9001 quality certified as primary manufacturer of specified products.
- B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer to apply polymer sealers.
- C. Mockups: Build mockups to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7. DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.
- B. Store cementitious materials off the ground, under cover, and in a dry location.
- C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.8. FIELD CONDITIONS

- A. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer. During hot weather, cool epoxy components before mixing, store mixed products in shade, and cool unused mixed products to retard setting. Do not apply to wet substrates unless approved by manufacturer.

PART 2 – PRODUCTS

2.1. OTHER MATERIALS

- A. Polymer Hardener / Liquid Densifier Sealer: is a blend of silicate and silicate polymers that penetrate concrete surfaces and chemically react to provide an increase in surface density, durability, and abrasion resistance. Concrete treated with Polymer Hardener / Liquid Densifier Sealer is dust-proofed, resists tire marks, and is easier to maintain. Over time, EUCO DIAMOND HARD provides an attractive, slip resistant sheen to concrete that never peels, fades, or wears away. Does not contain VOC's.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) FLOORING SOLUTIONS
    - 2) ASHFORD FORMULA
    - 3) Or approved equal
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241

PART 3 – EXECUTIONS

3.1. EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

- 
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
  - E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
    - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
  - F. Survey of Existing Conditions: Record existing conditions by use of as built drawings and preconstruction photographs.
    - 1. Comply with requirements specified in Section 013233 "Photographic Documentation."
    - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
    - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
- 3.2. UTILITY SERVICES AND MECHANICAL / ELECTRICAL SYSTEMS
- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
    - 1. Comply with requirements for existing services/systems interruptions specified in Section 011000 "Summary."
  - B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
    - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
    - 2. Arrange to shut off indicated utilities with utility companies.
    - 3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
- 3.3. PREPARATION
- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
    - 1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
  - B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.

#### 3.4. SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Protect items from damage during transport and storage.

#### 3.5. SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

#### 3.6. COMPREHENSIVE DEMOLITION PROCEDURES

- A. Concrete: Demolish in sections. Cut concrete full depth at junctures, and then remove concrete.
- B. Masonry: Demolish in sections. Cut masonry at junctures then remove masonry.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.7. CLEANING

- A. Clean dust, dirt, and debris caused by selective/comprehensive demolition operations. Return adjacent areas that have been damaged to condition existing before selective/comprehensive demolition operations began.

END OF SECTION 024119

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**SECTION 033000**

**CAST-IN-PLACE CONCRETE**

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: cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Foundation walls.
  - 3. Slabs-on-grade.
  - 4. Suspended slabs.
  - 5. Concrete toppings.
  - 6. Building walls.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For steel reinforcement.
- C. Material test reports and certificates.
- D. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- E. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- F. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
- G. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - 1. Location of construction joints is subject to approval of the Architect.

1.4. INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Steel reinforcement and accessories.
  - 3. Water stops.

4. Vapor retarders.
5. Repair materials.

1.5. QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 – PRODUCTS

2.1. FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2. STEEL REINFORCEMENTS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

2.3. CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
  1. Portland Cement: ASTM C 150, Type I Type II Type I/I
- B. Normal-Weight Aggregates: ASTM C 33, Use well-graded, clean hard particles of gravel or crushed rock conforming to the "STANDARD SPECIFICATIONS FOR CONCRETE AGGREGATES".
  1. Maximum Coarse-Aggregate Size: shall not be larger than 1/5 of the narrowest dimension between sides of the forms nor larger than 3/4 of the maximum clear spacing between reinforcing bars, and in no case larger than 38 mm (1 1/2") in diameter.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

2.4. ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
  
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
  - 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.5. WATERSTOPS

- A. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

2.6. VAPOR RETARDERS

- A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 0.25 mm thick.

2.7. CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
  
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 305 g/sq. m when dry.
  
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
  
- D. Water: Potable.

2.8. RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.9. METHOD OF DETERMINING OF CONCRETE STRENGTH AND PROPORTIONS

- A. Submit mix designs obtained from samples made in accordance with "Standard METHOD OF MAKING AND CURING CONCRETE COMPRESSION AND FLEXURE SPECIMENS" (ASTM Designation A192) and "STANDARD METHOD OF TEST COMPRESSIVE STRENGTH OF MOLDED CONCRETE CYLINDERS" (ASTM Designation C-39) for each strength required stating the proposed slump and the proportional weights of cement, saturated dry aggregates, and water.



- B. These mixes shall be proved by preliminary tests of 30 days before concreting and shall show a 28- day strength of 15% higher than the ultimate required.
- C. No substitution shall be made in the materials or mix without additional tests to show that the quality of concrete is satisfactory.
- D. As to the actual pouring to verify whether the established strength mix design is followed, specimen shall be taken on actual mixing trucks prior to pouring and will be tested for 28-day compressive strength using the same testing method.

### PART 3 – STEEL REINFORCEMENTS

#### 3.1. FABRICATING REINFORCEMENTS

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

#### 3.2. CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

- 1. When air temperature is between 30 and 32 deg C, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 32 deg C, reduce mixing and delivery time to 60 minutes.

### PART 4 – EXECUTION

#### 4.1. FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Chamfer exterior corners and edges of permanently exposed concrete.

#### 4.2. EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

#### 4.3. VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

- 1. Lap joints 150 mm and seal with manufacturer's recommended tape.

#### 4.4. STEEL REINFORCEMENTS

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

#### 4.5. JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 3.2 mm. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 3.2mm wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

#### 4.6. WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

#### 4.7. CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI

D. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 32 deg C at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

4.8. FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

4.9. FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 6mm in one direction.
  1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings and to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
  1. Apply float finish to surfaces indicated to receive trowel finish.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  1. Apply a trowel finish to surfaces indicated exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thinfilm-finish coating system.

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2. After floating, begin first trowel-finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and finish surfaces to tolerances of F(F) 20 (floor flatness) and F(L) 17 (floor levelness) measured according to ASTM E 1155. Grind smooth any surface defects that would telegraph through applied floor covering system
  3. For slabs to receive porcelain floor tile, finish floor slab surfaces to tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface: Specified overall values of flatness, F(F) 40; with minimum local values of flatness, F(F) 30; and of overall levelness, F(L) 30; and of local levelness, F(L) 20.
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
- F. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.
- 4.10. CONCRETE PROTECTING AND CURING
- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
  - B. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
  - C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
    1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      - a. Water.
      - b. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 300mm lap over adjacent absorptive covers.
- 4.11. CONCRETE SURFACE REPAIRS
- A. Non-Structural Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval. Limited to only non-structural defects.
  - B. Structural Defective Concrete: Notify the Architect and the Structural Engineer-of-Record of such defects. The Contractor should not continue work on areas affected by the said defect. Contractor to consult its own Structural Engineer (ASEP Member) to assess the defect and submit a report indicating the root cause/Root Cause Analysis Report and propose a rectification methodology to the designer for its review and approval prior to any repair and/or retrofitting of defective areas.

4.12. FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
  
- B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed.

END OF SECTION 033000

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**SECTION 042200**

**CONCRETE UNIT MASONRY**

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. Mortar and grout.
2. Steel reinforcing bars.

1.3. DEFINITIONS

- A. CMU(s): Concrete Masonry Unit(s).

1.4. PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314
2. Verify with Architect and Structural Consultant.

1.5. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

- B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

- C. Samples for Verification: For each type and color of the following:

1. Accessories embedded in masonry.

1.6. INFORMATIONAL SUBMITTALS

- A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

- B. Qualification Data: For testing agency.

- C. Material Certificates: For each type and size of the following:
1. Masonry units.
    - a. Include data on material properties material test reports substantiating compliance with requirements.
    - b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
  2. Cementitious materials. Include brand, type, and name of manufacturer.
  3. Grout mixes. Include description of type and proportions of ingredients.
  4. Reinforcing bars.
  5. Joint reinforcement.
  6. Anchors, ties, and metal accessories.
- D. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
  2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.
- E. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602. Testing is required for every batch of delivery.

1.7. QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockup of typical wall area as shown on Drawings.
  2. Build mockups for typical exterior walls in sizes approximately 1200 mm long by 1200mm high by full thickness, including face and backup wythes and accessories.
    - a. Include a sealant-filled joint at least 400mm long in each exterior wall mockup.

- b. Include through-wall flashing installed for a 600mm length in corner of exterior wall mockup approximately 400mm down from top of mockup, with a 300mm length of flashing left exposed to view (omit masonry above half of flashing).
  3. Protect accepted mockups from the elements with weather-resistant membrane.
  4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
    - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
  5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."
- 1.8. DELIVERY, STORAGE, AND HANDLING
- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
  - B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
  - C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
  - D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
- 1.9. PROJECT CONDITIONS
- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
    1. Extend cover a minimum of 600mm down both sides of walls and hold cover securely in place.
  - B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
  - C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.



1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

## PART 2 – PRODUCTS

### 2.1. MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

### 2.2. CONCRETE MASONRY UNITS

- A. Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
- B. CMUs: ASTM C 90.
  1. Density Classification: Normal weight.
  2. Size (Width): Manufactured to the following dimensions: a. 100 mm nominal size. b. 150 mm nominal size.
  3. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
  4. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

### 2.3. MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C 91.
- E. Mortar Cement: ASTM C 1329.
- F. Aggregate for Mortar: ASTM C
  1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  2. For joints less than 6mm thick, use aggregate graded with 100 percent passing 1.18mm sieve.
  3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Aggregate for Grout: ASTM C 404.

H. Water: Potable.

#### 2.4. REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420)

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

#### 2.5. TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.

2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.

4. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, Z180 zinc coating.

5. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.

6. Stainless-Steel Sheet: ASTM A 666, Type 304.

7. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

8. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304

B. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 6.35mm diameter, hot-dip galvanized steel wire.

C. Rigid Anchors: Fabricate from steel bars 38mm wide by 6.35mm thick by 610mm long, with ends turned up 51mm or with cross pins unless otherwise indicated bent to configuration indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM

#### 2.6. MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM F 568M, Property Class 4.6; with ASTM A 563M hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.7. EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing where needed and required as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.40mm thick
2. Fabricate continuous flashings in sections 2400 mm long minimum, but not exceeding 3.7m. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 76mm intervals along length of flashing to provide an integral mortar bond.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge with a sealant stop.
4. Where flashing is fully concealed, use metal flashing.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8. MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use masonry cement or mortar cement mortar unless otherwise indicated.

B. Mortar for Unit Masonry: Comply with ASTM C 270. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. CONCRETE MIXING

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

#### 3.3. TOLERANCES

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation do not vary by more than plus 12mm or minus 6mm.
  - 2. For location of elements in plan do not vary from that indicated by more than plus or minus 12mm.
  - 3. For location of elements in elevation do not vary from that indicated by more than plus or minus 6mm in a story height or 12mm total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls do not vary from level by more than 6mm in 3 m, or 12mm maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 3mm in 3 m, 6mm in 6 m, or 12mm maximum.
  - 3. For vertical lines and surfaces do not vary from plumb by more than 6mm in 3 m, 9mm in 6 m, or 12mm maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 3mm in 3 m, 6mm in 6 m, or 12mm maximum.
  - 5. For lines and surfaces do not vary from straight by more than 6mm in 3 m, 9mm in 6 m, or 12mm maximum.
  - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 6mm in 3 m, or 12mm

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 3mm, with a maximum thickness limited to 12mm.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 3mm.
3. For head and collar joints, do not vary from thickness indicated by more than plus 9mm or minus 6mm.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 3mm.

3.4. LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond pattern indicated on Drawings; do not use units with less than nominal 100mm horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 600mm under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.5. MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
  1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
  3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
  4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
  2. Allow cleaned surfaces to dry before setting.
  3. Wet joint surfaces thoroughly before applying mortar.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.
- 3.6. MASONRY JOINT REINFORCEMENT
- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 16mm on exterior side of walls, 13mm elsewhere. Lap reinforcement a minimum of 150mm.
1. Space reinforcement not more than 203mm on center in foundation walls and parapet walls or as directed by Structural consultant.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
- 3.7. ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE
- A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:
1. Provide an open space not less than 25mm wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  3. Space anchors as indicated, but not more than 610mm on center vertically and 915mm on center horizontally.
- 3.8. CONTROL AND EXPANSION JOINTS
- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
  2. Install preformed control-joint gaskets designed to fit standard sash block.
  3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.

4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

### 3.9. FLASHING

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

### 3.10. REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
  2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
  1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height

### 3.11. FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Testing Prior to Construction: One set of tests.
- C. Testing Frequency: One set of tests for each 464 sq. m of wall area or portion thereof.
- D. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

- E. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
  - F. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
  - G. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
  - H. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.
- 3.12. REPAIRING, POINTING, AND
- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
  - B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
  - C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
  - D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
    - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
    - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
    - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
    - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
    - 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

END OF SECTION 042200



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**SECTION 055000**

**METAL FABRICATIONS**

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. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Metal ladders.
4. Structural-steel door frames.
5. Abrasive metal nosings.
6. Support for Wall and Ceiling Mounted Items
7. Frames
8. Covers and Frames for Pits and Trenches
9. Gratings
10. Railings and Handrails for stairs, ramps and PWD ramps

B. Section 051200 "Structural Steel Framing."

1.3. COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4. ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

B. Manufacturer's Certificates:

1. Finish as specified.
2. Live load design as specified.

C. Design Calculations for specified live loads including dead loads:

1.5. INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.

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- B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.
  - C. Welding certificates.
  - D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- 1.6. QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel.
  - B. Welding Qualifications: Qualify procedures and personnel according to the following:
    - 1. AWS D1.1/D1.1M, "Structural Welding Code

## PART 2 – PRODUCTS

### 2.1. PERFORMANCE

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders, support for wall and ceiling mounted items, covers and frames for pits and trenches, gratings, stair railings, ramps as well as handrails for PWD ramps. Structural Steel works shall all be supervised by professional engineer of the contractor or its supplier.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
  - 1. Temperature Change: 67 deg C, ambient; 100 deg C.

### 2.2. METALS

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent
- C. Steel Plates, Shapes, and Bars: ASTM
- D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.
- E. Design Criteria: In addition to the dead loads, design fabrications for support the following live loads unless otherwise specified:
  - 1. Ladders and Rungs: 120 kg (250 pounds) at any point.
  - 2. Railings and Handrails: 900N (200 pounds) in any direction at any point.

3. Floor plates, Gratings, Covers, Trap Doors, Catwalks and Platforms: 500 kg/m<sup>2</sup> (100pounds per square foot)

F. Design:

1. Structural Steel: ASTM A36
2. Floor Plate: Steel A786; Aluminum: ASTM B632
3. Steel Pipe: ASTM A53
4. Cast-Iron: ASTM A48, Class 30, commercial pattern
5. Primer Paint: As specified in Section 099100 Painting
6. Grout: ASTM C1107, pourable type.

2.3. FASTENERS

- A. General: Unless otherwise indicated, provide stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
  1. Provide stainless-steel fasteners for fastening aluminum.
  2. Provide stainless-steel fasteners for fastening stainless steel.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
- C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.
- D. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.
  1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- E. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.
- F. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.
- G. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

2.4. MISCELLANEOUS MATERIALS

- A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of

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Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- B. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting," Section 099123 Interior Painting." Section 099113 "Exterior Painting," Section 099123 Interior Painting,"
- C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- D. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.
- E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- F. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- G. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- H. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 20 MPa.

#### 2.5. FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1 mm unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 3.2 by 38mm, with a minimum 150mm embedment and 50mm hook, not less than 200mm from ends and corners of units and 600mm on center, unless otherwise indicated.
- K. Workmanship
  - 1. General:
    - a. Fabricated items to design shown
    - b. Furnish members in longest lengths commercially available within the limits shown and specified.
    - c. Provide holes, sinkages and reinforcement shown and required for fasteners and anchorage items.
    - d. Provide openings, cut-outs and tapped holes for attachment and clearances required for work of other trades.
    - e. Cut openings in gratings and floor plates for the passage of ducts, sumps, pipes, conduits and similar items. Provide reinforcement to support cut edges.
  - 2. Welding:
    - a. Weld in accordance with AWS
    - b. Where exposed in the finished work, continuous weld for the full length of the members joined and have depressed areas filled and protruding welds finished smooth and flush with adjacent surfaces.
  - 3. Anchors:
    - a. Where metal fabrications are shown to be preset in concrete, weld 32 x 3mm steel strap anchors, 150mm long with 25mm hooked end to back of member 600mm on center unless otherwise shown.
    - b. Where metal fabrications are shown to be built into masonry use 32 x 3mm steel strap anchors, 250mm long with 50mm hooked end welded to back of member at 600mm on center, unless otherwise shown.
  - 4. Finish:
    - a. Finish expose surfaces in accordance with NAAMM Metal Finishes Manual.
    - b. Steel and Iron: NAAMM AMP 504
      - 1. Zinc coated (Galvanized) ASTM A123, G90 unless noted otherwise.
      - 2. Surfaces exposed in the finished work:

- 2.1. Fill holes, dents and similar voids and depressions with epoxy type patching compound.
3. Shop Prime Painting:
  1. Surfaces of Ferrous metal:
    - 1.1. Galvanized surfaces specified to have prime paint.
    - 1.2. Remove all loose mill scale, rust and paint by hand or power tool cleaning as defined in SSPC-SP2 and SP3.
    - 1.3. After cleaning and finishing apply (1) coat of primer as specified in Section 09 91 00, PAINTING.
  2. Non-ferrous metals: Comply with MAAMM – 500 series.
5. Stainless steel: NAAMM AMP – 504 Finish No. 4
- 2.6. MISCELLANEOUS FRAMING AND SUPPORTS
  - A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
  - B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
    1. Fabricate units from slotted channel framing where indicated.
    2. Furnish inserts for units installed after concrete is placed.
  - C. Galvanize miscellaneous framing and supports where indicated.
  - D. Prime miscellaneous framing and supports with zinc-rich primer indicated.
  - E. For Wall Mounted Items:
    1. For items supported by metal stud partitions.
    2. Steel strip or hat channel minimum of 1.5mm thick.
    3. Steel strip minimum of 150mm wide, length extending one stud space beyond end of item supported.
    4. Steel hat channels where shown. Flange cut and flatted for anchorage to stud.
    5. Structural steel tube or channel for grab bar at water closets floor to structure above with clip angles or end plates formed for anchors.
    6. Use steel angles for thru wall counters. Drill angle for fasteners at ends and not over 100mm on center between ends.
- 2.7. METAL LADDERS
  - A. General:
    1. Comply with ANSI A14.3
    2. For elevator pit ladders, comply with ASME A17.1/CSA B44.
  - B. Ladder rungs:
    1. Fabricate so that rungs will extend at least 100mm into wall with ends turned 50mm project out from wall 175mm be 400mm wide and be designed so that foot cannot slide off end.

2. Galvanized after fabrication, ASTM A123, G-90 rungs for exterior use and for access to pits.

## 2.8. STEEL FRAMES

### A. Main and Sub-frames for wall claddings and decorative wall treatments

1. Fabricate of channel shapes, plates, and angles as shown.
2. Weld or bolt head to anchorage (slab, beam, wall, etc.) as shown.
3. Submit Shopdrawing showing connection details to Architect/Consultant prior to execution.
4. Mock up samples are also required for approval by Architect/Consultant.

## 2.9. STRUCTURAL-STEEL DOOR FRAMES

### A. Where anchored to masonry or embedded in concrete, weld to back of frame at each jamb, 5mm thick by 44mm wide steel strap anchors, with ends turned 50mm and of sufficient length to extend at least 300mm into wall. Space anchors 600mm above bottom of frame and 600mm on center top of jamb. Weld clip angles to bottom of jambs and provide holes for expansion bolts.

1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.

### B. Where anchored to concrete or masonry in prepared openings, drill holes at jambs for anchoring with expansion bolts. Weld clip angles to bottom of frame and provide holes for expansion bolt anchors as shown. Drill holes starting 600mm above bottom of frame and 600mm on center to top of jamb and at top of jamb. Provide pipe spaces at holes welded to channel.

### C. Weld continuous 19x 19x3mm thick steel angles to the interior side of each channel leg at the head and jambs to form a caulking groove.

### D. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.

### E. Galvanize and prime exterior steel frames.

### F. Prime steel frames with zinc-rich primer. primer specified in Section 099600 "High-Performance Coatings."

### G. Prepare frame for installation of hardware specified in Section 087100 DOOR HARDWARE.

1. Cut a slot in the lock jamb to receive the lock bolt.
2. Where shown use continuous solid steel bar stops at perimeter of frame, weld or secure with countersunk machine screws at not more than 450mm on center.

## 2.10. RAILINGS AND HANDRAILS FOR RAMPS

### A. In addition to the dead load design railing assembly to support live load specified.

B. Fabrication General:

1. Provide continuous welded joints, dressed smooth and flush.
2. Standard flush fittings designed weldable may be used.
3. Exterior Post Anchors.
  - a. Fabricate tube or pipe sleeves with closed ends or plates as shown
  - b. Where inserts interfere with reinforcing bars provide flanged fittings welded or threaded to posts for securing to concrete with expansion bolts
  - c. Provide heavy pattern sliding flange base with set screws at base of pipe or tube posts.
4. Interior Post Anchors.
  - a. Provide flanged fittings for securing fixed posts to floor with expansion bolts, unless shown otherwise
  - b. Weld or thread flanged fitting to posts at base
  - c. Provide sliding flange base plate on posts secured with set screws.

C. Stainless steel Pipe Handrails:

1. Fabricate of SS pipe with welded joints
2. Space posts for railing not over 1800mm on center between end posts.
3. Form handrail brackets from malleable iron.

2.11. MISCELLANEOUS STEEL TRIM

- A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with zinc-rich primer. primer specified in Section 099600 "High- Performance Coatings.

2.12. COVERS AND FRAMES FOR PITS AND TRENCHES

- A. Fabricate covers to support live loads specified.
- B. Galvanized steel members after fabrication in accordance with ASTM A123, G-90 coating
- C. Cast Iron Covers:
  1. Fabricate from ASTM A48, cast iron, 13mm minimum metal thickness, cast with stiffeners as required.
  2. Fabricate as flush type with frame, reasonably watertight and be equipped with flush type lifting rings. Provide seals where watertight covers noted.
  3. Make covers in sections not over 90kg except round covers.



- D. Cast Iron Frames:
  - 1. Fabricate from ASTM A48 cast iron to shape shown.
  - 2. Provide anchors for embedding in concrete, spaced near ends and not over 600mm.
  
- 2.13. ABRASIVE METAL NOSINGS.
  - A. Fed. Spec RR-T-650, Type C
    - 1. Cast iron: Class 4
  
  - B. Cast-Metal Units: Cast iron with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.
    - 1. Fabricate nosing approximately 100mm wide with not more than 9mm nose
    - 2. Provide nosing with integral type anchors spaced not more than 100mm from each end and intermediate anchors spaced approximately 375mm on center
    - 3. Fabricate nosing to extend within 100mm of ends of concrete stair treads except where shown to extend full width.
  
  - C. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.
  
  - D. Drill for mechanical anchors and countersink. Locate holes not more than 100mm from ends and not more than 300 mm o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.
    - 1. Provide two rows of holes for units more than 125 mm wide, with two holes aligned at ends and intermediate holes staggered.
  
  - E. Apply bituminous paint to concealed surfaces of cast-metal units.
  
  - F. Apply clear lacquer to concealed surfaces of extruded units.
  
- 2.14. FINISHES, GENERAL
  - A. Finish metal fabrications after assembly. Cast iron: Class 4
  
  - B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.
  
- 2.15. STEEL AND IRON FINISHES
  - A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
    - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
  
  - B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

- C. Shop prime iron and steel item unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
- D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

### PART 3 – EXECUTION

#### 3.1. INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

#### 3.2. INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
- B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.
- C. Anchorage to structure.
  1. Secure angles or channels and clip to overhead structural steel by continuous welding unless bolting is shown.
  2. Secure support to mid height of concrete beams when inserts do not exist with expansion bolts and to slabs with expansion bolts unless shown otherwise.
  3. Secure steel plate or hat channels to studs as detailed.
- D. Supports for Wall Mounted items
  1. Locate center of support at anchorage point of supported item
  2. Locate supports where required for items shown.
- 3.3. COVERS AND FRAMES FOR PITS AND TRENCHES
  - A. Set frame and cover flush with finish floor
  - B. Secure plates to frame with flat head countersunk screws.
  - C. Set gratings loose in drainage trenches or over pits unless shown anchored.
- 3.4. DOOR FRAMES
  - A. Secure clip angles at bottom of frames to concrete slab with expansion bolts as shown.
  - B. Level and plumb frame; brace in position required.
  - C. At masonry, set frames in walls so anchors are built-in as the work progresses unless shown otherwise.
  - D. Set frames in formwork for frames cast into concrete.
  - E. Where frames are set in prepared openings, bolt to wall with spacers and expansion bolts.
- 3.5. OTHER FRAMES
  - A. Set frame flush with surface unless shown otherwise
  - B. Anchor frames at ends and not over 450mm on center
  - C. Set in formwork before concrete is placed
- 3.6. GRATINGS
  - A. Set grating flush with finish floor; top of curb or areaway wall. Set frame so that horizontal leg of angle frame is flush with face of wall except when frame is installed on face of wall.

- B. Set frame in formwork before concrete is placed.
  - C. Where grating terminated at a wall bolt frame to concrete or masonry with expansion bolts unless shown otherwise.
  - D. Bolt grating to supports.
- 3.7. SAFETY NOSING
- A. Except as specified and where preformed rubber treads are shown or specified install safety nosing.
  - B. Install flush with horizontal and vertical surfaces
  - C. Install nosing to within 100mm of ends of concrete stair treads.
  - D. Extend nosing full width of door openings.
- 3.8. RAILINGS AND HANDRAILS
- A. Stainless Steel Posts
    - 1. Secure fixed posts to concrete with expansion bolts through flanged fittings except where sleeves are shown with pourable grout.
    - 2. Install sleeves in concrete formwork.
    - 3. Set post in sleeve and pour grout to surface. Apply beveled bead of urethane sealant at perimeter of post or under flange fitting.
    - 4. Secure sliding flanged fittings to posts at base with set screws.
    - 5. Secure fixed flanged fitting to concrete with expansion bolts.
  - B. Anchor to Walls
    - 1. Anchor rails to concrete or solid masonry with machine screws through flanged fitting to steel plate
    - 2. Anchor flanged fitting with toggle bolt to steel support in frame walls.
  - C. Handrails
    - 1. Anchor brackets for metal handrails as detailed.
    - 2. Install brackets within 300mm of return of walls and at evenly spaced intermediate points not exceeding 1200mm on centers unless shown otherwise.
    - 3. Expansion bolt to concrete or solid masonry.
- 3.9. TALLING NOSINGS, TREADS, AND THRESHOLDS
- A. Center nosing on tread widths unless otherwise indicated.
  - B. For nosing embedded in concrete steps or curbs, align nosing flush with riser faces and level with tread surfaces.

- C. Seal thresholds exposed to exterior with elastomeric sealant complying with Section 079200 "Joint Sealants" to provide a watertight installation.

3.10. ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

- 1. Apply by brush or spray to provide a minimum 0.05mm dry film thickness.

- B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099113 "Exterior Painting." Section 099123 "Interior Painting."

- C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

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**SECTION 055213**

**PIPE AND TUBE RAILINGS**

**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. Steel pipe and tube railings.
2. Stainless-steel pipe and tube

**1.3. ACTION SUBMITTALS**

- A. Shop Drawings

1. Submit detailed Shop Drawings of metal handrails and railings, showing sized details of fabrication and construction bends and radii handrail brackets locations of hardware, anchors, and accessories and installation details.

- B. Product Data: For the following:

1. Submit manufacturer's product data of railing system and railing components, handrails and handrail brackets. Include corrosion inhibitive shop coat painting system.

**1.4. QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

**1.5. DELIVERY, STORAGE, AND HANDLING**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

**PART 2 – PRODUCTS**

**2.1. PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

- B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

- a. Uniform load of 0.73 kN/m applied in any direction.
- b. Concentrated load of 0.89 kN applied in any direction.

c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

- a. Concentrated load of 0.22 kN applied horizontally on an area of 0.093 sq. m.
- b. Infill load and other loads need not be assumed to act concurrently.

2.2. METALS, GENERAL

A. Metal Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Material

- a. Metal handrails shall be standard steel pipe Architectural Handrail grade of diameter and sized indicated. Provide safety returns for all stair handrails. Handrail brackets shall be galvanized malleable iron, manufactured for the purpose, for anchorage to concrete wall. Include all fittings and components, sleeves, hardware, backing plates and accessories as required for complete and finished handrail installations.
- b. Steel pipe for railings pipe supports and pipe sleeves shall be seamless steel pipe, conforming to ASTM A53, Type S, Grade A of diameter and sized indicated. Special Instruction shall be given to the manufacturer to provide Architectural Handrail Grade pipe.
- c. Steel plate for anchor plates shall be standard steel plate conforming to ASTM A36 weld able quality.
- d. Anchors, Fasteners and Accessories
  - 1. Bolts and studs nuts and washers shall conform to ASTM A307, A449, and A563 as applicable and shall be galvanized in accordance with ASTM A153.
- e. Paints to be used shall be corrosion inhibitive protective metal primer as herein specified under "Cleaning and Painting"
- f. Non Shrink grout to be used shall be premixed factory packaged non ferrous aggregate non staining, shrinkage resistant, non corrosive and non-gaseous with conformance with ASTM C1107. It shall have a minimum strength of 5,000 PSI at 28 days.

C. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

D. Galvanizing:

- a. Steel metal railings shall be galvanized after fabrication by the hot-dip process in accordance with ASTM A123. Weight of the zinc-coating shall conform to the requirements specified under "Weight of coating" in ASTM A123. Provide high-quality galvanizing in conformance with ASTM A385.
- b. Safeguarding against steel embrittlement shall conform to the applicable requirement of ASTM A143.
- c. Safeguarding against warpage and distortion of steel members shall conform to the applicable requirements of ASTM A384.

2.3. STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
- B. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- C. Steel Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  - 1. Provide galvanized finish for exterior installations and where indicated.
- D. Plates, Shapes, and Bars: ASTM A 36/A
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.4. STAINLESS STEEL

- A. Tubing: ASTM A 554.
- B. Pipe: ASTM A 312.
- C. Castings: ASTM A 743/A 743M,
- D. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666,

2.5. FASTENERS

- A. General: Provide the following:
  - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
  - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
  - 3. Aluminum Railings: stainless-steel fasteners.
  - 4. Stainless-Steel Railings: stainless-steel fasteners.
  - 5. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated.
- C. Fasteners for Interconnecting Railing Components:
  - 1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
  - 2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
  - 3. Provide Phillips tamper-resistant square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.



- D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

## 2.6. MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

- 1. For stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

- B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- C. Shop Primers: Provide primers that comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

- D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

- 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

- E. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

- F. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

- G. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

- H. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

- 1. Water-Resistant Product: At exterior locations and where indicated provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.7. FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.

- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1mm unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 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 flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- J. Close exposed ends of railing members with prefabricated end fittings.
- K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 6 mm or less.
- L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

- N. For railing posts set in concrete, provide steel sleeves not less than 150 mm long with inside dimensions not less than 13mm greater than outside dimensions of post, with metal plate forming bottom closure.

## 2.8. STEEL AND IRON FINISHES

### A. Galvanized Railings:

1. Hot-dip galvanize indicated steel railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

- D. For non-galvanized-steel railings, provide non-galvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

## 2.9. STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines, or blend into finish.

- B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches.

- C. 180-Grit Polished Finish: Oil-ground, uniform, directionally textured finish.

- D. Directional Satin Finish: No. 4.

- E. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 – EXECUTION

### 3.1. EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

### 3.2. INSTALLATION, GENERAL

- A. General Fit exposed connections together to form tight, hairline joints.

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- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
    - 1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
    - 2. Set posts plumb within a tolerance of 2 mm in 1 m.
    - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 6 mm in 3.5 m.
  - C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
    - 1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.
  - D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
  - E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
- 3.3. RAILING CONNECTIONS
- A. Non-welded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
  - B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
  - C. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- 3.4. ANCHOR POSTS
- A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
  - B. Form or core-drill holes not less than 125 mm deep and 20 mm larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.
  - C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material] [attached to post with setscrews.

- D. Leave anchorage joint exposed with 3mm buildup, sloped away from post] [anchoring material flush with adjacent surface.
- E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

### 3.5. ATTACHING RAILINGS

- A. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- B. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.

### 3.6. ADJUSTING AND CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.

### 3.7. PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 055213

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**SECTION 071416**

**LIQUID APPLIED WATERPROOFING**

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. Single-component bitumen modified polyurethane membrane.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
  - 1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal- supported concrete pavers.

1.4. INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

1.5. QUALITY ASSURANCE

- A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
- B. Source Limitations: Obtain waterproofing materials from single source from single manufacturer.
- C. Mockups: Before beginning installation, install waterproofing to 9.3 sq. m to demonstrate surface preparation, crack and joint treatment, corner treatment, thickness, texture, and execution quality.
  - 1. If Architect determines mockups do not comply with requirements, reapply waterproofing until mockups are approved.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Pre-installation Conference: Conduct conference at Project site.
1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and flashings, installation procedures, testing and inspection procedures, and protection and repairs.
- 1.6. DELIVERY, STORAGE, AND HANDLING
- A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
  - B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.
  - C. Remove and replace liquid materials that cannot be applied within their stated shelf life.
  - D. Protect stored materials from direct sunlight.
- 1.7. PROJECT CONDITIONS
- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 3 deg C above dew point.
    1. Do not apply waterproofing in rain, fog or mist, or when such weather conditions are imminent during application and curing period.
  - B. Maintain adequate ventilation during application and curing of waterproofing materials.
- 1.8. WARRANTY
- A. Special Manufacturer's Warranty: Manufacturer's standard form in which waterproofing manufacturer and Installer agree to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
    1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1.6 mm in width.
    2. Warranty Period 10 years from date of Substantial Completion.

## PART 2 – PRODUCTS

### 2.1. SINGLE-COMPONENT BITUMEN MODIFIED POLYURETHANE WATERPROOFING

A. Single-Component, Bitumen Modified Polyurethane Waterproofing: Comply with ASTM D 412 with manufacturer's written physical requirements. High performance, seamless, elastomeric single component moisture curing bitumen modified polyurethane. Application of fiber mesh shall be according to manufacturer's recommendation.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
  - a. BOSTIK – BOSCOSEAL PU-X
  - b. Or approved equal.

### 2.2. AUXILIARY MATERIALS

A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.

## PART 3 – EXECUTION

### 3.1. EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2. SURFACE PREPARATION

A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.

E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.



3.3. PREPARATION AT TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 898 and manufacturer's written instructions.
- B. Prime substrate unless otherwise instructed by waterproofing manufacturer.
- C. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
  - 1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.4. JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 898 ASTM C 1471 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.
  - 1. Comply with ASTM C 1193 for joint-sealant installation.
  - 2. Apply bond breaker between sealant and preparation strip.
  - 3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 75 mm along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.
- B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing manufacturer's written instructions.
  - 1. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.

3.5. WATERPROOFING APPLICATION

- A. Apply waterproofing according to ASTM C 898 ASTM C 1471 and manufacturer's written instructions.
- B. Start installing waterproofing in presence of manufacturer's technical representative.
- C. Follow manufacturer's written instructions on application of fiber mesh.
- D. Apply primer over prepared substrate.
- E. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
  - 1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 1.5 mm and a minimum dry film thickness of 1.3 mm at any point.
  - 2. Apply waterproofing to prepared wall terminations and vertical surfaces.
  - 3. Verify wet film thickness of waterproofing every 9.3 sq. m.

3.6. FIELD QUALITY CONTROL

- A. Engage a full time site representative qualified by the waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, and application of the membrane, flashings, protection, and drainage components; and to furnish daily reports to Architect.
  
- B. Flood Testing: Flood test each deck area for leaks, according to recommendations in ASTM D 5957, after completing waterproofing but before overlaying construction is placed. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
  - 1. Flood to an average depth of 64 mm with a minimum depth of 25 mm and not exceeding a depth of 100 mm. Maintain 50 mm of clearance from top of sheet flashings.
  - 2. Flood each area for 24 hours.
  - 3. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
  
- C. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

3.7. CURING, PROTECTION, AND CLEANING

- A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.
  - 1. Do not permit foot or vehicular traffic on unprotected membrane.
  
- B. Protect waterproofing from damage and wear during remainder of construction period.
  
- C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071416

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**SECTION 071616**

**CRYSTALLINE WATERPROOFING**

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 crystalline waterproofing.
- B. Related Sections include the following:
  - 1. Division 7 Section "Joint Sealants" for elastomeric and preformed sealants in concrete and masonry walls and floors.
  - 2. Division 7 Section "Portland Cement Plastering" for plaster finishes to be applied over waterproofing.

1.3. SUBMITTALS

- A. Product Data: Include construction details, and material descriptions and installation instructions for crystalline waterproofing.
- B. Samples for Verification: For each type of modified cement waterproofing indicated.
- C. Qualification Data: For Installer.
- D. Material Test Reports: For crystalline waterproofing.
- E. Manufacturer's inspection reports of completed installation.
- F. Warranty: Special warranty specified in this Section.

1.4. QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Mockups: Provide mockups of crystalline waterproofing to verify selections made under sample submittals and to demonstrate aesthetic effects.
  - 1. Architect will select locations of mockups that represent typical surfaces and conditions for applications of modified cement waterproofing.
    - a. Vertical Surfaces: Provide samples of at least 0.9 sq.m
  - 2. Apply waterproofing according to requirements for the completed Work after permanent lighting and other environmental services have been activated.
- C. Pre-installation Conference: Conduct conference at Project site. Review methods and procedures related to crystalline waterproofing including, but not limited to, the following:

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. Review required certifying procedures.

#### 1.5. PROJECT CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit crystalline waterproofing to be performed according to manufacturer's written instructions and warranty requirements.
- B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after concrete and masonry substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.
- C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 4.4 deg C or above during work and cure period, and space is well ventilated and kept free of water.

#### 1.6. WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer and or Installer agrees to repair or replace components of crystalline waterproofing that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Failure to maintain watertight conditions within specified warranty period.
  2. Warranty Period: Five years from date of Substantial Completion.

### PART 2 – PRODUCTS

#### 2.1. MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  1. Products: Modified-Cementitious / Flexible Cementitious Waterproofing:
    - a. AQUAFIN-IC Crystalline Waterproofing Slurry, SCHOMBURG, Aquaproof Contracting Specialist
    - b. Or approved equal.
- B. Crystalline Waterproofing: A prepackaged, UV resistant proprietary blend of portland cement specially treated sand, and active chemicals that, when mixed with water and applied, penetrates by capillary action into concrete or masonry and reacts chemically

with free lime in the presence of water to develop crystalline growth within concrete or masonry capillaries to produce an impervious, dense, waterproof concrete or masonry with properties meeting or exceeding the following criteria:

1. Permeability: 0 for water at 10 m when tested according to CE CRD-C 48.
  2. Compressive Strength: 27.6 Mpa when tested according to ASTM C 109/C 109m.
- C. Patching Compound: Cementitious waterproofing and repair mortar for filling and patching ties holes, honeycombs, reveals, and other imperfections; with properties meeting or exceeding the following criteria:
1. Compressive Strength: 52.44 Mpa at 28 days when tested according to ASTM C 109/ C 109M.
  2. Flexural Strength: 4.8 Mpa at 28 days when tested according to ASTM C 348.
  3. Shrinkage: Minus 0.093 percent at 28 days and plus 0.073 percent at 90 days when tested according to ASTM C 596.
- D. Water: Potable.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Acceptance of Conditions: Examine substrates, with Applicator present, where waterproofing is to be applied.
1. Proceed with application only after unsatisfactory conditions have been corrected.
  2. Notify Architect in writing of active leaks or structural defects that would affect system performance.

#### 3.2. PREPARATION

- A. Protect other work from damage from cleaning, preparation, and application of modified cement waterproofing. Provide temporary enclosure to confine spraying operation, and to ensure adequate ambient temperatures and ventilation conditions for application.
- B. Stop active water leaks according to waterproofing manufacturer's written instructions.
- C. Repair damaged or unsatisfactory concrete or masonry according to manufacturer's written instructions.
- D. Surface Preparation: Comply with waterproofing manufacturer's written instructions to remove efflorescence, chalk, dust, dirt, mortar spatter, grease, oils, paint, curing compounds, and form-release agents to ensure that waterproofing bonds to concrete or masonry surfaces.
1. Clean concrete surfaces according to ASTM D 4261.
    - a. Medium and Normal Weight Concrete Masonry: Sandblast or bushhammer to depth of 1.6m

2. Clean concrete surfaces according to ASTM D 4258.
  - a. Scratch and Float-finished concrete: Etch with 10 percent muriatic (hydrochloric) acid solution according to ASTM D 4260.
3. Concrete Joints: Clean reveals according to waterproofing manufacturer's written instructions.

### 3.3. APPLICATION

- A. General: Comply with waterproofing manufacturer's written instructions for application.
  1. Dampen surface for several hours prior to application with water and maintain damp condition until applying waterproofing.
  2. Apply waterproofing to negative-side surfaces.
  3. Number of Coats: Two for brush application.
  4. Dampen surface between coats.
- B. Final Coat Finish: Smooth Brushed or approved by Owner.
- C. Moist-cure waterproofing for three days immediately after application has set, followed by two days of air drying as recommended in writing by manufacturer.
- D. Waterproofing Treatment Extensions: Extend waterproofing treatment as follows:
  1. Onto columns integral with treatwalls.
  2. Onto interior nontreated walls intersecting exterior treated walls, for a distance of 600mm for cast-in-place concrete and 1200mm for masonry.
  3. Onto exterior walls and onto both exterior and interior columns, for a height of 300mm, where floor, but not walls, are treated.
  4. Onto every substrate in areas indicated for treatment, including pipe trenches, pipe chases, pits, sumps, and similar offsets and features.

### 3.4. PROTECTION

- A. Protect applied crystalline waterproofing from rapid drying, severe weather exposure, and water accumulation. Maintain completed work in moist condition for not less than three days by procedures recommended in writing by waterproofing manufacturer. Protect waterproofing from temperatures below 2 deg C.

### 3.5. PROTECTION

- A. Inspection: Manufacturer's representative to inspect completed application and to provide a written report that application complies with manufacturer's written instructions.

END OF SECTION 071616

**SECTION 072100**  
**THERMAL 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:
  - 1. Glass-fiber blanket insulation.
  - 2. Vapor retarders.

**1.3. ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
  - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

**1.4. INFORMATIONAL SUBMITTALS**

- A. Product Test Reports.
- B. Research/Evaluation Reports

**1.5. DELIVERY, STORAGE, AND HANDLING**

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

**PART 2 – PRODUCTS**

**2.1. GLASS-FIBER BOARD INSULATION**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Products: PATSUM PE FOAM INSULATION, Kassel International Or approved equal
- B. Foil-Faced, Glass-Fiber Board Insulation: 50mm thick 60kg acoustical resitivity conforming to the requirements of ASTM C 665, Type III (reflective faced), Class B

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(faced surface with a flame- propagation resistance of 0.12 W/sq. cm); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene.

- C. Sustainability Requirements: Provide glass-fiber boart insulation as follows:
1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
  2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05- ppm formaldehyde.

## 2.2. VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D 4397, 0.15 mm thick, with maximum permeance rating of 0.13 perm (7.5 ng/Pa x s x sq).
1. Products: Subject to compliance with requirements, provide one of the following
    - a. Mac Alpha Omega
    - b. Or approved equal
- B. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

## 2.3. INSULATION FASTENERS

- A. Spindle-Type Mechanical Clips: 300mm x 50mm x 25mm welded to steel purlins capable of holding insulation of specified thickness securely in position with self-locking washer in place.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.41mm thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 38mm square or in diameter.
1. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in ceiling plenums and where indicated.
- C. Wire mesh: #16 galvanized iron wire mesh.

## PART 3 – EXECUTION

### 3.1. INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.



- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

### 3.2. INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 76mm clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. For metal-framed wall cavities where cavity heights exceed 2438mm, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
  - 1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 40 kg/cu.

### 3.3. INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

- A. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
  - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
  - 2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
  - 3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
  - 4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

END OF SECTION 072100

**WATERPROOFING AND INSULATION SCHEDULE**

**LEGEND**

MARK

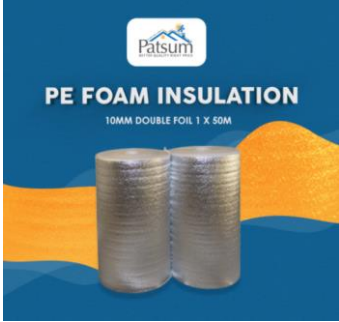
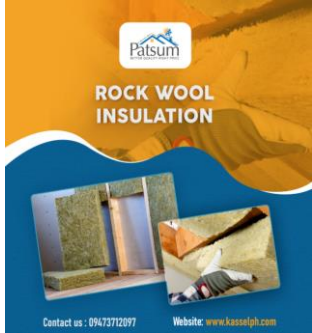

**WATERPROOFING**

- WP-001 Cementitious Capillary type waterproofing membrane by crystallization brush applied or admix to cement
- WP-002 Polyurethane - based liquid applied waterproofing
- DP-001 6-Mils Polyethylene Plastic vapor damp proofing

ROOM NO.	AREA	WATERPROOFING	INSULATION	REMARKS
<b>BASEMENT FLOOR</b>				
	Lower Ground	DP - 001	Polyethylene plastic vapor damp proofing	
	Male Toilet	WP-002	Polyurethane - based liquid applied waterproofing	
	Female Toilet	WP-002	Polyurethane - based liquid applied waterproofing	
		WP-001	Cementitious Capillary type waterproofing membrane by crystallization brush applied or admix to cement	Retaining walls
<b>GROUND FLOOR</b>				
	General Area			
	Female Toilet	WP-002	Polyurethane - based liquid applied waterproofing	
	PWD Toilet	WP-002	Polyurethane - based liquid applied waterproofing	
	Male Toilet	WP-002	Polyurethane - based liquid applied waterproofing	
	Faculty Room			
	Male Toilet	WP-002	Polyurethane - based liquid applied waterproofing	
	Female Toilet	WP-002	Polyurethane - based liquid applied waterproofing	
	Student Discipline Head			
	Toilet	WP-002	Polyurethane - based liquid applied waterproofing	

	Student Discipline Head				
	Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
	CID Head Office				
	Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
<b>SECOND FLOOR</b>					
	General Area				
	Female Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
	PWD Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
	Male Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
	Faculty Room				
	Male Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
	Female Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
<b>THIRD FLOOR</b>					
	General Area				
	Female Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
	PWD Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
	Male Toilet	WP-002	Polyurethane - based liquid applied waterproofing		
<b>ROOF DECK</b>					
	Roof deck	WP-002	Polyurethane - based liquid applied waterproofing	Rockwool Insulation (underslab)	
	Roofing			PE Foam Insulation	

WATERPROOFING & INSULATION MATERIAL LIST		
COLD FLUID APPLIED PU WATERPROOFING		
	MARK	
	MANUFACTURER	BOSTIK / BOSCOSEAL PU-X
	MODEL	BOSCOSEAL PU-X
	LOCATION	Parking areas, decks, balconies, bleachers, toilets, bathrooms, kitchen, and etc.
	DESCRIPTION	Bostik Bosco Seal PU-X is a single component, ready to use, highly elastic, cold-applied polyurethane waterproofing which cures into a membrane with excellent abrasion, mechanical, chemical, thermal and UV resistance.
CRYSTALLINE WATERPROOFING		
	MARK	
	MANUFACTURER	
	MODEL	Flexible Acrylic (negative side) / Aquafin-IC Crystalline Waterproofing Slurry
	LOCATION	Interior (negative side) waterproofing of below grade foundations, basements, utility vaults, elevator pits. Watertanks, waste water tanks, water catchment basins, manholes, parking garages, tunnels, slurry walls / retaining walls
	DESCRIPTION	AQUAFIN-IC (integral coat) is a state of the art one componentss, penetrating cementitious material which waterproofs and protects new or old structurally sound concrete or concrete masonry in-depth. It resists strong hydrostatic pressure and is not a vapor barrier (let's concrete "breathe") (WARRANTY 5 YEARS)
THERMAL INSULATION		
	MARK	
	MANUFACTURER	PATSUM / KASSEL INTERIONATIONAL

	MODEL	PE FOAM INSULATION
	LOCATION	Metal Roof
	DESCRIPTION	Patsum PE Foam roofing insulation and flooring underlay are the two primary applications of this product in the construction industry. It is a cost-effective insulation material that is widely used in various projects nationwide.
<b>THERMAL INSULATION</b>		
	MARK	
	MANUFACTURER	PATSUM / KASSEL INTERIONATIONAL
	MODEL	Rockwool Insulation
	LOCATION	Underslab
	DESCRIPTION	Our rockwool board is composed of 80% basalt with minimal slag content. Temperature is up to 650 deg C and is tested in accordance to ASTM standard.
<b>THERMAL INSULATION</b>		
	MARK	
	MANUFACTURER	MAC ALPHA OMEGA
	MODEL	POLYETHYLENE VAPOR DAMPROOFING (0.015mm)
	LOCATION	For Ground
	DESCRIPTION	Polyethylene damp-proof membrane is a moisture inhibiting foil that is 100% watertight. Thus damp, which exists in the surrounding air in the form of condensation, is prevented from penetrating the membrane. A damp-proof membrane prevents moisture, which exists in the surrounding air in the form of condensation, from penetrating. In doing so, the membrane acts to protect the underlying materials against damp. Where insulation is concerned, fitting a damp-proof membrane is important as it safeguards the insulating properties of the materials.

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**SECTION 074113**

**METAL ROOF PANELS**

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:

1. Concealed-fastener, Standing-seam metal roof panels. Mechanically seamed, Standing Seam Metal Roof Panels, with related metal trim and accessories.

- B. Related Sections:

1. Division 05 Section "Structural Steel Framing" for structural steel framing supporting metal panels.
2. Division 05 Section "Cold-Formed Metal Trusses" for cold-formed metal trusses supporting metal panels.
3. Division 07 Section ["Thermal Insulation"] ["Roof Insulation"] for thermal insulation installed under metal panels.
4. Division 07 Section "Sheet Metal Flashing and Trim" for formed sheet metal copings, flashings, reglets, and roof drainage items in addition to items specified in this Section.
5. Division 07 Section "Manufactured Roof Specialties" for manufactured copings, reglets, and roof drainage items in addition to items specified in this Section.
6. Division 07 Section "Joint Sealants" for field-applied sealants not otherwise specified in this Section.

1.3. DEFINITIONS

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weather-tight roofing system.

1.4. REFERENCES

- A. Metal Roof Panel Assembly: Metal roof panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weather-tight roofing system.

1. ASTM International (ASTM):

- a. ASTM A 653 - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- b. ASTM A 755 - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Pre-painted by the Coil-Coating Process for Exterior Exposed Building Products.
- c. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
- d. ASTM A 980 - Standard Specification for Steel, Sheet, Carbon, Ultra High Strength Cold Rolled.

- e. ASTM C 645 - Specification for Nonstructural Steel Framing Members.
- f. ASTM D 226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- g. ASTM D 1003 - Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics.
- h. ASTM D 2244 - Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates.
- i. ASTM D 4214 - Test Methods for Evaluating Degree of Chalking of Exterior Paint Films.
- j. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
- k. ASTM E 1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
- l. ASTM E 1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems.
- m. ASTM E 1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

2. Underwriters Laboratories, Inc. (UL):

- a. UL 580 - Tests for Uplift Resistance of Roof Assemblies

1.5. ADMINISTRATIVE REQUIREMENTS

- A. Pre-installation Meeting: Prior to erection of framing, conduct pre-installation meeting at site attended by Owner, Architect, manufacturer's technical representative, inspection agency and related trade contractors.
  - 1. Coordinate building framing in relation to metal panel system.
  - 2. Coordinate openings and penetrations of metal panel system.
  - 3. Coordinate work of Division 07 Sections "Roof Specialties" and "Roof Accessories" and openings and penetrations and manufacturer's accessories with installation of metal panels.

1.6. PERFORMANCE REQUIREMENTS

- A. General Performance: Metal roof panels shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Delegated Design: Design metal roof panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- C. Water Penetration: No water penetration when tested according to ASTM E 1646.
- D. FMG Listing: Provide metal roof panels and component materials that comply with requirements in FMG 4471 as part of a panel roofing system and that are listed in FMG's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.

- E. Structural Performance: Provide metal roof panel assemblies capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated, based on testing according to the following;
    - 1. ASTM E 1592: Wind Loads: Determine loads based on the following minimum design wind pressures: 250 KPH
    - 2. NSCP Latest ed.: Wind Loads: Determine loads based on the following minimum design wind pressures: 255 KPH
  - F. Thermal Performance: Provide insulated metal roof panel assemblies with thermalresistance value (R-value) indicated when tested according to ASTM C 518.
- 1.7. SUBMITTALS
- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of roof panel and accessory.
  - B. Shop Drawings: Show fabrication and installation layouts of metal roof panels; details of edge conditions, side-seam and endlap joints, panel profiles, corners, anchorages, trim, flashings, closures, and accessories; and special details. Distinguish between factory and field-assembled work.
  - C. Calculations: Include calculations with registered engineer seal, verifying roof panel and attachment method resist wind pressures imposed on it pursuant to applicable building codes.
  - D. Samples for Initial Selection: For each type of metal roof panel indicated with factory-applied color finishes.
    - 1. Include similar Samples of trim and accessories involving color selection.
  - E. Manufacturer Certificates: Signed by manufacturer certifying that roof panels comply with energy performance requirements specified in "Performance Requirements" Article.
    - 1. Submit evidence of meeting performance requirements.
  - F. Qualification Data: For qualified Installer.
  - G. Field quality-control reports.
  - H. Maintenance Data: For metal roof panels to include in maintenance manuals.
  - I. Warranties: Samples of special warranties.
- 1.8. QUALITY ASSURANCE
- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
  - B. Pre-installation Conference: Conduct conference at Project site.
  - C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.



1. Build mockup of typical roof area and eave[, including fascia,] [and soffit] as shown on Drawings; approximately 48 inches (1200 mm) square by full thickness, including attachments[, underlayment,] and accessories.
2. Build mockups for typical roof area only, including accessories.
  - a. Size: 48 inches (1200 mm) by 48 inches (1200 mm).
  - b. Each type of exposed seam and seam termination
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9. DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, sheets, metal roof panels, and other manufactured items so as not to be damaged or deformed. Package metal roof panels for protection during transportation and handling.
- B. Unload, store, and erect metal roof panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack metal roof panels on platforms or pallets, covered with suitable weather tight and ventilated covering. Store metal roof panels to ensure dryness. Do not store metal roof panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Protect strippable protective covering on metal roof panels from exposure to sunlight and high humidity, except to extent necessary for period of metal roof panel installation.

#### 1.10. PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit metal roof panel work to be performed according to manufacturer's written instructions and warranty requirements.
- B. Field Measurements: Verify actual dimensions of construction contiguous with metal roof panels by field measurements before fabrication.

#### 1.11. COORDINATION

- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
- B. Coordinate metal roof panels with rain drainage work, flashing, trim, and construction of decks, purlins and rafters, parapets, walls, and other adjoining work to provide a leak-proof, secure, and noncorrosive installation.

#### 1.12. WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal roof panel assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal roof panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
1. Finish Warranty Period: 5 years from date of Substantial Completion.

## PART 2 – PRODUCTS

### 2.1. STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weather tight installation.
1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.
  2. Aluminum Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1637.
- B. Vertical-Rib, Seam Cap Seamed Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and [panel striations] [a flat pan] between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of the panels, aligning vertical ribs and seaming on seam cap.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company; Tee-Lock or comparable product by one of the following:
    - a. DN STEEL - DN STEEL MARKETING, INC.
    - b. Or approved equal
  2. Metallic-Coated Steel Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Pre-painted by the coil-coating process to comply with ASTM A 755/A 755M.
  3. Aluminum Sheet: Coil-coated sheet, ASTM B 209 (ASTM B 209M), 3105 alloy with H14 temper as required to suit forming operations and structural performance required.
  4. Clips: Tee-Lock Clip to accommodate thermal movement.

2.2. MISCELLANEOUS METAL FRAMING

- A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal roof panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 0.4mm dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3. MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Sub framing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weather tight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  - 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
  - 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch (2400-mm) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match [metal roof panels] [roof fascia and rake trim].
- E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot (3-m) long sections, complete with formed elbows and offsets, of size and metal thickness. Finish downspouts to match gutters.
- F. Roof Curbs: Fabricated from same material as roof panels, galvalume or stainless steel; supply an integral full-length cricket for curbs wider than 24 inches (610 mm) supported by a structural metal deck. Fabricate curb flashing from [0.024 inch (0.61 mm)] [0.029 inch (0.74mm)]. On open framing, provide roof underlayment and decking at and about roof curb per roofing manufacturer's requirements. Maintain a minimum of 1/2 of roofing panel width on each side of roof curb, and start panels a minimum of 9 inches (229 mm) up slope of roof curb, flashing roofing panels to roof curb per roofing manufacturer's requirements. Fabricate curb and sub framing to withstand indicated

loads of size and height of roof top equipment. Where required insulate roof curbs with rigid insulation.

- G. Panel Fasteners: Zinc-coated steel, corrosion resisting steel, zinc cast head, or nylon capped steel, type and size as approved for the applicable loading requirements.
- H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are non-staining, and do not damage panel finish.
- I. Joint Sealant: Silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weather tight; and as recommended in writing by metal panel manufacturer.

#### 2.4. FABRICATION

- A. Fabricate and finish metal roof panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes and as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. End Seams for Other Than Aluminum: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 3. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
  - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 5. Fabricate cleats and attachment devices of size and metal thickness recommended by SMACNA's "Architectural Sheet Metal Manual" or by metal roof panel manufacturer for application, but not less than thickness of metal being secured.

#### 2.5. FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### PART 3 – EXECUTION

3.1. EXAMINATION

- A. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
- B. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
- C. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.
- D. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

- A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

3.3. METAL ROOF PANEL INSTALLATION, GENERAL

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated [below] [on Drawings], wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 36 inches (914.4 mm).[ Extend underlayment into gutter trough.] Roll laps with roller. Cover underlayment within 14 days or as directed by the underlayment product manufacturer.

- 1. Shim or otherwise plumb substrates receiving metal panels to be level to 1/4 inch in 20 ft. (6 mm in 6.1 m).
- 2. Flash and seal metal panels at perimeter of all openings. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
- 3. Locate and space fastenings in uniform vertical and horizontal alignment.
- 4. Install flashing and trim as metal panel work proceeds.
- 5. Panels should be continuous without end laps.
- 6. Align bottoms of metal panels and fasten.
- 7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners.

- 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
- 2. Aluminum Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use stainless-steel fasteners for surfaces exposed to the interior.

- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.
  
- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.
  
- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.
  - 1. Install clips to supports with self-tapping fasteners.
  - 2. Install pressure plates, if required, at locations indicated in manufacturer's written installation instructions.
  - 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied vinyl weather seal are completely engaged.
  
- F. Accessory Installation: Install accessories with positive anchorage to building and weather tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
  - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
  
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
  - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
  
- H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
  
- I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.
  - 1. Provide elbows at base of downspouts to direct water away from building.
  - 2. Connect downspouts to underground drainage system indicated.
  
- J. Roof Curbs: Install flashing around bases where they meet metal roof panels.

- K. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

#### 3.4. FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect metal roof panel installation, including accessories. Report results in writing.
- B. Remove and replace applications of metal roof panels where inspections indicate that they do not comply with specified requirements.
- C. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

#### 3.5. CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.
- B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074113

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**SECTION 076200**

**METAL COMPOSITE PANELS**

**PART 1 – GENERAL**

**1.1. SUMMARY**

A. This Section includes :

1. Formed roof drainage system.
2. Formed low-slope roof flashing and trim.
3. Formed steep-slope roof flashing and trim.
4. Formed wall flashing and trim.

**1.2. SUBMITTALS**

A. Product Data: For each type of product.

B. Shop Drawings: Show layouts, profiles, shapes, seams, dimensions, and details for fastening, joining, supporting and anchoring sheet metal flashing and trim.

C. Samples: For each type of sheet metal flashing and trim.

**1.3. QUALITY ASSURANCE**

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Mock-ups: Build mock-ups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mock-up of typical roof eave, approximately 1200 mm long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Pre-installation Conference: Conduct conference at Project site.

**PART 2 – PRODUCTS**

**2.1. PERFORMANCE REQUIREMENTS**

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.



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- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
  - C. SPRI Wind Design Standard: Manufacture and install copings roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:
    - 1. Design Pressure: As indicated on Drawings.
  - D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and night time-sky heat loss.
    - 1. Temperature Change: 67 deg C, ambient; 100 deg C, material surfaces.
- 2.2. SHEET METALS
- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
  - B. Metallic-Coated Steel Sheet: Provide aluminum-zinc alloy-coated steel sheet according to ASTM A 792/A 792M, Class AZM150 coating designation, Grade 275; prepainted by coil-coating process to comply with ASTM A 755/A 755M.
    - 1. Surface: Smooth, flat and with manufacturer's standard clear acrylic coating on both sides.
    - 2. Exposed Coil-Coated Finish:
      - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- 2.3. MISCELLANEOUS MATERIALS
- A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.
  - B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
    - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
      - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
      - b. Blind Fasteners: High-strength aluminum rivets suitable for metal being fastened. c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Aluminum-Zinc Alloy-Coated Steel Sheet: Copper, hardware bronze or passivated Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/ A 153M or ASTM F 2329.

#### 2.4. FABRICATION, GENERAL

- A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  2. Obtain field measurements for accurate fit before shop fabrication.
  3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 6mm in 6 m on slope and location lines indicated on Drawings and within 3mm offset of adjoining faces and of alignment of matching profiles.
- C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."
- D. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
  1. Form expansion joints of intermeshing hooked flanges, not less than 25mm deep, filled with butyl sealant concealed within joints.
  2. Use lapped expansion joints only where indicated on Drawings.
- E. Sealant Joints: Where movable, non-expansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.
- F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.
- H. Do not use graphite pencils to mark metal surfaces.

#### 2.5. ROOF-DRAINAGE SHEET METAL FABRICATIONS

- A. Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 2400mm long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than dimension indicated on Drawings. Fabricate expansion joints, expansion-joint covers and gutter accessories from same metal as gutters.
  
- B. Built-in Gutters: Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required. Fabricate in minimum 2400mm long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
  - 1. Fabricate gutters with built-in expansion joints and gutter-end expansion joints at walls.
  - 2. Accessories: Continuous, removable leaf screen with sheet metal frame and hardware cloth screen, Wire-ball downspout strainer.
  
- C. Counter-flashing: Shop fabricate interior and exterior corners. Fabricate from same materials as sheet metal roof.

#### 2.6. WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 2400mm long, but not exceeding 3.6m long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar lashings to extend 150 mm beyond each side of wall openings; and form with 50mm high, end dams. Fabricate from the following materials:

### PART 3 – EXECUTION

#### 3.1. INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 2. Torch cutting of sheet metal flashing and trim is not permitted.
  
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
  
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
  - 1. Space cleats not more than 300 mm apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 3 m with no joints allowed within 600 mm of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 25 mm deep, filled with elastomeric sealant concealed within joints.
- G. Fasteners: Use fasteners of sizes that will penetrate substrate.
  - 1. Galvanized or Pre-painted, Metallic-Coated Steel: Use stainless-steel fasteners.
  - 2. Aluminum: Use aluminum or stainless-steel fasteners.
- H. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- I. Seal joints with elastomeric sealant as required for watertight construction.
- J. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 38mm; except where pre-tinned surface would show in finished Work.
  - 1. Pre-tinning is not required for lead-coated copper.

### 3.2. ROOF-DRAINAGE SYSTEM INSTALLATION

- A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with elastomeric sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchored gutter brackets spaced not more than 900mm apart. Provide end closures and seal watertight with sealant. Slope to downspouts.
  - 1. Install gutter with expansion joints at locations indicated, but not exceeding, 15.24 m apart. Install expansion-joint caps.
- C. Downspouts: Join sections with 38-mm telescoping joints. Provide fasteners designed to hold downspouts securely 25 mm away from walls; locate fasteners at top and bottom and at approximately 1500 mm on center in between.

- D. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
- E. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 25mm below gutter discharge.

### 3.3. ROOF FLASHING INSTALLATION

- A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual.". Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight.
- B. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 100mm over base flashing. Lap counterflashing joints minimum of 100mm and bed with elastomeric sealant.
- C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows.
  - 1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
  - 2. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

### 3.4. WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 100mm beyond wall openings.
- A. installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.
- B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.
- C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.00

END OF SECTION 076200

**SECTION 079200**

**JOINT SEALANTS**

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. Silicone joint sealants.
- 2. Polyurethane joint sealants.
- 3. Latex joint sealants.

B. Related Sections:

- 1. Division 08 Section "Glazing" for glazing sealants.
- 2. Division 09 Section "Gypsum and Cement Board" for sealing perimeter joints.
- 3. Division 09 Section "Tiling" for sealing tile joints.

1.3. ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.

B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 13mm wide joints formed between two 150mm long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.4. INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

- C. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.

- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

- E. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

- 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- G. Field-Adhesion-Test Reports: For each sealant application tested.
- H. Sample Warranties: For special warranties.
- 1.5. QUALITY ASSURANCE
- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
  - B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
  - C. Product Testing: Test joint sealants using a qualified testing agency.
    1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
    2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
  - D. Mock-ups: Install sealant in mock-ups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
  - E. Pre-installation Conference: Conduct conference at Project site.
- 1.6. PRECONSTRUCTION TESTING
- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
    1. Use ASTM C 1087 or manufacturer's standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
    2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
    3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
    4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
    5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

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- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  2. Conduct field tests for each kind of sealant and joint substrate.
  3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### 1.7. FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
  2. When joint substrates are wet.
  3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
  4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

#### 1.8. WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: (2) years from date of Substantial Completion.
- B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.



2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 – PRODUCTS

### 2.1. JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following:
  1. Architectural sealants shall have a VOC content of 250g/L or less.
  2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250g/L or less.
  3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.
- C. Low-Emitting Interior Sealants: Sealants and sealant primers shall comply with the testing and product requirements of the California Department of Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. Colors of Exposed Joint Sealants: Match Architect's samples.

### 2.2. SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 100/50, NT: Single-component, non-sag, plus 100 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
- B. Silicone, S, NS, 50, NT: Single-component, non-sag, plus 50 percent and minus 50 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation
    - b. Or approved equal
- C. Silicone, S, NS, 35, NT: Single-component, non-sag, plus 35 percent and minus 35 percent movement capability. Non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 35, Use NT.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation

b. Or approved equal

D. Silicone, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:

a. Dow Corning Corporation

b. Or approved equal

E. Silicone, Acid Curing, S, NS, 25, NT: Single-component, non-sag, plus 25 percent and minus 25 percent movement capability, non-traffic-use, acid-curing silicone joint sealant: ASTM C 920, Type S, Grade NS, Class 25, Use NT.

### 2.3. POLYURETHANE JOINT SEALANTS

A. Urethane, NS: Single-component, non-sag, urethane joint sealant; ASTM C 920, conforme Grade NS.

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation

b. Or approved equal

### 2.4. LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

### 2.5. JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Non-staining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C closed-cell material with a surface skin Type O open-cell material Type B bi-cellular material with a surface skin or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

### 2.6. MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Masonry.
    - c. Exterior insulation and finish systems.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.

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Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3. INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
  - 4. Provide flush joint profile at where indicated per Figure 8B in ASTM C 1193.
  - 5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.
    - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4. FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform (10) tests for the first 300m of joint length for each kind of sealant and joint substrate.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.

b. Whether sealant dimensions and configurations comply with specified requirements.

c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5. CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6. PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If,

despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7. JOINT-SEALANT SCHEDULE

#### A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces

##### 1. Joint Locations:

- a. Isolation and contraction joints in cast-in-place concrete slabs.
- b. Joints between plant-precast architectural concrete paving units.
- c. Tile control and expansion joints.
- d. Joints between different materials listed above.
- e. Other joints as indicated on Drawings.

##### 2. Silicone Joint Sealant: Single component, non-sag, traffic grade, neutral curing.

##### 3. Joint-Sealant Color: Match Architect's sample.

#### B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.

##### 1. Joint Locations:

- a. Construction joints in cast-in-place concrete.
- b. Joints between plant-precast architectural concrete units.
- c. Joints between different materials listed above.
- d. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
- e. Control and expansion joints in ceilings and other overhead surfaces.
- f. Other joints as indicated on Drawings.

##### 2. Joint Sealant: Single component, non-sag, neutral curing, Class 100/50, Single component, non-sag, neutral curing, Class 50.

##### 3. Joint-Sealant Color: Match Architect's sample.

#### C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

##### 1. Joint Locations:

- a. Isolation joints in cast-in-place concrete slabs.
- b. Control and expansion joints in tile flooring.
- c. Other joints as indicated.

##### 2. Joint Sealant: Single component, non-sag, traffic grade, neutral curing.

##### 3. Joint-Sealant Color: Match Architect's sample.

#### D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

##### 1. Joint Locations:

- a. Control and expansion joints on exposed interior surfaces of exterior walls.

- b. Tile control and expansion joints.
    - c. Perimeter joints of exterior openings where indicated.
    - d. Vertical joints on exposed surfaces of walls and partitions.
    - e. Other joints as indicated.
  2. Joint Sealant: Latex.
  3. Joint-Sealant Color: Match Architect's sample.
- E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.
  1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Other joints as indicated.
  2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
  3. Joint-Sealant Color: Match Architect's sample.

END OF SECTION 079200

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**SECTION 081113**

**HOLLOW METAL DOORS AND FRAMES**

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 hollow-metal work.

B. Related Requirements:

- 1. Section 087100 "Door Hardware" for door hardware for hollow-metal doors.

1.3. DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM- HMMA 803 or SDI A250.8.

1.4. COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5. PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.6. ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

- 1. Elevations of each door type.
- 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
- 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
- 4. Locations of reinforcement and preparations for hardware.
- 5. Details of each different wall opening condition.
- 6. Details of anchorages, joints, field splices, and connections.
- 7. Details of accessories.
- 8. Details of mouldings, removable stops, and glazing.



C. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 75 by 127mm.
2. For "Doors" and "Frames" subparagraphs below, prepare Samples approximately 305 by 305mm to demonstrate compliance with requirements for quality of materials and construction:
  - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
  - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.

D. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.7. INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.
- B. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

1.8. DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use non vented plastic.
  1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 102mm high wood blocking. Provide minimum 6mm space between each stacked door to permit air circulation.

PART 2 – PRODUCTS

2.1. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following;
  1. Metrotech Steel Industries.
  2. or approved equal
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2. REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3. INTERIOR DOORS AND FRAMES

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Hollow-Metal Doors and Frames: NAAMM-HMMA 860. At locations indicated in the Door and Frame Schedule.
  - 1. Physical Performance: Level A according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Face: Metallic-coated, cold-rolled steel sheet.
    - c. Edge Construction: Continuously welded with no visible seam.
    - d. Core: Steel stiffened.
  - 3. Frames:
    - a. Materials: Metallic-coated steel sheet.
    - b. Construction: Knocked down

2.4. EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Hollow-Metal Doors and Frames: NAAMM-HMMA 860. At locations indicated in the Door and Frame Schedule.
  - 1. Physical Performance: Level A according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 44.5mm.
    - c. Face: Metallic-coated steel sheet, minimum thickness of Ga. 18, with minimum Z180 or ZF180 coating.
    - d. Edge Construction: Continuously welded with no visible seam.
    - e. Core: Steel stiffened.
      - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 0.370 K x sq. m/W when tested according to ASTM C 1363.
      - 2) Fire door assemblies receive a fire protection rating based on fire testing in accordance with NFPA 252, UL 10B or UL 10C.

3. Frames:

- a. Materials: Metallic-coated steel sheet, minimum thickness of 1.3mm, with minimum Z180 or ZF180 coating. b. Construction: Knocked down.

4. Exposed Finish: Factory.

2.5. FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 1.0mm thick, with corrugated or perforated straps not less than 51mm wide x 254mm long; or wire anchors not less than 4.5mm thick.
2. Post-installed Expansion Type for In-Place Concrete or Masonry: Minimum 9.5mm diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 1.0mm, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 51mm height adjustment. Terminate bottom of frames at finish floor surface.

2.6. MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
  1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 102mm, as measured according to ASTM C 143/C 143M.

- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

## 2.7. FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

- B. Hollow-Metal Doors:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.66mm, steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 152mm apart. Spot weld to face sheets no more than 127mm on center. Fill spaces between stiffeners with glass- or mineral-fiber insulation.
2. Fire Door Cores: As required to provide fire-protection and temperature-rise ratings indicated.
3. Vertical Edges for Single-Acting Doors: Bevel edges 3.2 mm in 51 mm.
4. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
5. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
6. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
7. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 19mm beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
4. Jamb Anchors: Provide number and spacing of anchors as follows:
  - a. Masonry Type: Locate anchors not more than 406mm from top and bottom of frame. Space anchors not more than 813mm on center, to match coursing, and as follows:
    - 1) (2) anchors per jamb up to 1524mm high.
    - 2) (3) anchors per jamb from 1524 to 2286mm high.

- 3) (4) anchors per jamb from 2286 to 3048mm high.
  - 4) (4) anchors per jamb plus (1) additional anchor per jamb for each 610mm or fraction thereof above 3048mm high.
- b. Compression Type: Not less than (2) anchors in each frame.
  - c. Post-installed Expansion Type: Locate anchors not more than 152mm from top and bottom of frame. Space anchors not more than 660mm on center.
5. Head Anchors: (2) anchors per head for frames more than 1067mm wide and mounted in metal-stud partitions.
  6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive (3) door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive (2) door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- 2.8. STEEL FINISHES
- A. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.
    1. Color and Gloss: Match existing.
- 2.9. ACCESSORIES
- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
  - B. Grout Guards: Formed from same material as frames, not less than 0.4mm thick.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

#### 3.3. INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80
    - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable stops located on secure side of opening
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
    - a. For Floor anchors may be set with power-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.

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3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  4. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
  5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1.6mm, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1.6mm, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1.6mm, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1.6mm, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
    - a. Between Door and Frame Jambs and Head: 3.2mm plus or minus 0.8mm.
    - b. Between Edges of Pairs of Doors: 3.2mm to 6.3mm plus or minus 0.8mm.
    - c. At Bottom of Door: 19.1mm plus or minus 0.8mm.
    - d. Between Door Face and Stop: 1.6mm to 3.2mm plus or minus 0.8mm.
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

#### 3.4. ADJUSTING AND CLEANING

- A. Final Adjustments: 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.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touch-up: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touch-up: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 081113

**SECTION 081416**

**FLUSH WOOD DOORS**

**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. Hollow-core doors with hardboard or MDF and plastic-laminate faces.

**1.3. PRE-INSTALLATION MEETINGS**

- A. Pre-installation Conference: Conduct conference at Project site.

**1.4. SUBMITTALS**

- A. Product Data: For each type of door. Include details of core and edge construction louvers and trim for openings.

- B. LEED Submittals:

- 1. Certificates for Credit MR 7: Chain-of-custody certificates indicating that flush wood doors comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.
- 2. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.

- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

- 1. Dimensions and locations of mortises and holes for hardware.
- 2. Dimensions and locations of cut-outs.
- 3. Doors to be factory finished and finish requirements.

- D. Samples for Verification:

- 1. Factory finishes applied to actual door face materials, approximately 200 by 250 mm, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
- 2. Corner sections of doors, approximately 200 by 250 mm, with door faces and edges representing actual materials to be used.
  - a. Provide Samples for each color, texture, and pattern of plastic laminate required.
- 3. Louver blade and frame sections, 150mm long, for each material and finish specified.



4. Frames for light openings, 150mm long, for each material, type, and finish required.

1.5. QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC- accredited certification body.
- B. Vendor Qualifications: A vendor that is certified for chain of custody by an FSC- accredited certification body.
- C. Source Limitations: Obtain flush wood doors from single manufacturer.
- D. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
  - 1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- E. Forest Certification: Provide doors made with all wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."
- F. Pre-installation Conference: Conduct conference at Project site.

1.6. DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7. PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weather tight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.8. WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Warping (bow, cup, or twist) more than 6.4mm in a 1067-by-2134-mm section.
    - b. Telegraphing of core construction in face veneers exceeding 0.25 mm in a 76.2-mm span.
  - 2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.

3. Warranty Period for Solid-Core Exterior Doors: (2) years from date of Substantial Completion.
4. Warranty Period for Solid-Core Interior Doors: Life of installation.

## PART 2 – PRODUCTS

### 2.1. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. METRO STYLE DOORS - METROTECH STEEL INDUSTRIES.
2. PATECO MOLDERD DOORS - PACIFIC TIMBER EXPORT CORPORATION
3. or approved equal

- B. Source Limitations: Obtain flush wood doors and wood paneling from single manufacturer.

### 2.2. FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards and WDMA I.S.1-A, "Architectural Wood Flush Doors."indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.

- B. Certified Wood: Flush wood doors shall be certified as "FSC Pure" according to FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship," and to FSC STD-40-004, "FSC Standard for Chain of Custody Certification."

- C. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.

- D. WDMA I.S.1-A Performance Grade: Heavy Duty.

- E. Particleboard-Core Doors:

1. Particleboard: Medium Density Fiberboard, made with binder containing no urea-formaldehyde.
2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through- bolting hardware follows:

- a. 125mm top-rail blocking, in doors indicated to have closers.

- F. Hollow-Core Doors:

1. Construction: Institutional hollow core on 6mm thick marine plywood.
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- 2.3. LOUVERS
    - A. Metal Frames for Light Openings: Anodized aluminum to match existing.
    - B. Metal Louvers:
      1. Blade Type: As indicated.
      2. Metal and Finish: Extruded aluminum with Class II, clear anodic finish, AA-M12C22A31, to match existing.
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- 2.4. FABRICATION
    - A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
    - B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI- WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
      1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
      2. Astragals: Factory machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.
    - C. Openings: Factory cut and trim openings through doors.
      1. Light Openings: Trim openings with moldings of material and profile indicated.
      2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."
        - a. 6mm Tempered clear glass vision panel
      3. Louvers: Factory install louvers in prepared openings.
- 
- 2.5. FACTORY FINISHING
    - A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

### PART 3 – EXECUTION

- 3.1. EXAMINATION
  - A. Examine doors and installed door frames, with Installer present, before hanging doors.
    1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.

2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2. INSTALLATION

A. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

B. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cut-outs, and mortises after fitting and machining.

1. Clearances: Provide 3.2mm at heads, jambs, and between pairs of doors. Provide 3.2mm from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 6.4mm from bottom of door to top of threshold unless otherwise indicated.

2. Factory-Fitted Bevel non-fire-rated doors 3-1/2 degrees at lock and hinge edges.

C. Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### 3.3. ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

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**SECTION 084213**

**ALUMINUM-FRAMED ENTRANCES**

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. Exterior manual-swing entrance doors and door-frame units.
- 2. Interior manual-swing entrance doors and door-frame units.

1.3. ALLOWANCES

- A. Field quality-control testing is part of testing and inspecting allowance.

1.4. PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site

1.5. ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For aluminum-framed entrances. Include plans, elevations, sections, full-size details, and attachments to other work.

- 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.

- 2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances, showing the following:

- a. Joinery, including concealed welds.
- b. Anchorage.
- c. Expansion provisions.
- d. Glazing.
- e. Flashing and drainage.

- 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

- C. Samples for Initial Selection: For units with factory-applied color finishes.

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- D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
  - E. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 300 mm lengths of full-size components and showing details of the following:
    - 1. Joinery, including concealed welds.
    - 2. Anchorage.
    - 3. Expansion provisions.
    - 4. Glazing.
    - 5. Flashing and drainage.
  - F. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
- 1.6. INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
  - B. Energy Performance Certificates: For aluminum-framed entrances, accessories, and components, from manufacturer.
    - 1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance.
  - C. Product Test Reports: For aluminum-framed entrances.
  - D. Field quality-control reports.
  - E. Sample Warranties: For special warranties.
- 1.7. CLOSEOUT SUBMITTALS
- A. Maintenance Data: For aluminum-framed entrances to include in maintenance manuals.
- 1.8. QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
  - B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.
- 1.9. WARRANTY
- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
    - 1. Warranty Period: Five (5) years from date of Substantial Completion.

- B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 421.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: Five (5) years from date of Substantial Completion.

## PART 2 – PRODUCTS

### 2.1. PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Loads:
  - 1. Wind Loads: As indicated on NSCP LATEST ED.
  - 2. Other Design Loads: As indicated on Drawings.
- C. Structural: Test according to ASTM E 330 as follows:
  - 1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  - 2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  - 3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- D. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
  - 1. Entrance Doors:
    - a. Pair of Doors: Maximum air leakage of 5.08 L/s per square meters at a static-air- pressure differential of 75 Pa.
    - b. Single Doors: Maximum air leakage of 2.54 L/s per square meter at a static-air- pressure differential of 75 Pa.
- E. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
  - 1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 300 Pa.

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- F. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 2.55 W/sq. m x K as determined according to NFRC 100.
  2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.27 as determined according to NFRC 200.
  3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500
- G. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 67 degrees C, ambient; 100 degrees C, material surfaces.

## 2.2. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product or comparable product by one of the following:
1. GCSI GELDC GLOBAL SOLUTIONS INC
  2. ALUMINUM RESOURCE AND INSTALLATION SYSTEMS (ARIS), INC
  3. DTT GLASS & ALUMINUM
  4. FAMCOR GLASSWORKS
  5. CRANMORE WINDOWS AND DOORS
  6. or approved equal

## 2.3. ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: 45 mm thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
    - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
  2. Door Design: As indicated.
  3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
    - a. Provide nonremovable glazing stops on outside of door.
- B. Framing Members: Manufacturer's standard extruded aluminum, minimum or formed aluminum framing members of thickness required and reinforced as required to support imposed loads.



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- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
  - D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
  - E. Materials:
    - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
      - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
      - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
      - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
      - d. Structural Profiles: ASTM B 308/B 308M
    - 2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC- SP COM, and prepare surfaces according to applicable SSPC standard.
      - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
      - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
      - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

#### 2.4. ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."
- B. General: Provide entrance door hardware for each entrance door to comply with requirements in this Section.
- C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:
- D. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.
- E. Cylinders: As specified in Section 087100 "Door Hardware." BHMA A156.5, Grade 1.
  - 1. Keying: Master key system.
- F. Operating Trim: BHMA
- G. Removable Mullions: BHMA A156.3, extruded aluminum.
  - 1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for

panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

- H. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.
- I. Surface-Mounted Holders: BHMA A156.16, Grade
- J. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.
- K. Weather Stripping: Manufacturer's standard replaceable components.
  - 1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
- L. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
- M. Silencers: BHMA A156.16, Grade 1
- N. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 12.7 mm.
- O. Finger Guards: Manufacturer's standard collapsible neoprene or PVC gasket anchored to frame hingejamb at center-pivoted doors.

## 2.5. GLAZING

- A. Glazing: Comply with Section 088000 "Glazing."
- B. Glazing Gaskets: Comply with Section 088000 "Glazing."
- C. Glazing Sealants: As recommended by manufacturer.

## 2.6. ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Use exposed fasteners with countersunk Phillips screw heads, framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 25.4 mm that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
  - 1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.

## 2.7. FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
  - 1. At exterior doors, provide compression weather stripping at fixed stops
  - 2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
  - 1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge. 2. At exterior doors, provide weather sweeps applied to door bottoms.
- F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.8. ALUMINUM FINISHES

- A. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 0.04 mm. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: Match Architect's sample.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. PREPARATION

- A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

#### 3.3. INSTALLATION

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure non-movement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
  - 6. Seal perimeter and other joints watertight, unless otherwise indicated.
- B. Metal Protection:
  - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.
  - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weather tight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement for proper operation.
- F. Install glazing as specified in Section 088000 "Glazing."
- G. Install weather sealant according to Section 079200 "Joint Sealants" and according to sealant manufacturer's written instruction to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.
- H. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
  - 1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4. FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on aluminum-framed entrances.
  - 1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.
- C. Aluminum-framed entrances will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.5. MAINTENANCE SERVICE

- A. Entrance Door Hardware:
  - 1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
  - 2. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Use parts and supplies that are the same as those used in the manufacture and installation of original equipment.

END OF SECTION 084213

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**SECTION 084226**

**ALL-GLASS ENTRANCES**

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. Interior and exterior swinging all-glass entrance doors.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for overhead-steel support for all-glass systems.

1.3. PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.4. ACTION SUBMITTALS

- A. Product Data: For each type of product.

- 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all-glass system.

- B. Shop Drawings: For all-glass entrances.

- 1. Include plans, elevations, and sections.
- 2. Include details of fittings and glazing, including isometric drawings of patch fittings.
- 3. Door hardware locations, mounting heights, and installation requirements.

- C. Samples for Verification: For each type of exposed finish indicated, prepared on Samples of size indicated below.

- 1. Metal Finishes: 150 mm long sections of patch fittings and other items.
- 2. Glass: 150 mm square, showing exposed-edge finish and color.
- 3. Door Hardware: For exposed door hardware of each type, in specified finish, full size.

- D. Fabrication Sample: Patch fitting at sill on pivot side only, made from 300 mm lengths of full-size components and showing details of the following:

- 1. Joinery.
- 2. Anchorage.
- 3. Glazing.

- E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and

diagrams. Coordinate final entrance door hardware schedule with doors sidelights, transoms, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

- F. Delegated-Design Submittal: For all-glass systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.5. INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For all-glass systems, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

#### 1.6. CLOSEOUT SUBMITTALS

- A. Maintenance Data: For all-glass systems to include in maintenance manuals.

#### 1.7. QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

#### 1.8. MOCKUPS

- A. Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockup of typical all-glass system as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9. WARRANTY

A. Special Warranty: Manufacturer and/or Installer agree to repair or replace components of all-glass systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

- a. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- b. Failure of operating components.

2. Warranty Period: Five (5) years from date of Substantial Completion, except as follows:

- a. Concealed Floor Closers: Five (5) years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, to design all-glass entrances.

B. General Performance: Comply with performance requirements specified, as determined by testing of all-glass entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings

D. Seismic Performance: All-glass entrances shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

E. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes.

1. Temperature Change: 67 degrees C, ambient; 100 degrees C, material surfaces.

2.2. METAL COMPONENTS

A. Fitting Configuration:

1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Patch Fittings: Stainless-steel-clad aluminum.

C. Accessory Fittings: Match patch-fitting metal and finish for the following:



1. Overhead doorstop.
  2. Center-housing lock.
  3. Glass-support-fin brackets.
- D. Anchors and Fastenings: Concealed.
- E. Weather Stripping: Pile type; replaceable without removing all-glass entrance doors from pivots.
- F. Materials:
1. Stainless-Steel Cladding: ASTM A 666, Type 304.
    - a. Finish: No. 4 directional satin finish.
- 2.3. GLASS
- A. Glass: ASTM C 1048, Kind FT (fully tempered), bluish grey in color, 12 mm thick, Type I (transparent), tested for surface and edge compression per ASTM C 1048 and for impact strength per 16 CFR 1201 for Category II materials.
1. Exposed Edges: Machine ground and flat polished.
  2. Butt Edges: Flat ground.
  3. Corner Edges: Lap-joint corners with exposed edges polished.
- 2.4. ENTRANCE DOOR HARDWARE
- A. General: Heavy-duty entrance door hardware units in sizes, quantities, and types recommended by manufacturer for all-glass entrance systems indicated. For exposed parts, match metal and finish of patch fittings.
- B. Concealed Floor Closers and Top Pivots: Center hung; BHMA A156.4, Grade 1; including cases, bottom arms, top walking beam pivots, plates, and accessories required for complete installation.
1. Swing: Single and Double acting.
    - a. Positive Dead Stop: Coordinated with hold-open angle if any, or at angle selected.
  2. Hold Open: Automatic, at angle selected.
  3. Opening-Force Requirements:
    - a. Egress Doors: Not more than 67 N to release the latch and not more than 133 N to set the door in motion and not more than 67 N to open the door to its minimum required width.
    - b. Accessible Interior Swinging Doors: Not more than 22.2 N to fully open door.
- C. Concealed Overhead Holder: BHMA A156.8, Grade 1, with dead-stop setting coordinated with concealed floor closer.
- D. Push-Pull Set: As specified in "Section 087100 Door Hardware Schedule".
- E. Single-Door and Active-Leaf Locksets: Bottom-fitting or bottom-rail deadbolt.

1. Deadbolt operated by key outside and key inside.
- F. Inactive-Leaf Locksets: Bottom-fitting or bottom-rail deadbolt.
  1. Deadbolt operated by key outside and key
- G. Cylinders: Six-pin cylinder, BHMA A156.5, Grade 1
- H. Threshold: Not more than 13 mm high.

#### 2.5. FABRICATION

- A. Provide holes and cutouts in glass to receive hardware, fittings, and accessory fittings before tempering glass. Do not cut, drill, or make other alterations to glass after tempering.
  1. Fully temper glass using horizontal (roller-hearth) process, and fabricate so that when glass is installed, roll-wave distortion is parallel with bottom edge of door or lite.
- B. Factory assemble components and factory install hardware and fittings to greatest extent possible.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. INSTALLATION

- A. Install all-glass systems and associated components according to manufacturer's written instructions.
- B. Set units level, plumb, and true to line, with uniform joints.
- C. Maintain uniform clearances between adjacent components.
- D. Lubricate hardware and other moving parts according to manufacturer's written instructions.
- E. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.

#### 3.3. ADJUSTING AND CLEANING

- A. Adjust all-glass entrance doors and hardware to produce smooth operation and tight fit at contact points and weather stripping.

1. For all-glass entrance doors accessible to people with disabilities, adjust closers to provide a three-second closer sweep period for doors to move from a 70 degrees open position to 75 mm from the latch measured to the leading door edge.
- B. Remove excess sealant and glazing compounds and dirt from surfaces.

END OF SECTION 084226

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**SECTION 084413**

**ALUMINUM WINDOWS**

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 aluminum windows for exterior locations.
- B. Related Requirements:
  - 1. Section 084113 "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.3. PRE-INSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.4. ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified, 50 by 100 mm in size
- D. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
  - 1. Exposed Hardware: Full-size units.
- E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5. INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.
- B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.
- C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.6. QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7. WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.

b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.

c. Faulty operation of movable sash and hardware.

d. Deterioration of materials and finishes beyond normal weathering.

e. Failure of insulating glass.

2. Warranty Period:

a. Window: Five years from date of Substantial Completion.

b. Glazing Units: Five years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1. MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

1. GCSI GELDC GLOBAL SOLUTIONS INC

2. ALUMINUM RESOURCE AND INSTALLATION SYSTEMS (ARIS), INC

3. DTT GLASS & ALUMINUM

4. FAMCOR GLASSWORKS
5. CRANMORE WINDOWS AND DOORS
6. or approved equal

## 2.2. WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: AMMA certified with label attached to each window.

- B. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

## 2.3. ALUMINUM WINDOWS

- A. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Awning: Project out.
2. Horizontal sliding.
3. Fixed.
4. Or as indicated on drawings.

- B. Frames and Sashes: Aluminum extrusions complying with AAMA/WDMA/CSA 101/I.S.2/A440.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

- C. Glass: Clear annealed glass, ASTM C 1036, Type 1, Class 1, q3.

1. Kind: 6mm Thk Annealed Glass
2. Low-E Glass: where indicated on Drawings.

- D. Glazing System: Manufacturer's standard factory-glazing system that produces weather tight seal.

- E. Projected Window Hardware:

1. Gear-Type Rotary Operators: Complying with AAMA 901 when tested according to ASTM E 405, Method A. Provide operators that function without requiring the removal of interior screens or using screen wickets.

- a. Type and Style: Match Architect's sample .

2. Hinges: Non-friction type, not less than two per sash
  3. Lock: Lever handle and cam-action lock with keeper
  4. Limit Devices: Concealed support arms with adjustable, limited, hold-open limit devices designed to restrict sash opening.
    - a. Limit clear opening to 150 mm for ventilation; with custodial key release.
- F. Horizontal-Sliding Window Hardware:
1. Sill Cap/Track: Extruded-aluminum track with natural anodized finish, of dimensions and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.
  2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only. Provide custodial locks.
  3. Roller Assemblies: Low-friction design
- G. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- H. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Do not use exposed fasteners to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
- 2.4. ACCESSORIES
- A. Entrances Dividers (False Muntins): Provide extruded-aluminum divider grilles in designs indicated for each sash lite.
  - B. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.
  - C. Interior Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
  - D. Panning Trim: Extruded-aluminum profiles in sizes and configurations indicated on Drawings.
  - E. Receptor System: Two-piece, snap-together, thermally broken, extruded-aluminum receptor system that anchors windows in place.
- 2.5. FABRICATION
- A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.
  - B. Glaze aluminum windows in the factory.

- C. Weather strip each operable sash to provide weathertight installation.
  - D. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.
  - E. Provide water-shed members above side-hinged sashes and similar lines of natural water penetration.
  - F. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design wind loads of window units.
  - G. Window Assemblies: Provide fixed units in configuration indicated. Provide window frames, sashes, hardware, and other trim and components necessary for a complete, secure, and weathertight installation, including the following:
    - 1. Angled mullion posts with interior and exterior trim.
    - 2. Angled interior and exterior extension and trim.
    - 3. Exterior head and sill casings and trim.
  - H. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation.
- 2.6. GENERAL FINISH REQUIREMENTS
- A. Comply with NAAMM's "Metal Finishes Manual" for recommendations for applying and designating finishes.
  - B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
  - C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7. ALUMINUM FINISHES

- A. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 0.04 mm. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  - 1. Color and Gloss: Match Architect's sample.



### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.
- C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weather tight window installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weather tight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

#### 3.3. FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
  - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- B. Remove and replace noncomplying windows and retest as specified above.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- D. Prepare test and inspection reports.

#### 3.4. ADJUSTING, CLEANING, AND PROTECTION

- A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weather tight closure.
- B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.
- C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

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**SECTION 087100**

**DOOR HARDWARE**

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. Mechanical door hardware for the following:
  - a. Swinging doors.
- 2. Cylinders for door hardware specified in other Sections.

B. Related Sections:

- 1. Division 08 Section "Flush Wood Doors" for astragals and integral intumescent seals provided as part of labeled fire-rated assemblies.
- 2. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for entrance door hardware, including cylinders.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: Details of electrified door hardware, indicating the following:

- C. Samples for Verification: For exposed door hardware of each type required, in each finish specified, prepared on Samples of size indicated below. Tag Samples with full description for coordination with the door hardware schedule. Submit Samples before, or concurrent with, submission of door hardware schedule.

D. Other Action Submittals:

- 1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
  - b. Content: Include the following information:
    - 1) Identification number, location, hand, fire rating, size, and material of each door and frame.

- 2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
  - 3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
  - 4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
  - 5) Fastenings and other pertinent information.
  - 6) List of related door devices specified in other Sections for each door and frame.
2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.
- 1.4. INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
  - B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
  - C. Warranty: Special warranty specified in this Section.
- 1.5. CLOSEOUT SUBMITTALS
- A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying
- 1.6. QUALITY ASSURANCE
- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.
  - B. Source Limitations: Obtain each type of door hardware from a single manufacturer.
  - C. Means of Egress Doors: Latches do not require more than 67N to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
  - D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines ICC/ANSI A117.1 HUD's "Fair Housing Accessibility Guidelines".
  - E. Keying Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." In addition to Owner, Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, 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 key system schematic diagram.
  3. Requirements for key control system.
  4. Requirements for access control.
  5. Address for delivery of keys
- F. Pre-installation Conference: Conduct conference at Project site.
- 1.7. DELIVERY, STORAGE, AND HANDLING
- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
  - 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 keys to manufacturer of key control system for subsequent delivery to Owner.
- 1.8. COORDINATION
- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
  - B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- 1.9. WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
    1. Failures include, but are not limited to, the following:
      - a. YALE, CHAIN GLASS ENTERPRISES & METROTECH
      - b. Or approved equal

## PART 2 – PRODUCTS

- 2.1. HINGES
- A. Hinges: BHMA A156.1.
    1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on or comparable product by one of the following:
      - a. YALE, CHAIN GLASS ENTERPRISES & METROTECH
      - b. Or approved equal
- 2.2. SELF-CLOSING HINGES AND PIVOTS
- A. Self-Closing Hinges and Pivots: BHMA A156.17.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on or comparable product by one of the following:
  - a. YALE, CHAIN GLASS ENTERPRISES & METROTECH
  - b. Or approved equal

### 2.3. MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
  1. Bored Locks: Minimum 13mm latchbolt throw.
  2. Mortise Locks: Minimum 19mm latchbolt throw.
  3. Deadbolts: Minimum 25mm latchbolt throw.
- C. Lock Backset: 70mm, unless otherwise indicated.
- D. Lock Trim:
  1. Description: As indicated on Drawings or as verified by the Architect.
  2. Levers: Cast.
  3. Escutcheons (Roses): Cast.
  4. Dummy Trim: Match lock trim and escutcheons.
  5. Operating Device: Lever with escutcheons (roses).
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
- F. Bored Locks: BHMA A156.2; Grade 1; Series
- G. Mortise Locks: BHMA A156.13; Operational Grade 2; stamped steel case with steel or brass parts; Series 1000.

### 2.4. EXIT LOCKS PANIC DEVICE

- A. Exit Locks: BHMA A156.29, Grade 1.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on or comparable product by one of the following:
    - a. YALE, CHAIN GLASS ENTERPRISE & METROTECH
    - b. Or approved equal.

### 2.5. DOOR BOLT

- A. Dustproof Strikes conforming to the requirements of BHMA A156.16, Grade 1.

- B. Manual flush bolts shall conform to the requirements of BHMA A156.16, Grade 2; designed for surface-mounting into door edge.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on or comparable product by one of the following:
    - a. YALE, CHAIN GLASS ENTERPRISE & METROTECH
    - b. Or approved equal.

## 2.6. EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
- B. Accessibility Requirements : Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22N).
- C. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.
- D. Outside Trim: Lever with cylinder; material and finish to match locksets, unless otherwise indicated. Match design for locksets and latchsets, unless otherwise indicated.

## 2.7. LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1 unless Grade 2; permanent cores that are interchangeable; face finished to match lockset.
- C. High-Security Lock Cylinders: BHMA A156.30; Grade 1; Type M, mechanical E, electrical; permanent cores that are removable; face finished to match lockset.
- D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
- E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

## 2.8. KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
  - 1. Master Key System: Change keys and a master key operate cylinders.
- B. Keys: Brass or as verify and approved by the Architect.
  - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

- a. Notation: "DO NOT DUPLICATE."
2. Quantity: In addition to one extra key blank for each lock, provide the following:
  - a. Cylinder Change Keys: (3).
  - b. Master Keys: (5).
- 2.9. OPERATING TRIM
  - A. Operating Trim: BHMA A156.6; brass stainless steel, unless otherwise indicated
- 2.10. ACCESSORIES FOR PAIRS OF DOORS
  - A. Astragals: BHMA A156.2
- 2.11. SURFACE CLOSERS
  - A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- 2.12. DOOR GASKETING
  - A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.000774 cu. m/s per m of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
- 2.13. THRESHOLDS
  - A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
- 2.14. METAL PROTECTIVE TRIM UNITS
  - A. Metal Protective Trim Units: BHMA A156.6; fabricated from 1.3mm thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
- 2.15. AUXILIARY DOOR HARDWARE
  - A. Auxiliary Hardware: BHMA A156.16.
- 2.16. FABRICATION
  - A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
    1. Manufacturer's identification is permitted on rim of lock cylinders only.
  - B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and



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hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA.

- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - 2. Fire-Rated Applications:
    - a. Steel Through Bolts: For the following unless door blocking is provided:
      - 1) Surface hinges to doors.
      - 2) Closers to doors and frames.
      - 3) Surface-mounted exit devices.
    - 3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
    - 4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
    - 5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

#### 2.17. FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. 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.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2. PREPARATION

- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

### 3.3. INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated on Drawings unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. 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. 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.
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 750mm of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 750mm of door height greater than 2286mm.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
- F. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- H. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- I. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

- J. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

#### 3.4. FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: Owner will engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
  - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

#### 3.5. ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
  - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
  - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

#### 3.6. CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

END OF SECTION 087100

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**SECTION 088000**

**GLAZING**

**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: Glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

- 1. Windows.
- 2. Doors.
- 3. Glazed curtain walls.
- 4. Glazed entrances

**1.3. REFERENCES**

- A. General:
  - 1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
  - 2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
- B. ANSI Z 97.1, "Safety Glass Test Requirements".
- C. ASTM International.
  - 1. ASTM C864 Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
  - 2. ASTM C1036 Standard Specification for Flat Glass
  - 3. ASTM C1048 Standard Specification for Heat-Treated Flat Glass – Kind HS, Kind FT Coated and Uncoated Glass
- D. BAAQMD Regulation 8-51 – Adhesive and Sealant Products.

**1.4. SYSTEM DESCRIPTION**

- A. Install each piece of glass watertight and airtight. Each installation shall withstand local, normal temperature changes, wind loading, impact loading (for operating sash and doors) without failure of any kind, including loss or breakage of glass, failure of sealants or gaskets to remain watertight, deterioration of glazing materials, and other defects of work.
- B. Where no thickness of glass is given in the glass schedule, it shall be determined by glass manufacturer for the wind loads specified in the California Building Code Chapter 16 as modified by Division 01 Section "Lateral Force Procedures".

1.5. DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
  
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

1.6. COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.7. PRE-INSTALLATION MEETINGS

- A. 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. Review temporary protection requirements for glazing during and after installation.

1.8. PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
  
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
  - 1. Design Wind Pressures: As indicated on Drawings.
  - 2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.

1.9. PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
  - 1. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
  - 2. Test no fewer than three Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
  - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 4. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

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- B. Preconstruction performance mock-up test based on parameters previously stated. Architect to specify sections/ portions of the system to be subjected to performance test.
    - 1. Reputable third party to conduct the test either local or abroad on a reputable/ duly approved by the consultant, architect or owner testing facility.

#### 1.10. SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glass Samples: For each type of 300 mm square.
  - 1. Annealed glass.
  - 2. Clear Tempered glass.
  - 3. Tempered Tinted glass.
- C. Glazing Accessory Samples: For sealants, in 300 mm lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.
- D. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- E. Qualification Data: For installers.
- F. Product Certificates: For glass and glazing products, from manufacturer.
- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for tempered tinted glass and glazing gaskets.
  - 1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36 month period.
- H. Preconstruction adhesion and compatibility test report.
- I. Warranties: Sample of special warranties.

#### 1.11. QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
- B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
- C. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Mock-ups: Build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Install glazing in mockups specified in Section 084113 "Aluminum-Framed Entrances and Storefronts", Section 085113 "Aluminum Windows" to match glazing systems required for Project, including glazing methods.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Pre-installation Conference: Conduct conference at Project site.

#### 1.12. PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

#### 1.13. DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

#### 1.14. FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

#### 1.15. WARRANTY

A. Manufacturer's Special Warranty for Tinted-Glass Products: Manufacturer agrees to replace tinted- glass units that deteriorate within specified warranty period. Deterioration of tint glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning tinted glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in tint.

1. Warranty Period: 5 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated- glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed

to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: Five (5) years from date of Substantial Completion.

## PART 2 – PRODUCTS

### 2.1. MANUFACTURERS

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
  1. Obtain glass from single source from single manufacturer.
- B. Source Limitations for Glazing Treatment: Obtain from single source from single manufacturer for each product and installation method.

### 2.2. PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction
- B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
  1. Design Wind Pressures: As indicated on Drawings.
  2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
    - a. Wind Design Data: Based on NSCP Latest Edition.
  3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
  4. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 25 mm, whichever is less.
  5. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
  6. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

### 2.3. MATERIALS



- 
- A. Glass types, thicknesses and fabricated assemblies are scheduled in the Glass Schedule included in PART 3. EXECUTION of this Section. Where no thickness is given, it shall be determined by glass manufacturer.
  
  - B. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass in thicknesses as needed to comply with requirements indicated.
    - 1. Minimum Glass Thickness for Exterior: 6.0 mm for exterior steel and aluminum windows & 12mm for Curtain wall Aluminum windows and entrances.
  
  - C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
    - 1. For laminated-glass , properties are based on products of construction indicated.
    - 2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
- 2.4. GLASS PRODUCTS
- A. Annealed (float) Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), unless otherwise indicated.
  
  - B. Tinted Tempered Glass: 12 mm thick for curtain wall aluminum windows.
    - 1. Tint Color: Green & Bronze or as approved by the Architect.
  
  - C. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Type II, Class 1 (clear), Form 3; Quality- Q3
    - 1. 6 mm thick clear, float glass for vision panel of doors.
    - 2. 6 mm thick clear, annealed glass for exterior windows
    - 3. 12 mm thick clear, tempered glass for curtain walls.
- 2.5. LAMINATED GLASS
- A. Laminated Glass: 12 mm thick clear laminated glass. ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
- 2.6. GLAZING GASKETS
- B. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from the following:
    - 1. EPDM complying with ASTM C 864.
    - 2. Silicone complying with ASTM C 1115.
  
  - C. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure- glazing stops on opposite side of glazing.
- D. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock-strips, complying with ASTM C
- 2.7. GLAZING SEALANTS
- A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
- 2.8. GLAZING TAPES
- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
  2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
  3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
  2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.
- 2.9. MISCELLANEOUS GLAZING MATERIALS
- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

#### 2.10. FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
  - 1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic glass float glass to produce square edges with slight chamfers at junctions of edges and faces.
- C. Grind smooth and polish exposed glass edges and corners.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. PREPARATION

- 
- A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
  - B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

### 3.3. GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- G. Set float glass in each series with uniform pattern, draw, bow, and similar characteristics.
- H. Set float glass with proper orientation so that coatings face exterior or interior as specified.
- I. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- J. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

### 3.4. TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

- C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant.
- G. Center float glass in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape.

### 3.5. GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weather tight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

### 3.6. SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7. LOCK-STRIP GASKET GLAZING

- A. Install Comply with ASTM C 716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

3.8. CLEANING AND PROTECTION

- A. Immediately after installation remove non-permanent labels and clean surfaces.
- B. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove non-permanent labels and clean surfaces.
- C. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- D. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- E. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- F. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088000

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**SECTION 089119**

**FIXED LOUVERS**

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. Fixed formed-metal louvers

1.3. DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4. ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
  - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
  - 2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.
- D. Delegated-Design Submittal: For louvers indicated to comply with structural performance requirements, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5. INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Windborne-debris-impact-resistance test reports.

1.6. FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 – PRODUCTS

2.1. MANUFACTURERS

- A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2. PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
- B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change (Range): 67 deg C, ambient; 100 deg C, material surfaces.
- D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3. FIXED METAL LOUVERS

- A. Horizontal, drainable-Blade Louver

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. METROTECH STEEL INDUSTRIES
  - b. Or approved equal
- 2. Blade Profile: Blade with center baffle.
- 3. Frame and Blade Nominal Thickness: as per manufacturers standard
- 4. Mullion Type: Fully recessed.
- 5. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

- B. Extruded Louver

- 1. Louver Depth: As per Manufacturers standard.
- 2. Frame and Blade Nominal Thickness: As per Manufacturers Standard Thickness.
- 3. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4. MATERIALS

- A. Fasteners: Use types and sizes to suit unit installation conditions.



1. Use Phillips flat-head hex-head or Phillips pan-head tamper-resistant screws for exposed fasteners unless otherwise indicated.
  2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
- B. Post-installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- 2.5. FIXED, FORMED-METAL LOUVER FABRICATION
- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
  - B. Maintain equal louver blade spacing to produce uniform appearance.
  - C. Fabricate of extruded aluminum aerofoil fin type fixed louvers shall match existing. Fin ends shall be closed with end caps made from aluminum plates 3mm to 4mm in thickness. Fixation disc and fin suspension shall be of nylon filled fiberglass. Fixed fin cap bracket shall be in 30 degree angle. Installation shall include provision of extruded sliding U profile.
  - D. Include supports, anchorages, and accessories required for complete assembly.
- 2.6. FINISH: As per manufacturer's profile

### PART 3 – EXECUTION

- 3.1. EXAMINATION
- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - B. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2. PREPARATION
- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.
- 3.3. INSTALLATION
- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
  - B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weather tight connection.

- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or non-metallic flashing.
- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weather tight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

#### 3.4. ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
  - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

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**SECTION 092216**

**NON-STRUCTURAL METAL FRAMING**

PART 1 – GENERAL

1.1. SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum and fiber cement board assemblies.
2. Suspension systems for interior gypsum and fiber cement ceilings and soffits.

1.2. ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 – PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Provide materials and construction identical to those tested according to ASTM E 119.
- B. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.

2.2. FRAMING SYSTEMS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.
- B. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
- C. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

2.3. SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 1.59-mm- diameter wire, or double strand of 1.21-mm- diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 4.12 mm in diameter.
- C. Flat Hangers: Steel sheet, 25 by 25 mm by length indicated.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 1.34 mm and minimum 13-mm- wide flanges.
1. Depth: 38 mm.

- E. Furring Channels (Furring Members):
    - 1. Cold-Rolled Channels: 1.34-mm uncoated-steel thickness, with minimum 13-mm-wide flanges, 19 mm deep.
    - 2. Steel Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners of equivalent minimum base-metal thickness.
    - 3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 22 mm deep.
  
  - F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
    - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - a. JEA STEEL INDUSTRIES, INC.
      - b. "BAILEY BRAND" ULTRA PETRONNE INTERIOR SUPPLY CORP
      - c. Or approved equal
- 2.4. AUXILIARY MATERIALS
- A. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

### PART 3 – EXECUTION

#### 3.1. INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
  - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
  - 3. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
  
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
  
- C. Install bracing at terminations in assemblies.
  
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

#### 3.2. INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacing indicated, but not greater than spacing required by referenced installation standards for assembly types.
  
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior.

- C. Install studs so flanges within framing system point in same direction.
  
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 13-mm clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  - 6. Curved Partitions:
    - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
    - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 150 mm o.c.
  
- E. Z-Furring Members:
  - 1. Erect insulation vertically and hold in place with Z-furring members spaced [ 610 mm] o.c
  - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 610 mm o.c
  - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 305 mm from corner and cut insulation to fit.
  
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 3 mm from the plane formed by faces of adjacent framing.

3.3. INSTALLATION SUSPENSION SYSTEMS

- A. Install suspension system components according to spacing indicated, but not greater than spacing required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacing that interfere with locations of hangers, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
  - 3. Do not attach hangers to steel roof deck.
  - 4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  - 5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Installation Tolerances: Install suspension systems that are level to within 3 mm in 3.6 m measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

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**SECTION 092400**

**PORTLAND CEMENT PLASTERING**

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. Interior Portland cement plasterwork on unit masonry and monolithic concrete.
- 2. Exterior Portland cement plasterwork (stucco) on unit masonry.

B. Related Sections:

- 1. Section 072100 "Thermal Insulation" for thermal insulations and vapor retarders included in Portland cement plaster assemblies.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.
- C. Samples for Initial Selection: For each type of factory-prepared finish coat indicated.
- D. Samples for Verification: For each type of finish coat indicated; 305 mm x 305 mm, and prepared on rigid backing.

1.4. QUALITY ASSURANCE

- A. Fire-Resistance Ratings: Where indicated, provide Portland cement plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
- B. Sound-Transmission Characteristics: Where indicated, provide Portland cement plaster assemblies identical to those of assemblies tested for STC ratings per ASTM E 90 and classified according to ASTM E 413 by a qualified testing agency.
- C. Mock-ups: Before plastering, install mock-ups of at least 9.3 square meters in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Install mock-ups for each type of finish indicated.

2. For interior plasterwork, simulate finished lighting conditions for review of mock-ups.
- D. Pre-installation Conference: Conduct conference at Project site.
- 1.5. DELIVERY, STORAGE, AND HANDLING
- A. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
- 1.6. PROJECT CONDITIONS
- A. Comply with ASTM C 926 requirements.
  - B. Interior Plasterwork: Maintain room temperatures at greater than 4.4 degrees C for at least 48 hours before plaster application, and continuously during and after application.
    1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
    2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.
  - C. Exterior Plasterwork:
    1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
    2. Apply plaster when ambient temperature is greater than 4.4 degrees C.
  - D. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

## PART 2 – PRODUCTS

- 2.1. ACCESSORIES
- A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.
  - B. Plastic Accessories: Fabricated from high-impact PVC.
    1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.
    2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.
    3. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work.
    4. Cornerbeads: With perforated flanges.
      - a. Small nose cornerbead; use unless otherwise indicated.



- b. Bull nose cornerbead, radius 19.1 mm minimum; use at locations indicated on Drawings.
    5. Casing Beads: With perforated flanges in depth required to suit plaster bases indicated and flange length required to suit applications indicated.
      - a. Square-edge style; use unless otherwise indicated.
      - b. Bull-nose style, radius 19.1 mm minimum; use at locations indicated on Drawings
    6. Control Joints: One-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
    7. Expansion Joints: Two-piece type, formed to produce slip-joint and square-edged reveal that is adjustable from 6.34 to 16 mm wide perforated concealed flanges.
- 2.2. MISCELLANEOUS MATERIALS
- A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster or accessories.
  - B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 13 mm long, free of contaminants, manufactured for use in portland cement plaster.
  - C. Bonding Compound: ASTM C 932.
  - D. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.
  - E. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063.
  - F. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 1.21 mm diameter, unless otherwise indicated.
  - G. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
    1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
  - H. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."
- 2.3. PLASTER MATERIALS
- A. Portland Cement: ASTM C 150, Type I or Type II.
  - B. Masonry Cement: ASTM C 91, Type N.
  - C. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color to match Architect's sample.

- D. Lime: ASTM C 206, Type S; or ASTM C 207, Type S.
- E. Sand Aggregate: ASTM C 897.
  - 1. Color for Job-Mixed Finish Coats: In color matching Architect's sample.

#### 2.4. PLASTER MIXES

- A. General: Comply with ASTM C 926 for applications indicated.
  - 1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 0.6 kg of fiber/cubic meter of cementitious materials.
- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:
  - 1. Portland Cement Mixes:
    - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
    - b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
  - 2. Masonry Cement Mixes:
    - a. Scratch Coat: 1 part masonry cement and 2-1/2 to 4 parts aggregate.
    - b. Brown Coat: 1 part masonry cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
  - 3. Portland and Masonry Cement Mixes:
    - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
    - b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- C. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:
  - 1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
  - 2. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
- D. Base-Coat Mixes: Single base coats for two-coat plasterwork as follows:

1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
  2. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.
- E. Job-Mixed Finish-Coat Mixes:
1. Portland Cement Mix: For cementitious materials, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
  2. Masonry Cement Mix: 1 part masonry cement and 1-1/2 to 3 parts aggregate.
  3. Portland and Masonry Cement Mix: For cementitious materials, mix 1 part portland cement and 1 part masonry cement. Use 1-1/2 to 3 parts aggregate per part of cementitious material.
- F. Factory-Prepared Finish-Coat Mixes: For ready-mixed acrylic-based finish coatings, comply with manufacturer's written instructions

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, castin anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering
- B. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

#### 3.3. INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
- B. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.
- C. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.

#### 3.4. INSTALLING ACCESSORIES

- A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External Corners:

1. Install cornerbead at interior and exterior locations.

C. Control Joints: Install control joints at locations indicated on Drawings or in specific locations approved by Architect for visual effect as follows:

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

a. Vertical Surfaces: 13.4 square meters.

b. Horizontal and other Nonvertical Surfaces: 9.3 square meters.

2. At distances between control joints of not greater than 5.5 m on

3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.

4. Where control joints occur in surface of construction directly behind plaster.

5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.5. PLASTER APPLICATION

A. General: Comply with ASTM C 926.

1. Do not deviate more than plus or minus 6.4 mm in 3 m from a true plane in finished plaster surfaces, as measured by a 3 m straightedge placed on surface.

2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground, unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on unit masonry and concrete plaster bases.

C. Plaster Finish Coats: Apply to provide finish to match Architect's sample.

D. Acrylic-Based Finish Coatings: Apply coating system, including primers, finish coats, and sealing topcoats, according to manufacturer's written instructions.

E. Concealed Exterior Plasterwork: Where plaster application will be used as a base for adhered finishes, omit finish coat.

F. Concealed Interior Plasterwork:

1. Where plaster application will be concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.

2. Where plaster application will be concealed above suspended ceilings and in similar locations, finish coat may be omitted.

3. Where plaster application will be used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.6. PLASTER REPAIRS

- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

3.7. PROTECTION

- A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092400

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**SECTION 092900**

**GYPSUM AND FIBER CEMENT BOARD**

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. Interior gypsum board.
- 2. Fiber Cement Board.

- B. Related Sections:

- 1. Section 092216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 300 mm long length for each trim accessory indicated.

1.4. QUALITY ASSURANCE

- A. Mock-ups: Before beginning gypsum board installation, install mock-ups of at least 9 square meters in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

- 1. Install mock-ups for the following:

- a. Each level of gypsum board and fiber cement board finish indicated for use in exposed locations.

- 2. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5. DELIVERY, STORAGE, AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6. FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum and fiber cement board manufacturer's written recommendations, whichever are more stringent.

- B. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum and fiber cement board manufacturer's written recommendations, whichever are more stringent.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 – PRODUCTS

### 2.1. PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### 2.2. GYPSUM AND FIBER CEMENT BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.3. INTERIOR GYPSUM AND FIBER CEMENT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. KNAUF MOISTURESHIELD - GYPSUM BOARD - SPURWAY
  - 2. NEAT H-GUARD, BORAL – FOR MEDICAL / LABORATORY AREAS - SPURWAY
  - 3. TAIGA HYGIENE CLIMA PLUS, BORAL - FOR MEDICAL / LABORATORY AREAS - SPURWAY
  - 4. FICEMBOARD – HARDIE FLEX
  - 5. 6. as per approved equal.
- B. Gypsum Wallboard: ASTM C 1396/C 1396M
  - 1. Thickness: 12 mm.
  - 2. Long Edges: Tapered.
- C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.
  - 1. Thickness: 12 mm.
  - 2. Long Edges: Tape
- D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and moldresistant core and paper surfaces;
  - 1. Core: 12 mm, regular type.
  - 2. Long Edges: Tapered.
  - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D

E. Fiber Cement Board

1. Thickness: 9 mm.

2.4. TRIM AND OTHER ACCESSORIES

A. Interior Trim: ASTM C 1047

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
  - a. Cornerbead.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
  - c. L-Bead: L-shaped; exposed long flange receives joint compound.
  - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
  - e. Expansion (control) joint.

B. Access Panels: For access at locations indicated provide hinge assembly, retainer clip and retainer bar, assembled with ceiling panels and carrier sections into access doors of required size, permitting downward opening.

1. Basis of Design Products: Subject to compliance with requirements, available products that may be incorporated into the Work.

2.5. JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum and Fiber Cement Board: Paper.

C. Joint Compound for Interior Gypsum and Fiber Cement Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 3 finish, use setting-type, sandable topping compound.

2.6. AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.84 to 2.84 mm thick.



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2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
  - C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1.5 mm of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum and fiber cement board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum and fiber cement panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

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1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 0.7 square meters in area.
  2. Fit gypsum and fiber cement panels around ducts, pipes, and conduits.
- G. Isolate perimeter of gypsum and fiber cement board applied to non-load-bearing partitions at structural abutments, except floors. Provide 6.4 to 12.7 mm wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.
- 3.3. INSTALLATION, GENERAL
- A. Install interior gypsum and fiber cement board in the following locations:
1. Gypsum Board
    - a. Wallboard Type: As indicated on Drawings.
    - b. Ceiling Type: As indicated on Drawings.
    - c. c. Moisture- and Mold-Resistant Type: As indicated on Drawings.
  2. Fiber Cement Board
    - a. Ceiling Type: As indicated on Drawings.
- B. Single-Layer Application:
1. On ceilings, apply gypsum and fiber cement panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
  2. On wall cladding, apply gypsum panels vertically (parallel to framing) and minimize end joints.
- 3.4. INSTALLING ACCESSORIES
- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners, unless otherwise indicated.
  2. LC-Bead: Use at exposed panel edges.
  3. L-Bead: Use where indicated.
  4. U-Bead: Use at exposed panel edges where indicated.
- D. Aluminum Trim: Install in locations indicated on Drawings.

3.5. FINISHING GYPSUM AND FIBER CEMENT BOARD

- A. General: Treat gypsum and fiber cement board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 3: Where indicated on Drawings.
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.6. PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non- drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

END OF SECTION 092900

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**SECTION 093000**

**TILING**

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. Vitrified Ceramic tile
- 2. Homogeneous tile.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
- 2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products 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. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

1.4. MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.5. QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one (1) source or producer.

- 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one (1) manufacturer and each aggregate from one (1) source or producer.

- C. Mock-ups: Build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mock-up of each type of floor tile installation.
  - 2. Build mock-up of each type of wall tile installation.
  - 3. Approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.
  
- D. Pre-installation Conference: Conduct conference at Project site.
  - 1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.
  
- 1.6. DELIVERY, STORAGE, AND HANDLING
  - A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
  
  - B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
  
  - C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
  
  - D. Store liquid materials in unopened containers and protected from freezing.
  
  - E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.
  
- 1.7. PROJECT CONDITIONS
  - A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

## PART 2 – PRODUCTS

### 2.1. PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  - 1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
  
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.

- C. Low-Emitting Materials: Tile flooring systems 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. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one (1) package show same range in colors as those taken from other packages and match approved Samples.
- E. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.
  - 1. Where tile is indicated for installation on exteriors or in wet areas, do not use back- or edge- mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

## 2.2. TILE PRODUCTS

- A. Tile Type: Ceramic Tile, Non-skid Floor Tile.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. GUANCO DEVELOPMENT CORP.
    - b. TILE TRENDS INC.
    - c. Or approved equal
  - 2. Composition: Homogenous, Ceramic.
  - 3. Module Size: 300 mm x 300 mm.
  - 4. Face: Plain with cushion edges.
  - 5. Surface: Slip-resistant, without abrasive admixture.
  - 6. Finish: Match architect's sample.
  - 7. Tile Color and Pattern: Match Architect's sample.
  - 8. Grout Color: Match Architect's sample
  - 9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.
- B. Tile Type: Homogeneous, Polished
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
    - a. GUANCO DEVELOPMENT CORP.
    - b. TILE TRENDS INC.
    - c. Or approved equal
  - 2. Composition: Homogeneous

3. Module Size: 600 mm x 600 mm.
4. Face: Plain with square cushion edges.
5. Surface: Smooth
6. Finish: Glazed.
7. Tile Color and Pattern: Match Architect's sample.
8. Grout Color: Match Architect's sample.
9. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile.

### 2.3. SETTING MATERIALS

#### A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

#### B. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), that complies 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."

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 60 degrees C and 100 degrees C, respectively, and certified by manufacturer for intended use.

### 2.4. GROUT MATERIALS

#### A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored aggregate as required to produce color indicated.that may be incorporated into the Work include, but are not limited to, the following:

#### B. Standard Cement Grout: ANSI A118.6.

#### C. Water-Cleanable Epoxy Grout: ANSI A118.3[, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D].

1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 60 degrees C and 100 degrees C, respectively, and certified by manufacturer for intended use.

### 2.5. MISCELLANEOUS MATERIALS

#### A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

#### B. Temporary Protective Coating: Product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 49 to 60 degrees C per ASTM D 87.
  2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- D. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
- 2.6. MIXING MORTARS AND GROUT
- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
  - B. Add materials, water, and additives in accurate proportions.
  - C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  1. Verify that substrates for setting tile are firm, dry, clean, and free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  2. Verify that concrete substrates for tile floors installed with adhesives comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect
- B. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.2. PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1:50 toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one (1) package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either returns to manufacturer or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

### 3.3. TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
    - a. Exterior tile floors.
    - b. Tile floors in wet areas.
    - c. Tile floors composed of tiles 200 mm x 200 mm or larger.
  - B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
  - C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
  - D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
  - E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
  2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
  3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints, unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with 1.6 mm.
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
- I. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- 3.4. CLEANING AND PROTECTING
- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove epoxy and latex-portland cement grout residue from tile as soon as possible.
  2. Clean grout smears and hazes from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
  3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven (7) days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

END OF SECTION 093000

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**SECTION 096516**

**RESILIENT SHEET FLOORING**

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. Vinyl and rubber sheet flooring

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product.

- B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
- 2. Laboratory Test Reports for Credit IEQ 4.1: For adhesives, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- 3. Product Data for Credit IEQ 4.3: For adhesives, documentation including printed statement of VOC content.
- 4. Product Data for Credit IEQ 4.3: For resilient stair accessories, documentation from an independent testing agency indicating compliance with the FloorScore standard.
- 5. Laboratory Test Reports for Credit IEQ 4.3: For resilient stair accessories, documentation indicating that products comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

- C. Samples: For each exposed product and for each color and texture specified, not less than 300 mm long.

- D. Samples for Initial Selection: For each type of product indicated.

- E. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 300 mm long

1.4. MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.5. QUALITY ASSURANCE

- A. Mock-ups: Build mock-ups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Coordinate mock-ups in this Section with mock-ups specified in other Sections.

1.6. DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F

1.7. FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F , in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

- B. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 – PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient base shall comply with requirements of Floor Score certification.

- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

1. Provide tile complying with Standard grade requirements, unless otherwise indicated.

2.2. RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. GERFLOR, SPURWAY ENTERPRISES
- b. TRIOFLOR SKY HOMOGENOUS, STRUCTURES – 1
- c. Or approved equal

- B. Product Standard: ASTM F 1861, Type TS rubber.
  - 1. Style and Location
    - a. Style B, Cove: Provide in areas with resilient flooring.
- C. Thickness: as per Manufacturers standard.
- D. Height: 100 mm or As indicated on Drawings.
- E. Lengths: Cut lengths coils in manufacturer's standard length.
- F. Colors: As selected by Architect from full range of industry colors.

### 2.3. INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. Stair-Tread Nose Filler: Two-part epoxy compound recommended by resilient stair-tread manufacturer to fill nosing substrates that do not conform to tread contours.
- D. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.
- E. Floor Polish: Provide protective, liquid floor-polish products recommended by resilient stair-tread manufacturer.

## PART 3 – EXECUTION

### 3.1. EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges,

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depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2. PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates for Resilient Stair Accessories: Prepare horizontal surfaces according to ASTM F 710
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:
    - a. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient products until they are the same temperature as the space where they are to be installed
  - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### 3.3. RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

- G. Preformed Corners: Install preformed corners before installing straight pieces.

#### 3.4. RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Stair Accessories:
  - 1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
  - 2. Tightly adhere to substrates throughout length of each piece.
  - 3. For treads installed as separate, equal-length units, install to produce a flush joint between units.
- C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

#### 3.5. CLEANING AND PROTECTING

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum horizontal surfaces thoroughly.
  - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
- E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096516

**SECTION 096516**

**RESINOUS FLOORING**

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. High-performance resinous flooring systems.

- B. Related Sections:

- 1. Section 079200 "Joint Sealants" for sealants installed at joints in resinous flooring systems.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

- B. LEED Submittals:

- 1. Product Data for Credit IEQ 4.2: For liquid-applied flooring components, documentation including printed statement of VOC content.
- 2. Laboratory Test Reports for Credit IEQ 4: For flooring systems, documentation indicating that products 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. Samples for Initial Selection: For each type of exposed finish required.

- D. Samples for Verification: For each resinous flooring system required, 150 mm square, applied to a rigid backing by Installer for this Project.

- E. Product Schedule: For resinous flooring. As indicated on Drawings and Schedule of Finishes.

1.4. INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

- B. Material Certificates: For each resinous flooring component, from manufacturer.

- C. Material Test Reports: For each resinous flooring system



1.5. CLOSEOUT SUBMITTALS

- A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6. QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of flooring systems required for this Project.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

- C. Mock-ups: Apply mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 1200mm square floor area selected by Architect.
2. Simulate finished lighting conditions for Architect's review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

- D. Pre-installation Conference: Conduct conference at Project site.

1.7. DELIVERY, STORAGE, AND HANDLING

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application unless manufacturer recommends a longer period.

PART 2 – PRODUCTS

2.1. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. FLOWFRESH – FLOWCRETE / FLOORING SOLUTIONS
2. Or approved equal

2.2. MATERIALS

- A. VOC Content of Liquid-Applied Flooring Components: Not more than 100 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
  
- B. Low-Emitting Materials: Flooring system 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."

2.3. HIGH-PERFORMANCE RESINOUS FLOORING

- A. Resinous Flooring: Abrasion impact and chemical resistant (acid) for epoxy, high-performance- aggregate-filled, resin-based, monolithic floor surfacing designed to produce a seamless floor.
  
- B. System Characteristics:
  - 1. Color and Pattern: Gray or As selected by Architect from manufacturer's full range.
  - 2. Wearing Surface: Orange-peel texture and Smooth finish or as per Manufacturer's standard wearing surface.
  - 3. Overall System Thickness: as per Manufacturers standard system thickness.
  - 4. Federal Agency Approvals: USDA and FDA approved for food-processing environments.
  
- C. Body Coats
  - 1. Resin: Epoxy and Polyurethane resin.
  - 2. Formulation Description: as per Manufacturers standard.
  - 3. Application Method: Self-leveling slurry, Troweled or screeded.
    - a. Thickness of Coats: as per Manufacturers System thickness.
    - b. Number of Coats: Two (2)
  
- D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:
  - 1. Compressive Strength: as per ASTM C 579.
  - 2. Tensile Strength: as per ASTM C 307.
  - 3. Flexural Modulus of Elasticity: as per ASTM C 580.
  - 4. Water Absorption: as per ASTM C 413.
  - 5. Coefficient of Thermal Expansion: as per ASTM C 531.
  - 6. Impact Resistance: No chipping, cracking, or delamination and not more than 1.6mm permanent indentation per MIL-D-3134.
  - 7. Resistance to Elevated Temperature: No slip or flow of more than 1.6 mm per MIL-D-3134.
  - 8. Abrasion Resistance: maximum weight loss per ASTM D 4060.
  - 9. Flammability: Self-extinguishing per ASTM D 635.
  - 10. Critical Radiant Flux: greater per NFPA 253.
  - 11. Hardness: Shore D per ASTM D 2240.
  - 12. Bond Strength: 100 percent concrete failure per ACI 503R
  
- E. System Chemical Resistance: Test specimens of cured resinous flooring system are unaffected when tested according to ASTM D 1308 for 50 percent immersion, ASTM D

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543, Procedure A, for immersion, ASTM C 267 for immersion in the following reagents for no fewer than seven days:

### PART 3 – EXECUTION

#### 3.1. PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
  - 1. Roughen concrete substrates as follows:
    - a. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.
    - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
    - 3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.
    - 4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

#### 3.2. APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
  - 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
  - 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
  - 3. At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

- C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.
  - 1. Apply waterproofing membrane to integral cove base substrates.
- D. Apply self-leveling slurry body coats in thickness indicated for flooring system.
  - 1. Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.
- E. Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, remove trowel marks and roughness using method recommended by manufacturer.
- F. Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat and to produce wearing surface indicated.
- G. Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer.

### 3.3.FIELD QUALITY CONTROL

- A. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per 92.9 sq. m of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.
- B. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.
  - 1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
  - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
  - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

### 3.4.PROTECTION

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer

END OF SECTION 096723

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**SECTION 099123**

**EXTERIOR PAINTING**

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 surface preparation and the application of paint systems on exterior substrates.

1. Concrete.
2. Concrete masonry units (CMU).
3. Steel.
4. Exterior Portland cement plaster.
5. Interior gypsum board.

- B. Related Sections:

1. Section 099123 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.

- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 200mm square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. 4. Label each Sample for location and application area

- C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.

1.4. QUALITY ASSURANCE

- A. Mock-ups: Apply mock-ups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

- a. Vertical and Horizontal Surfaces: Provide samples of at least 9 sq. m.
- b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mock-ups.
    - a. If preliminary color selections are not approved, apply additional mock-ups of additional colors selected by Architect at no added cost to Owner.
  3. Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  4. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.5. DELIVERY, STORAGE, AND HANDLING
- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 7 deg C.
    1. Maintain containers in clean condition, free of foreign materials and residue.
    2. Remove rags and waste from storage areas daily.
- 1.6. FIELD CONDITIONS
- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 10 and 35 deg C.
  - B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 3 deg C above the dew point; or to damp or wet surfaces.

## PART 2 – PRODUCTS

### 2.1. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Pacific Paint (BOYSEN) Philippines Inc.
  2. Or approved equal
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.
  1. Pacific Paint (BOYSEN) Philippines Inc.
  2. Or approved equal

### 2.2. PAINT, GENERAL

- A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
1. Flat Paints and coatings : 50 g/L
  2. Non-flat Paints and Coatings: 150 g/L
  3. Primers, Sealers, and Undercoaters: 200 g/L.
  4. Anti-corrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
  5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
- C. Colors: Match Architect's samples As indicated in a color schedule.
- 2.3. BLOCK FILLERS
- A. Block Filler, Latex, Exterior.
- 2.4. ACRYLIC ELASTOMERIC PAINTS
- A. Acrylic, Exterior, water based elastomeric wall paint.
- 2.5. SOURCE QUALITY CONTROL
- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
    1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
    2. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

### PART 3 – EXECUTION

#### 3.1. PREPARATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Portland Cement Plaster: 12 percent.
  - 3. Cement Board: 12 percent.
- C. Portland Cement Plaster Substrates: Verify that plaster is fully cured
- D. Exterior Cement Board Substrates: Verify that finishing compound is sanded smooth.
- E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

#### 3.2. PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.
  - 1. Pressure wash surfaces to remove embedded dirt and grime.
  - 2. Treat Mildew growth by washing with a diluted household bleach solution (i.e., 1:3 bleach to water, respectively). Let stand overnight then wipe off residue with clean rag.
  - 3. Repair all relevant defects by corrective civil works as necessary.
  - 4. Make sure that the surface is clean, dry, and that good weather persists prior to painting.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface- applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.



- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC- PA 1 for touching up shop-primed surfaces.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- H. Aluminum Substrates: Remove loose surface oxidation.

### 3.3.APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
  - 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 4. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
    - a. Uninsulated metal piping.
    - b. Uninsulated plastic piping.
    - c. Pipe hangers and supports.
    - d. Metal conduit.
    - e. Plastic conduit.

- f. Tanks that do not have factory-applied final finishes.

#### 3.4.FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
  - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

#### 3.5.CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION 099113

**SECTION 099123**

**INTERIOR PAINTING**

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 surface preparation and the application of paint systems on exterior substrates.

- 1. Concrete.
- 2. Concrete masonry units (CMU).
- 3. Steel.
- 4. Gypsum board.
- 5. 5. Plaster

- B. Related Sections:

- 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
- 2. Section 064113 "Wood-Veneer-Faced Architectural Cabinets".

1.3. DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 52
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4. ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.

- 
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
1. Submit Samples on rigid backing, 200 mm square
  2. Step coats on Samples to show each coat required for system.
  3. Label each coat of each Sample.
  4. Label each Sample for location and application area.
- D. Product List: For each product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  2. VOC content.
- 1.5. QUALITY ASSURANCE
- A. Mock-ups: Apply mock-ups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 9 sq. m.
    - b. Other Items: Architect will designate items or areas required.
  2. Final approval of color selections will be based on mock-ups.
    - a. If preliminary color selections are not approved, apply additional mock-ups of additional colors selected by Architect at no added cost to Owner.
  3. Approval of mock-ups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  4. Subject to compliance with requirements, approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.6. DELIVERY, STORAGE, AND HANDLING
- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 7 deg C.
1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.
- 1.7. FIELD CONDITIONS
- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 10 and 35 deg C.

- 
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 3 deg C above the dew point; or to damp or wet surfaces.

## PART 2 – PRODUCTS

### 2.1. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- 1. Pacific Paint (BOYSEN) Philippines Inc.
- 2. Or approved equal

- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

- 1. Pacific Paint (BOYSEN) Philippines Inc.
- 2. Or approved equal

### 2.2. PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

- B. Material Compatibility:

- 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
- 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- 1. Flat Paints and coatings : 50 g/L
- 2. Non-flat Paints and Coatings: 150 g/L
- 3. Primers, Sealers, and Undercoaters: 200 g/L.
- 4. Anti-corrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
- 5. Pre-treatment Wash Primers: 420 g/L.

- D. Low-Emitting Materials: Interior paints and coatings 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."

- E. Colors: Match Architect's samples for LDS approved color selections.

### 2.3. BLOCK FILLERS

- A. Block Filler, Latex, Interior/Exterior:

1. Pacific Paint Boysen Philippines
  2. Or approved equal
- 2.4. METAL PRIMERS
- A. Primer, Galvanized, Water Based
- 2.5. WATER-BASED PAINTS
- A. Latex, Interior, Institutional Low Odor:
- 2.6. SOURCE QUALITY CONTROL
- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
    1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
    2. Testing agency will perform tests for compliance with product requirements.
    3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  1. Concrete: 12 percent.
  2. Masonry: 12 percent.
  3. Gypsum Board: 12 percent.
  4. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2. PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface- applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC- PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

### 3.3. APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.

2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed
    - a. Equipment, including panelboards and switch gear.
    - b. Uninsulated metal piping.
    - c. Uninsulated plastic piping.
    - d. Pipe hangers and supports.
    - e. Metal conduit.
    - f. Plastic conduit.
    - g. Tanks that do not have factory-applied final finishes.
    - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - i. Other items as directed by Architect.
  2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

#### 3.4.FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
  2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

#### 3.5.CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.



- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6.INTERIOR PAINTING SCHEDULE

#### A. Concrete Substrates, Non-traffic Surfaces:

##### 1. Latex System:

- a. Prime Coat: Primer, alkali resistant, water based
- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- c. Topcoat: Latex, interior, flat

#### B. CMU Substrates:

##### 1. Latex System:

- a. Block Filler: Block filler, latex, interior/exterior
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, semi-gloss, interior

#### C. Steel and Galvanized-Metal Substrates:

##### 1. Water-Based Light Industrial Coating over Waterborne Primer System: (Railings and Handrails).

- a. Prime Coat: Primer, galvanized, water based.
- b. Intermediate Coat: Light industrial coating, interior, water based, and matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based.

#### D. Gypsum Board, Fiber Cement Board and Plaster Substrates:

##### 1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior
- b. Prime Coat: Latex, interior, matching topcoat.
- c. Intermediate Coat: Latex, interior, matching topcoat.
- d. Topcoat: Latex, interior

END OF SECTION 099123

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**SECTION 102113**

**TOILET COMPARTMENTS**

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. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

- 1. Show locations of cutouts for compartment-mounted toilet accessories.
- 2. Show locations of centerlines of toilet fixtures.

- C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

- 1. Each type of material, color, and finish required for units, prepared on 152mm square Samples of same thickness and material indicated for Work.
- 2. Each type of hardware and accessory.

1.4. INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5. CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.6. QUALITY ASSURANCE

- A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- C. Regulatory Requirements: Comply with applicable provisions in BP344: An Act to Enhance the Mobility of Disabled Persons by Requiring Certain Buildings, Institutions, Establishment & Other Public Utilities to Install Facilities & Other Devices or otherwise known as Accessibility Law for toilet compartments designated as accessible.

1.7. PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 – PRODUCTS

2.1. MATERIALS

- A. Stainless-Steel Castings: ASTM A 743/A 743M.
- B. Particleboard: ANSI A208.1, Grade M-2 with 20.4 kg density, made with binder containing no urea formaldehyde.
- C. Adhesives: Manufacturer's standard product that complies 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."

2.2. PHENOLIC-CORE UNITS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - 1. JEBSEN INTERNATIONAL TRADING
  - 2. GUANCO DEVELOPMENT CORP
  - 3. ARCHIWALL
  - 4. Or approved equal
- B. Toilet-Enclosure Style: Floor anchored.
- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system. Provide minimum 19mm thick doors and pilasters and minimum 13mm thick panels.
- E. Pilaster Shoes and Sleeves (Caps): Fabricated from stainless-steel sheet, not less than 0.79mm nominal thickness and 76mm high, finished to match hardware.
- F. Brackets (Fittings):
  - 1. Stirrup Type: Ear or U-brackets, stainless steel.
- G. Phenolic-Panel Finish:
  - 1. Facing Sheet Finish: (1) color and pattern in each room.
  - 2. Color and Pattern: As selected by Architect from manufacturer's full range, with manufacturer's standard through-color core matching face sheet.

### 2.3. ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
  - 1. Material: Stainless steel.
  - 2. Hinges: Manufacturer's standard paired; self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
  - 3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
  - 4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
  - 5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
  - 6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
  
- B. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

### 2.4. FABRICATION

- A. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
  
- B. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

## PART 3 – EXECUTION

### 3.1. INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
    - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.

- B. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 51 mm into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.
  
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

### 3.2.ADJUSTING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.
  - a. Prime Coat: Latex, interior, matching topcoat.
  - b. Intermediate Coat: Latex, interior, matching topcoat.
  - c. Topcoat: Latex, interior

END OF SECTION 102113

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**SECTION 102800**

**TOILET, BATH, AND 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. Section Includes:

1. Public-use washroom accessories.
2. Private-use shower room accessories.
3. Private-use bathroom accessories.
4. Warm-air dryers.
5. Custodial accessories.

1.3. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

- B. Samples: Full size, for each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

- C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.4. INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5. CLOSEOUT SUBMITTALS

- A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.6. QUALITY ASSURANCE

- A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

- B. 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.

1.7. DELIVERY, STORAGE, AND HANDLING

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 – PRODUCTS

2.1. MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.8mm minimum nominal thickness unless otherwise indicated.
- B. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- C. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

2.2. TOILET AND BATH ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. ASI (American Specialties Inc.), Nikman Soha Corp.
  - 2. VADO U.K., Nikman Soha Corp
  - 3. American Standard
  - 4. Or approved equal.
- B. Toilet Tissue (Roll) Dispenser:
  - 1. Description: Single-roll dispenser.
  - 2. Mounting: Surface mounted.
  - 3. Operation: Noncontrol delivery with standard spindle.
  - 4. Capacity: Designed for 114mm or 127mm diameter tissue rolls.
  - 5. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. Liquid-Soap Dispenser:
  - 1. Description: Designed for dispensing soap in liquid or lotion form.
  - 2. Mounting: Horizontally oriented, surface mounted.
  - 3. Capacity: 40-fl oz (1.2 L).
  - 4. Materials: Stainless steel, No. 4 finish (satin).
  - 5. Lockset: Tumbler type.
  - 6. Refill Indicator: Window type.

D. Grab Bar:

1. Panel Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 1.3mm thick
  - a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
3. Outside Diameter: 38 mm.
4. Configuration and Length: Straight, 760mm long.

E. Mirror Unit: To match existing

F. Soap Dish:

1. Description: Without washcloth bar.
2. Mounting: Surface mounted.

G. Robe Hook / Towel Pin:

1. Description: Single-prong unit.
2. Material and Finish: Solid Aluminum casting in matte finish with rubber bumper.

H. Warm-Air Dryer:

1. Mounting: Surface mounted.
2. Operation: Electronic-sensor activated with timed power cut-off switch.
3. Cover Material and Finish: Stainless steel, No.
4. finish (satin).

I. Shower Head

1. Mounting: Wall mounted.
2. Operation: Lever handle
3. Cover Material and Finish: Polish chrome plate finish.

2.3. FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates

PART 3 – EXECUTION

3.1. INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 1112 N, when tested according to ASTM F 446.











3.2. ADJUSTING AND CLEANING






- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
  
- B. Remove temporary labels and protective coatings.
  
- C. Clean and polish exposed surfaces according to manufacturer's written recommendations.


END OF SECTION 102800

GENERAL PLUMBING FIXTURE LEGEND		
<b>WATER CLOSET</b>		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	Winplus II 3/4.5 LPF TP 2399-2
	SIZE	712+mm x 400mm x 770+mm
	DESCRIPTION	Vitreous China Fixture, washdown, close coupled copact elongated toilet.
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	Floor-mount Tankless Toilet
	DESCRIPTION	Floor-mount Tankless Toilet with flush valve & top spud, bottom outlet bowl
<b>URINAL</b>		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	Active Urinal
	SIZE	L340mm x W300mm x H570mm
	DESCRIPTION	Vitreous China wall hung fixture, back inlet and wall outlet
<b>LAVATORY (UNDERCOUNTER)</b>		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	ACTIVA 0440 Undercounter
	SIZE	L600mm x W422mm x H290mm
	DESCRIPTION	Vitreous China Fixture, undercounter lavatory, siphon trap, flexible hose, angle valve, drain and rubber plug (be ordered separately)

LAVATORY (WALLHUNG)		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	ACTIVE 535mm Wall hung basic 0955
	SIZE	L535 x W480 X H200
	DESCRIPTION	Wallhung vitreous china fixture
KITCHEN SINK		
	MARK	
	MANUFACTURER	TEKA
	MODEL	BE 2B 780
	SIZE	304mm x 400mm x 200mm
	DESCRIPTION	Double bowl, polished stainless steel kitchen sink, 780mm x 464mm (304mm x 400mm x 200mm)
HYGIENIC SPRAY		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	DOUCHE BS2-002
	APPLICATION	Specific waterclosets
	DESCRIPTION	Stainless steel spray with flexible shower hose and anti-swivel ring
LAVATORY FAUCET (LEVER TYPE)		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	CODE BASIN MIXER W/POP UP DRAIN B201
	APPLICATION	To all lavatories
	DESCRIPTION	Chromium plating, single hole, equipped with pop up drain

KITCHEN SINK FAUCET		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	Ceraplan Kitchen Mixer Faucet 5637
	APPLICATION	Kitchens / Pantry
	DESCRIPTION	Deck mounted kitchen mixer
URINAL FLUSHOMETER VALVE (MANUAL LEVER)		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	F511 Toilet flush valve lever type 5110
	APPLICATION	To all urinals
	DESCRIPTION	Toilet flush valve 4.5li water saving lever type
TOILET PAPER HOLDER		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	9002
	APPLICATION	
	DESCRIPTION	Ceramic toilet paper holder
TOILET PAPER DISPENSER		
	MARK	
	MANUFACTURER	BOBRICK
	MODEL	B-2890
	APPLICATION	On public restrooms
	DESCRIPTION	Surface mounted paper towel dispenser, satin finish stainless steel

HAND BLOWER		
	MARK	
	MANUFACTURER	DRY MASTER
	MODEL	Hand dryer dry master G81003
	APPLICATION	On public restrooms
	DESCRIPTION	Wall-mounted aluminum alloy casing, 18000W power, airspeed 12m/s
SOAP HOLDER		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	Ceramic soap holder 9000
	SIZE	L240mm x W24mm x H113mm
	DESCRIPTION	Recessed type soap holder
SOAP DISPENSER		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	CF-8006
	SIZE	L108mm x W108mm x H270mm
	APPLICATION	On public restrooms
	DESCRIPTION	Infrared sensor control soap dispenser, plastic
MIRROR		
	MARK	
	MANUFACTURER	As approved by Architect
	MODEL	
	APPLICATION	
	DESCRIPTION	6mm thick, stainless steel angle with satin finish
GRAB BAR (FOR PWD TOILETS)		
	MARK	
	MANUFACTURER	AMERICAN STANDARD
	MODEL	HR-320370-01

	APPLICATION	On PWD toilets
	DESCRIPTION	Stainless steel corner L-Handrail

**SECTION 123640**

**STONE COUNTERTOPS**

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 stone countertops.

1.3. ACTION SUBMITTALS

- A. Product Data: For each variety of stone, stone accessory, and manufactured product.
- B. Shop Drawings: Include plans, sections, details, and attachments to other work.
  - 1. Show locations and details of joints.
- C. Samples for Verification:
  - 1. For each stone type indicated, in sets of Samples not less than 300mm square. Include (2) or more Samples in each set and show the full range of variations in appearance characteristics expected in completed Work.

1.4. INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Material Test Reports:
  - 1. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone.

1.5. CLOSEOUT SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Material Test Reports:
  - 1. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone.

1.6. QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate stone countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of stone countertops.

1.7. DELIVERY, STORAGE, AND HANDLING

- A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. Store stone on wood A-frames or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

1.8. FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of construction to receive stone countertops by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 – PRODUCTS

2.1. MANUFACTURERS

- A. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.

1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
2. Make stone slabs available for examination by Architect.

- a. PHILAB
- b. GUANCO DEVELOPMENT CORP
- c. PHILIPPINE GRANITE
- d. Or approved equal.

- B. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2. STONE COUNTERTOPS

- A. General: Comply with recommendations in MIA's "Dimension Stone - Design Manual VI."

- B. Nominal Thickness: Provide thickness indicated, but not less than 12mm. Gage backs to provide units of identical thickness.

- C. Edge Detail: As indicated.

- D. Splashes: Provide 12mm thick backsplashes and end splashes unless otherwise indicated.

1. Height: as indicated.



2. Top-Edge Detail: As indicated.
  - E. Joints: Fabricate countertops without joints.
  - F. Cutouts and Holes:
    1. Undercounter Fixtures: Make cutouts for undercounter fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
      - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 5mm into fixture opening.
      - b. Provide vertical edges, rounded to 10mm radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 5mm into fixture opening.
      - c. Provide 20mm full bullnose edges projecting 10mm into fixture opening.
    2. Counter-Mounted Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
    3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
- 2.3. GRANITE, SLATES, TRAVERTINES /NATURAL STONE (HARDSTONE)
- A. Material Standard: Comply with ASTM C 615.
  - B. Description: Uniform, medium-grained
  - C. Cut: Vein.
  - D. Cut stone from contiguous, matched slabs in which natural markings occur.
  - E. Finish: Polished.
  - F. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.
- 2.4. ADHESIVES, GROUT, SEALANTS, AND STONE ACCESSORIES
- A. General: Use only adhesives formulated for stone and ceramic tile and that are recommended by their manufacturer for the application indicated.
  - B. Water-Cleanable Epoxy Adhesive: ANSI A118.3, with a VOC content of 65 g/L or
  - C. Water-Cleanable Epoxy Grout: ANSI A118.3, chemical-resistant, water-cleanable, tile-setting and - grouting epoxy.
  - D. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Section "Joint Sealants" and will not stain the stone it is applied to.
    1. Mildew-Resistant Joint Sealant: Single component, nonsag, mildew resistant, acid curing, silicone.

2. Joint Sealant: Single component, nonsag, neutral curing, silicone; Class 25.
3. Color: Clear.

- E. Stone Cleaner: Specifically formulated for stone types, finishes, and applications indicated, as recommended by stone producer and, if a sealer is specified, by sealer manufacturer. Do not use cleaning compounds containing acids, caustics, harsh fillers, or abrasives.
- F. Stone Sealer: Colorless, stain-resistant sealer that does not affect color or physical properties of stone surfaces, as recommended by stone producer for application indicated.

#### 2.5. STONE FABRICATION, GENERAL

- A. Select stone for intended use to prevent fabricated units from containing cracks, seams, and starts that could impair structural integrity or function.
1. Repairs that are characteristic of the varieties specified are acceptable provided they do not impair structural integrity or function and are not aesthetically displeasing, as judged by Architect.
- B. Grade and mark stone for final locations to produce assembled countertop units with an overall uniform appearance.
- C. Fabricate stone countertops in sizes and shapes required to comply with requirements indicated.
1. For granite, comply with recommendations in NBGQA's "Specifications for Architectural Granite."
  2. Cut and drill sinkages and holes in stone for anchors, supports, and attachments.
  3. Provide openings, reveals, and similar features as needed to accommodate adjacent work.
  4. Finish exposed faces of stone to comply with requirements indicated for finish of each stone type required and to match approved Samples and mockups. Provide matching finish on exposed edges of countertops, splashes, and cutouts.
- D. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fume hoods.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. PREPARATION

- A. Advise installers of other work about specific requirements for placement of inserts and similar items to be used by stone countertop Installer for anchoring stone countertops. Furnish installers of other work with Drawings or templates showing locations of these items.
- B. Before installing stone countertops, clean dirty or stained stone surfaces by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives. Allow stone to dry before installing.

### 3.3. CONSTRUCTION TOLERANCES

- A. Variation from Level: Do not exceed 3mm in 2400 mm, 6mm maximum
- B. Variation in Joint Width: Do not vary joint thickness more than one-fourth of nominal joint width.
- C. Variation in Plane at Joints (Lipping): Do not exceed 0.4mm difference between planes of adjacent units.
- D. Variation in Line of Edge at Joints (Lipping): Do not exceed 0.4mm difference between edges of adjacent units, where edge line continues across joint.

### 3.4. INSTALLATION OF COUNTERTOPS

- A. General: Install countertops over plywood subtops with full spread of water-cleanable epoxy adhesive.
- B. General: Install countertops by adhering to supports with water-cleanable epoxy adhesive.
- C. Do not cut stone in field unless otherwise indicated. If stone countertops or splashes require additional fabrication not specified to be performed at Project site, return to fabrication shop for adjustment.
- D. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight, true, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- E. Set stone to comply with requirements indicated. Shim and adjust stone to locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances. Install anchors and other attachments indicated or necessary to secure stone countertops in place.
- F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Use power saws with diamond blades to cut stone. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- G. Install backsplashes and end splashes by adhering to wall with water-cleanable epoxy adhesive and to countertops with stone adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

- H. Install backsplashes and end splashes by adhering to countertops with stone adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- I. Grout joints to comply with ANSI A108.10. Remove temporary shims before grouting. Tool grout uniformly and smoothly with plastic tool.
- J. Apply sealant to joints and gaps specified for filling with sealant; comply with Section 079200 "Joint Sealants." Remove temporary shims before applying sealant.

### 3.5. ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Remove and replace stone countertops of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
  - 2. Defective countertops.
  - 3. Defective joints, including misaligned joints.
  - 4. Interior stone countertops and joints not matching approved Samples and mockups.
  - 5. Interior stone countertops not complying with other requirements indicated.
- C. Replace in a manner that results in stone countertops matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.
- D. Clean stone countertops no fewer than six days after completion of sealant installation, using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

END OF SECTION 123640

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**SECTION 142100**

**ELECTRIC TRACTION ELEVATORS**

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 electric traction passenger elevators.

- B. Related Requirements:

- 1. Section 055000 "Metal Fabrications" for the following:
    - a. Pit ladders.

1.3. DEFINITIONS

- A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.
- B. Service Elevator: A passenger elevator that is also used to carry freight.

1.4. ACTION SUBMITTALS

- A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.
- B. Shop Drawings:
  - 1. Show Include plans, elevations, sections, and large-scale details indicating service at each landing coordination with building structure, relationships with other construction, and locations of equipment.
  - 2. Include large-scale layout of car-control station and standby power operation control panel.
  - 3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.
- C. Samples for Initial Selection: For finishes involving color selection.
- D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 75mm square Samples of sheet materials; and 100mm lengths of running trim members.

1.5. INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoist way, pit, and layout and dimensions, as shown on Drawings, and electrical service as shown and specified, are adequate for elevator system being provided.

- C. Sample Warranty: For special warranty.
- 
- 1.6. CLOSEOUT SUBMITTALS
    - A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.
      - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.
    - B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.
- 
- 1.7. QUALITY ASSURANCE
    - A. Installer Qualifications: Elevator manufacturer or an authorized representative who is trained and approved by manufacturer.
- 
- 1.8. DELIVERY, STORAGE, AND HANDLING
    - A. Deliver, store, and handle materials, components, and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.
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- 1.9. COORDINATION
    - A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.
    - B. Coordinate locations and dimensions of other work relating to electric traction elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoist ways, pits, and machine rooms.
- 
- 1.10. WARRANTY
    - A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.
      - 1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
      - 2. Warranty Period: (5) year(s) from date of Substantial Completion.

## PART 2 – PRODUCTS

### 2.1. MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements provide or comparable product by one of the following:
  - 1. Shoetac'z Trading Enterprise
  - 2. Kone Elevators
  - 3. Hitachi Elevators
  - 4. Schindler
  - 5. or approved equal
- C. Source Limitations: Obtain elevators from single manufacturer.
  - 1. Major elevator components, including driving machines, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

### 2.2. PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.
- B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1
- C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to ASCE/SEI 7 and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.

### 2.3. PASSENGER ELEVATOR

- A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard elevator systems and as required for complete system.
- B. Elevator Description:
  - 1. Elevator Number(s): One (2) Passenger/Service Elevators
  - 2. Machine-Room Less system
  - 3. Number of Persons: 13 persons or as per manufacturers standard and selected by the Architect.
  - 4. Entrance width: indicated in plans or as per manufacturers standard
  - 5. No. of stops / openings: 5
  - 6. Travel height (meters): (Verify Drawings)
  - 7. Door Type: 2 – panel center opening.
  - 8. Machine Type: Machine Room less Traction Elevator with frequency controlled drive
  - 9. Maximum Rated Capacity (kg): PASSENGER 1000 kg. SERVICE 1600 kg
  - 10. Pit depth (mm): Verify Drawings
  - 11. Overhead (mm): Verify Drawings

12. Rated Speed: 1 m/s. or as per manufacturers standard and selected by the Architect
13. Car internal dimensions: 1100mm x 2100mm varies based on Manufacturers standard
14. Minimum hoist way width to be verified on the Drawings.
15. Auxiliary Operations:
  - a. Standby power operation.
  - b. Standby-powered lowering.
  - c. Battery-powered lowering.
  - d. Earthquake Emergency Operation: Comply with requirements in ASME A17.1/CSA B44.
  - e. Automatic dispatching of loaded car.
  - f. Loaded-car bypass.
16. Security Features: Key switch operation.
17. Car Enclosures:
  - a. Front Walls (Return Panels): Aluminum finish mill finish
  - b. Door Sills: Aluminum, mill finish.
  - c. Ceiling: Painted steel sheet with a milky white resin lighting cover. Central lighting.
  - d. Handrails: satin stainless steel, No. 4 finish at sides and rear of car.
18. Additional Requirements:
  - a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.

#### 2.4. TRACTION SYSTEMS

- A. Elevator Machines: Variable-Traveling Speed Elevator System (VSE)
- B. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.
- C. Machine Beams: Provide framing to support elevator hoisting machine and deflector sheaves from the building structure. Comply with Section 055000 "Metal Fabrications" for materials and fabrication.
- D. Car Frame and Platform: Bolted- or welded-steel units.
- E. Guides: Roller guides or polymer-coated, non-lubricated sliding guides. Provide guides at top and bottom of car and counterweight frames

#### 2.5. OPERATION SYSTEMS

- A. General: Provide manufacturer's standard microprocessor operation systems as required to provide type of operation indicated.
- B. Destination-Based Group Automatic Operation: Provide reprogrammable group automatic system that assigns elevators leaving the main lobby in the up direction to a selected group of floors and directs passengers to an elevator serving their destination floor. System dispatches cars in a regulated sequence for optimum system efficiency; dispatch is based on origin and destination of calls. System automatically adjusts to



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changes in demand for different traffic conditions including heavy incoming, heavy two-way, heavy outgoing, and light off-hours as variations of normal two-way traffic.

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Key switch Operation: Push buttons are activated and deactivated by security key switches at car-control stations and hall push-button stations. Key is removable only in deactivated position.
2. Keypad Operation: Allows each landing to be restricted or unrestricted. When a restricted landing button is pressed, a "Restricted Floor" lamp lights and remains lit until landing access code has been entered into a keypad or predetermined time period has elapsed. Car calls for restricted landings do not register until landing access code is entered into keypad within predetermined time period after landing button is pressed.
  - a. Access codes are programmed at each car operating panel using a security key switch. Keypad operation can be activated and deactivated by security key switch at main landing.

#### 2.6. DOOR REOPENING DEVICES

- A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor- controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.
- B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

#### 2.7. CAR ENCLOSURES

- A. General: Provide steel-framed car enclosures with non-removable wall panels, car roof, access doors, power door operators, and ventilation.
  1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

#### 2.8. HOISTWAY ENTRANCES

- A. hoist way Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoist way entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoist way wall construction.
- B. Fire-Rated hoist way Entrance Assemblies: Door and frame assemblies shall comply with NFPA 80 and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction based on testing at as close-to-neutral pressure as possible according to NFPA 252.

#### 2.9. SIGNAL EQUIPMENT

- A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.

- B. Car-Control Stations: Provide manufacturer's standard recessed or semirecessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.
  - 1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
  - 2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.
- C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.
- D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified.
- E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.
- F. Hall Push-Button Stations: Provide one hall push-button station at each landing.
- G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:
  - 1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
  - 2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.
  - 3. Units mounted in both jambs of entrance frame.
- H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.
  - 1. At manufacturer's option, audible signals may be placed on cars.
- I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above each hoist way entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.
  - 1. Integrate ground-floor hall lanterns with hall position indicators.
- J. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed. For each elevator, provide illuminated signals that indicate when they are operational and when they are at the designated emergency return level with doors open.
- K. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the

designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

- L. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

#### 2.10. FINISH MATERIALS

- A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoist way entrance doors and frames, and signal equipment as indicated.
- B. Aluminum: ASTM B 221 (ASTM B 221M), Alloy 6063.

### PART 3 – EXECUTION

#### 3.1. EXAMINATION

- A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Examine hoist ways, hoist way openings, pits, and machine rooms as constructed; verify critical dimensions; and examine supporting structure and other conditions under which elevator work is to be installed.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2. INSTALLATION

- A. Comply with manufacturer's written instructions.
- B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.
- C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

- D. Lubricate operating parts of systems, including ropes, as recommended by manufacturers.
  - E. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay final adjustment of sills and doors until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.
  - F. Leveling Tolerance: 3mm, up or down, regardless of load and travel direction.
  - G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
  - H. Locate hall signal equipment for elevators as follows unless otherwise indicated:
    - 1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
    - 2. Place hall lanterns either above or beside each hoistway entrance.
    - 3. Mount hall lanterns at a minimum of 1829mm above finished floor
- 3.3. CONSTRUCTION TOLERANCES
- A. Variation from Level: Do not exceed 3mm in 2400 mm, 6mm maximum
  - B. Variation in Joint Width: Do not vary joint thickness more than one-fourth of nominal joint width.
  - C. Variation in Plane at Joints (Lipping): Do not exceed 0.4mm difference between planes of adjacent units.
  - D. Variation in Line of Edge at Joints (Lipping): Do not exceed 0.4mm difference between edges of adjacent units, where edge line continues across joint.
- 3.4. INSTALLATION OF COUNTERTOPS
- A. General: Install countertops over plywood subtops with full spread of water-cleanable epoxy adhesive.
  - B. General: Install countertops by adhering to supports with water-cleanable epoxy adhesive.
  - C. Do not cut stone in field unless otherwise indicated. If stone countertops or splashes require additional fabrication not specified to be performed at Project site, return to fabrication shop for adjustment.
  - D. Do necessary field cutting as stone is set. Use power saws with diamond blades to cut stone. Cut lines straight, true, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

- E. Set stone to comply with requirements indicated. Shim and adjust stone to locations indicated, with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances. Install anchors and other attachments indicated or necessary to secure stone countertops in place.
- F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Use power saws with diamond blades to cut stone. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- G. Install backsplashes and end splashes by adhering to wall with water-cleanable epoxy adhesive and to countertops with stone adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- H. Install backsplashes and end splashes by adhering to countertops with stone adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- I. Grout joints to comply with ANSI A108.10. Remove temporary shims before grouting. Tool grout uniformly and smoothly with plastic tool.
- J. Apply sealant to joints and gaps specified for filling with sealant; comply with Section 079200 "Joint Sealants." Remove temporary shims before applying sealant.

### 3.5. ADJUSTING AND CLEANING

- A. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.
- B. Remove and replace stone countertops of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
  - 2. Defective countertops.
  - 3. Defective joints, including misaligned joints.
  - 4. Interior stone countertops and joints not matching approved Samples and mockups.
  - 5. Interior stone countertops not complying with other requirements indicated.
- C. Replace in a manner that results in stone countertops matching approved Samples and mockups, complying with other requirements, and showing no evidence of replacement.
- D. Clean stone countertops no fewer than six days after completion of sealant installation, using clean water and soft rags. Do not use wire brushes, acid-type cleaning agents, cleaning compounds with caustic or harsh fillers, or other materials or methods that could damage stone.
- E. Sealer Application: Apply stone sealer to comply with stone producer's and sealer manufacturer's written instructions.

END OF SECTION 123640

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**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 the following conventional plumbing fixtures and related components:
  - 1. Faucets for lavatories, showers and sinks.
  - 2. Flushometers.
  - 3. Water closets.
  - 4. Urinals.
  - 5. Lavatories.
  - 6. Kitchen sinks.
- B. Related Requirements:
  - 1. Section 102800 "Toilet, Bath, and Laundry Accessories."

1.3. DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

1.4. SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- C. Warranty: Special warranty specified in this Section.

1.5. QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  1. Stainless-Steel Residential Sinks: ASME A112.19.3.
  2. Vitreous-China Fixtures: ASME A112.19.2M.
  3. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
  4. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
  1. Faucets: ASME A112.18.1.
  2. NSF Potable-Water Materials: NSF 61.
  3. Pipe Threads: ASME B1.20.1.
  4. Supply Fittings: ASME A112.18.1.
  5. Brass Waste Fittings: ASME
- I. Comply with the following applicable standards and other requirements specified for shower faucets:
  1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
  2. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
  3. Faucets: ASME A112.18.1.
  4. Hand-Held Showers: ASSE 1014.
  5. Hose-Coupling Threads: ASME B1.20.7.
  6. Manual-Control Antiscald Faucets: ASTM F 444.
  7. Pipe Threads: ASME B1.20.1.
- J. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
  1. Atmospheric Vacuum Breakers: ASSE 1001.
  2. Brass and Copper Supplies: ASME A112.18.1.

3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

K. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Grab Bars: ASTM F 446.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.

#### 1.6. WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
  - a. Structural failures of unit shell.
  - b. Faulty operation of controls, blowers, pumps, heaters, and timers.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Commercial Applications: Three (3) years from date of Substantial Completion.
3. Warranty Period for Residential Applications of Shells: Five (5) years from date of Substantial Completion.

## PART 2 – PRODUCTS

### 2.1. WATER CLOSETS

A. Water Closets: Floor mounted, Tank type

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - a. AMERICAN STANDARD
  - b. HCG
  - c. TOTO
  - d. Or approved equal.
2. Bowl:
  - a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
  - b. Material: Vitreous china.
  - c. Type: Washdown,
  - d. Style: Close-coupled.



- e. Dimension: 380 x 712 x 800mm
- f. Rim Contour: Elongated.
- g. Water Consumption: 3/6L dual flush
- h. Spud Size and Location: DN 40; top.
- i. i. Color: White.

3. Toilet Seat: Provide slow closing seat and cover.

B. Water Closets: Floor mounted, Siphon jet flush action.

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

- a. American Standard
- b. HCG
- c. Toto
- d. Or approved equal.

2. Bowl:

- a. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
- b. Material: Vitreous china.
- c. Type: Siphon jet,
- d. Style: Flushometer valve type.
- e. Rim Contour: Round
- f. Flushometer valve: Top inlet.
- g. Color: White.

3. Toilet Seat: Provide slow closing seat and cover.

2.2. HYGIENIC SPRAY

A. Hygienic Spray:

1. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:

- a. AMERICAN STANDARD
- b. HCG
- c. TOTO
- d. or approved equal.

2.3. URINALS

A. Urinals: Wall hung, back outlet

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

- a. AMERICAN STANDARD
- b. HCG
- c. TOTO
- d. or approved equal.

2. Fixture:

- a. Material: Vitreous china.
- b. Type: Washout with extended shields.
- c. Color: White.

2.4. FLUSHOMETERS

A. Water Closet Flushometer:

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - a. SLOAN VALVE COMPANY
  - b. AMERICAN STANDARD
  - c. HCG
  - d. TOTO
  - e. Or approved equal.
  
2. Description:
  - a. Standard: ASSE 1037.
  - b. Minimum Pressure Rating: 860 kPa.
  - c. Features: Include integral check stop and backflow-prevention device.
  - d. Material: Brass body with corrosion-resistant components.
  - e. Exposed Flushometer-Valve Finish: Chrome plated.
  - f. Panel Finish: Chrome plated.
  - g. Style: Exposed.
  - h. Consumption: 1.6/1.1 L per flush. Dual-flush type. Low consumption.

2.5. LAVATORIES

A. Lavatory: vitreous china, under counter mounted.

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - a. AMERICAN STANDARD
  - b. HCG
  - c. TOTO
  - d. Or approved equal.
  
2. Fixture:
  - a. Standard: ASME A112.19.2/CSA B45.1.
  - b. Type: For under-counter mounting.
  - c. Faucet-Hole Punching: No holes.
  - d. Faucet-Hole Location: On countertop.
  - e. Color: White.

B. Lavatory: Vitreous china, wall mounted, with back.

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
  - a. AMERICAN STANDARD
  - b. HCG
  - c. TOTO
  - d. Or approved equal.

2. Fixture:

- a. Standard: ASME A112.19.2/CSA B45.1.
- b. Type: For wall hanging.
- c. Faucet-Hole Punching: One (1) hole.
- d. Faucet-Hole Location: Top.
- e. Color: White.

2.6. SINKS

- A. Sink: One bowl, under counter mounted, stainless steel, 1 tap hole strainer with overflow and trap.

1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

- a. TEKA; KUYSEN
- b. AMERICAN STANDARD
- c. or approved equal.

2. Fixture:

- a. Metal Thickness: 1.3 mm.

2.7. LAVATORY FAUCETS

- A. Lavatory Faucets:

1. Description: Single lever handle allows for both on/off activation and temperature setting with 1.5 gpm (gallons per minute) flow rate.

- a. Finish: Polished chrome.
- b. Centers: Single hole.
- c. Mounting: Deck, concealed.
- d. Valve Handle: Lever.
- e. Operation: Compression, manual.

2. Basis-of-Design Product: Subject to compliance with requirements, provide indicated on Drawings or a comparable product by one of the following:

- a. AMERICAN STANDARD
- b. TOTO
- c. LINEA SANITARYWARE; KUYSEN
- d. Or approved equal.

2.8. SHOWER FAUCETS

- A. Shower Faucets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

- a. AMERICAN STANDARD

- b. TOTO
- c. CAE YORK; KUYSEN
- d. Or approved equal.

2. Description: Single-handle pressure-balance valve. Check stops; and shower head, arm, and flange.

- a. Body Material: Solid brass
- b. Finish: Polished chrome plate
- c. Mounting: Exposed
- d. Shower Head Type: Ball joint
- e. Shower Head Material: Metallic with chrome-plated finish.
- f. Spray Pattern: Adjustable.

## 2.9. SINK FAUCETS

### A. Sink Faucets:

- 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 following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 3. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:

- a. AMERICAN STANDARD COMPANIES, INC.
- b. TOTO
- c. LINEA SANITARYWARE; KUYSEN
- d. Or approved equal

4. Description:

- a. Body Material: Commercial, solid brass
- b. Finish: Polished chrome plate
- c. Mixing Valve: Single control
- d. Mounting: Deck
- e. Handle(s): Lever

## PART 3 – EXECUTION

### 3.1. EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Set sills flush with finished floor surface at landing. Fill space under sill solidly with non-shrink, nonmetallic grout.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- R. Install shower flow-control fittings with specified maximum flow rates in shower arms.

- S. Install traps on fixture outlets.
  
  - T. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildewresistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."
- 3.3. CONNECTIONS
- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- 3.4. FIELD QUALITY CONTROL
- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
  
  - B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
  
  - C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
  
  - D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- 3.5. ADJUSTING
- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
  
  - B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
  
  - C. Replace washers and seals of leaking and dripping faucets and stops.
- 3.6. CLEANING
- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
    - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
    - 2. Remove sediment and debris from drains.
  
  - B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.
- 3.7. PROTECTION
- A. Provide protective covering for installed fixtures and fittings.

- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

**SECTION 224500  
INTERIOR LIGHTING**

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

- 1. Interior lighting fixtures and lamps.
- 2. Emergency lighting units.
- 3. Lighting fixture supports.
- 4. Fluorescent lighting fixtures.

1.3. SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Energy-efficiency data.
  - 2. Preparation instructions and recommendations
  - 3. Product literature.
  - 4. Installation methods.
- B. Shop Drawings: Show sizes, layout, configuration, attachment details, relationships with adjacent construction and wiring diagrams.
- C. Samples: For each lighting fixture indicated in the Interior Lighting Fixture Schedule. Each Sample shall include the following:
  - 1. Lamps installed.
  - 2. Suspended type support system.
- D. Installation instructions.

1.4. INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Lighting fixtures.
  - 2. Suspended ceiling components.
  - 3. Partitions and millwork that penetrate the ceiling or extends to within 305 mm of the plane of the luminaires.
  - 4. Ceiling-mounted projectors.
  - 5. Structural members to which suspension systems for lighting fixtures will be attached.



- 6. Other items in finished ceiling including the following:
  - a. Air outlets and inlets.
  - b. Speakers.
  - c. Sprinklers.
  - d. Smoke and fire detectors.
  - e. Access panels.

B. Air outlets and inlets. b. Speakers. c. Sprinklers. d. Smoke and fire detectors. e. Access panels.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

D. Warranty: Sample of special warranty.

#### 1.5. CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

- 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### 1.6. QUALITY ASSURANCE

A. 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.

B. Comply with NFPA 70.

C. Mockups: Provide interior lighting fixtures for room or module mockups, complete with power and control connections.

- 1. Obtain Architect's approval of fixtures for mockups before starting installations.
- 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
- 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7. COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

#### 1.8. WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

## PART 2 – PRODUCTS

### 2.1. MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings available products that may be incorporated into the Work include, but are not limited to the following:

1. LIGHTFORCE CORP.
2. ECOSHIFT CORP. LED LIGHTING
3. PANASONIC
4. Or approved equal.

### 2.2. GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Luminaires: Comply with UL 1598; test according to NEMA LE 6.

C. Light Emitting Diode (LED): Comply with UL8750; test according to NEMA LE 6.

D. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

E. Metal Parts: Free of burrs and sharp corners and edges.

F. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

H. Diffusers :

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

- a. Lens Thickness: At least minimum unless otherwise indicated.
- b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

I. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:
  - a. "USE ONLY" and include specific lamp type.

- b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
- c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
- d. CCT and CRI for all luminaires.

### 2.3. BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
  1. Lamp end-of-life detection and shutdown circuit.
  2. Automatic lamp starting after lamp replacement.
  3. Sound Rating: Class A.
  4. Total Harmonic Distortion Rating: Less than 20 percent.
  5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
  6. Operating Frequency: 20 kHz or higher.
  7. Lamp Current Crest Factor: 1.7 or less.
  8. BF: 0.95 or higher unless otherwise indicated.
  9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

### 2.4. EMERGENCY FLUORESCENT POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
  1. Emergency Connection: Operate one fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  2. Nightlight Connection: Operate one fluorescent lamp continuously.
  3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
  4. Battery: Sealed, maintenance-free, nickel-cadmium type.
  5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  6. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

### 2.5. EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours of rated lamp life.
2. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
  - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
  - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
  - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  - g. Integral Self-Test: Factory-installed electronic device automatically initiates code required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.6. LED LIGHTS

- A. LED bulb, 7watts, standard E27 socket, 520 lumens (lm), Color Temp (K) 3000 unless otherwise indicated.

2.7. LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angleiron supports and nonmetallic channel and angle supports.
- B. Twin-Stem Hangers: Two, 13-mm steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel.
- D. Rod Hangers: 5mm minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 – EXECUTION

3.1. INSTALLATION

- A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 150 mm from lighting fixture corners.
  2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 20-mm metal channels spanning and secured to ceiling tees.
  4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- D. Suspended Lighting Fixture Support:
1. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  2. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- 3.2. IDENTIFICATION
- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- 3.3. FIELD QUALITY CONTROL
- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.
- C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 265100

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**SECTION 311000**

**SITE CLEARING**

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

1. Protecting existing vegetation to remain.
2. Clearing and grubbing.
3. Stripping and stockpiling topsoil.
4. Removing above- and below-grade site improvements.

1.3. MATERIAL OWNERSHIP

- A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4. INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

- B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.5. QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at Project site.

1.6. PROJECT CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
  - 1. Do not proceed with work on adjoining property until directed by Architect.
- C. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premise.
- D. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- E. The following practices are prohibited within protection zones:
  - 1. Storage of construction materials, debris, or excavated material.
  - 2. Parking vehicles or equipment.
  - 3. Foot traffic.
  - 4. Erection of sheds or structures.
  - 5. Impoundment of water.
  - 6. Excavation or other digging unless otherwise indicated.
  - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- F. Do not direct vehicle or equipment exhaust towards protection zones.
- G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.
- H. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

## PART 2 – PRODUCTS

### 2.1. MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
  - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on- site.

## PART 3 – EXECUTION

### 3.1. PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2. TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3. EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
  - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed.
  - 1. Arrange with utility companies to shut off indicated utilities.
  - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections and Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

3.4. EXISTING UTILITIES

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Grind down stumps and remove roots, obstructions, and debris to a depth of 450 mm below exposed subgrade.
  - 3. Use only hand methods for grubbing within protection zones.



- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
    - 1. Place fill material in horizontal layers not exceeding a loose depth of 200 mm, and compact each layer to a density equal to adjacent original ground.
- 3.5. TOPSOIL STRIPPING
- A. Remove sod and grass before stripping topsoil.
  - B. Strip topsoil to depth indicated on Drawings in a manner to prevent intermingling with underlying subsoil or other waste materials.
    - 1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 50 mm in diameter; trash, debris, weeds, roots, and other waste materials.
  - C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
    - 1. Limit height of topsoil stockpiles to 72 inches (1800 mm).
    - 2. Do not stockpile topsoil within protection zones.
    - 3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
    - 4. Stockpile surplus topsoil to allow for respreading deeper topsoil.
- 3.6. DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
  - B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

**SECTION 313116**  
**TERMITE CONTROL**

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

- 1. Installation of Anti-termite Reticulated piping system.
- 2. Establishment of termite killing zone and chemical barrier by soil treatment.
- 3. Three (3) years post-construction termite inspection and monitoring work and other services.

1.3. SUBMITTALS

- A. Work Program and Methodology

- B. Product Data: For each type of termite control product.

- 1. Technical Brochure.
- 2. Include the FDA/FPA-Registered Label for termiticide products.
- 3. Material Safety Data Sheets.

- C. Qualification Data:

- 1. Pest Management Operator's accreditation certificate issued by the Philippine Federation of Pest Management Operator's Association Inc. (PFPMOA)
- 2. Profile of completed termite management services projects.

- D. Product Certificates: For termite control products from manufacturer.

- E. Pre-treatment Report: Before application of termiticide, submit the following:

- 1. Lay-out plans.
- 2. Shop drawings.
- 3. Installation program.

- F. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

- 1. Date and time of application.
- 2. Moisture content of soil before application.
- 3. Termiticide brand name and manufacturer.
- 4. Quantity of undiluted termiticide used.
- 5. Dilutions, methods, volumes used, and rates of application.
- 6. Areas of application, As-built plan.
- 7. Water source for application.
- 8. Systems operating instructions.

G. Warranties: Sample of special warranties.

H. Soil treatment Completion Report

1. After completion of the soil treatment work, submit a report stating that the soil termiticide treatment has been undertaken and completed in accordance with the approved soil treatment program and methodology.

#### 1.4. QUALITY ASSURANCE

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located.
- B. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the FDA/FPA-Registered Label.
- C. Source Limitations: Obtain termite control products from single source from single manufacturer.
- D. In addition to requirements of these specifications, comply with the chemical manufacturer's instructions and recommendations relative to dilution; dosage and application methodologies.
- E. Use only termiticides as herein specified that bears FPA/FDA registration numbers.
- F. Pre-installation Conference: Conduct conference at Project site.

#### 1.5. PROJECT CONDITIONS

- A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the FDA/FPA- Registered Label and requirements of authorities having jurisdiction.
- B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

#### 1.6. WARRANTY AND CERTIFICATION

- A. Manufacturer's standard form, signed by Applicator and Contractor, certifying the following:
  1. The soil treatment work was undertaken and completed with the use only of FDA/FPA- approved chemicals and in accordance with the approved specification and soil treatment program.
- B. Provide written warranty that the applied soil termiticides treatment will serve as deterrent and prevent infestation of subterranean termites.
  1. Warranty Period: Three (3) years from date of soil treatment Completion.

1.7. DELIVERY AND STORAGE

- A. Termiticides shall be delivered to project site in sealed and labeled containers as supplied by manufacturer. The label shall be complete with application and safety instructions and bear the FPA/FDA registration number. Temporary storage of insecticides utilized at the project site shall be allowed subject to standard environmental safety requirement.

PART 2 – PRODUCTS

2.1. SOIL TREATMENT

- A. Termiticide: Provide an FDA/FPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's FDA/FPA-Registered Label.

PART 3 – EXECUTION

3.1. EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2. PREPARATION

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

- 1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3. DELIVERY AND STORAGE

- A. General: Termiticides shall be delivered to project site in sealed and labeled containers as supplied by manufacturer. The label shall be complete with application and safety instructions and bear the FPA/FDA registration number. Temporary storage of insecticides utilized at the project site shall be allowed subject to standard environmental safety requirement.

3.4. APPLICATION, GENERAL

- A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's FDA/FPA-Registered Label for products.

3.5. APPLYING SOIL TREATMENT

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's FDA/FPA-Registered Label, so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.
- B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.
- C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground- supported slabs are installed. Use waterproof barrier according to FDA/FPA-Registered Label instructions.
- D. Post warning signs in areas of application.
- E. Re-apply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

3.6. INSTALLATION OF ANTI-TERMITE RETICULATION SYSTEM

- A. Use the approved lay-out plan and installation program. Any deviation there from must have prior approval of the Architects.
- B. Conduct operation ability test on all reticulation pipes installed before they are finally covered. The Construction Manager must certify that test has been successfully undertaken.
- C. Upon completion, submit an as-built plan and operating instruction of the system.
- D. Ensure that filler point covers are properly installed and that they conform with designer's specification.

3.7. POST CONSTRUCTION TERMITE MANAGEMENT SERVICES

- A. After substantial completion, undertake comprehensive termite inspection and monitoring work every (6) months for a period of three (3) years.
- B. In the event of any discovery of termite activity during the three (3) years period, undertake termite abatement work and re-treat the soil as deemed necessary and appropriate under the circumstances.

END OF SECTION 313116

SCHEDULE OF FINISHES							
ROOM TAG	AREA	FLOOR	WALL	CEILING			
<b>BASEMENT FLOOR</b>							
BF-01	Basement Lobby	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
BF-02	Faculty Room	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
BF-03	Discussion Room	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
BF-04	Pantry	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
BF-05	Lounge Area	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
BF-06	Fire Exit 1	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-04	STAIR SOFFIT IN LATEX PAINT FINISH
BF-07	Sleeping Room (Male)	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH

BF-08	Sleeping Room (Female)	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
BF-09	Fitness Room	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
BF-10	Gender & Development (GAD)	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
BF-11	Toilet (Male)	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON-SKID)	CF-02	12mm THK SAG-RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
BF-12	Toilet (Female)	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON-SKID)	CF-02	12mm THK SAG-RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
BF-13	Main Stairs	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-04	STAIR SOFFIT IN LATEX PAINT FINISH
<b>GROUND FLOOR</b>							
GF-01	Entrance Lobby	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-02	12mm THK. GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX BASED PAINT FINISH

GF-02	Faculty Room	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-03	Discussion Room	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-04	Female Toilet (Faculty Room)	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON-SKID)	CF-02	12mm THK SAG-RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
GF-05	Male Toilet (Faculty Room)	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON-SKID)	CF-02	12mm THK SAG-RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
GF-06	Storage	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-07	Fire Exit 1	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-04	STAIR SOFFIT IN LATEX PAINT FINISH
GF-08	Library	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH



GF-09	Male Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
GF-10	PWD Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
GF-11	Female Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
GF-12	EE Room / Utility Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-13	Records Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-14	Stockroom Supplies	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-15	Reproduction Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH

GF-16	Fire Exit 2	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-04	STAIR SOFFIT IN LATEX PAINT FINISH
GF-17	Student Discipline Head	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-18	Toilet (SD Head)	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
GF-19	Counceling Room	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-20	Office of the Student Discipline	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-21	Student Service Division (SSD)	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-22	Sleeping Room (SSD)	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH

GF-23	Toilet (SSD)	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
GF-24	Toilet (CID)	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
GF-25	SSD Head Office	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-26	CID Head Office	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-27	Sleeping room (CID)	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-28	Curriculum & Instruction Division	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-29	Conference Room	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH

GF-30	Mechanical Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
GF-31	EE Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
<b>SECOND FLOOR</b>							
2F-01	Hallway	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-01	12mm THK. GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX BASED PAINT FINISH
2F-02	Faculty Room	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
2F-03	Discussion Room	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
2F-04	Female Toilet (Faculty Room)	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
2F-05	Male Toilet (Faculty Room)	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH

2F-06	Classroom 1	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
2F-07	Fire Exit 1	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-04	STAIR SOFFIT IN LATEX PAINT FINISH
2F-08	Classroom 2	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
2F-09	Male Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
2F-10	PWD Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
2F-11	Female Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON- SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON- SKID)	CF-02	12mm THK SAG- RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
2F-12	Classroom 3	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH

2F-13	Classroom 4	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
2F-14	Classroom 5	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
2F-15	Fire Exit 2	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-04	STAIR SOFFIT IN LATEX PAINT FINISH
2F-16	Classroom 6	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
2F-17	Mechanical Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
2F-18	EE Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
<b>THIRD FLOOR</b>							
3F-01	Hallway	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-01	12mm THK. GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX BASED PAINT FINISH

3F-02	Technology & Innovation	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
3F-03	Design & Engineering	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
3F-04	Classroom 7	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
3F-05	Fire Exit 1	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-04	STAIR SOFFIT IN LATEX PAINT FINISH
3F-06	Classroom 8	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
3F-07	Male Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON-SKID)	CF-02	12mm THK SAG-RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
3F-08	PWD Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON-SKID)	CF-02	12mm THK SAG-RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH
3F-09	Female Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID)	WF-03	300mmX300mm HOMOGENOUS TILES (NON-SKID)	CF-02	12mm THK SAG-RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH

3F-10	Classroom 12	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
3F-11	Fire Exit 2	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-04	STAIR SOFFIT IN LATEX PAINT FINISH
3F-12	Classroom 11	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
3F-13	Classroom 10	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
3F-14	Classroom 9	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
3F-15	Mechanical Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
3F-16	EE Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
<b>ROOF DECK</b>							
RD-01	Mechanical Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH



RD-02	EE Room	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI- GLOSS LATEX PAINT FINISH	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH
RD-03	Main Stairs	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	WF-02	PLAIN CEMENT PLASTER IN ELASTOMERIC PAINT EXTERIOR FINISH	CF-04	STAIR SOFFIT IN LATEX PAINT FINISH
RD-04	DECK	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING	N/A	N/A	N/A	N/A

PROPOSED MULTI-PURPOSE GYMNASIUM  
 Address: Brgy.Rizal, Odiongan, Romblon  
 Date: 06/03/2021

**PROJECT MATERIAL LIST**

**ARCHITECTURAL**

	AREA	PLAN CODE	FINISH	CONTACT PERSON	CONTACT NO.
<b>A. FLOOR FINISHES (supplier to submit sample for approval)</b>					
<b>BASKETBALL COURT WING - BASEMENT FLOOR</b>					
LG-01	Male Toilet, Shower Room & Lockers (Beneath Bleachers)	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
LG-02	Utility / Maintenance	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
LG-03	Female Toilet, Shower Room & Lockers (Beneath Bleachers)	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
LG-04	Equipment Storage	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
<b>BASKETBALL COURT WING- GROUND FLOOR</b>					
GF-01	Male Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
GF-02	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
GF-03	Admission & Lounge Area	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
GF-04	Female Toilet & Dressing Room	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
GF-05	Center Stage	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
GF-06	Backstage	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
GF-07	Male Toilet & Dressing Room	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
GF-08	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
GF-09	Female Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
GF-10	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
GF-11	Basketball Court	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
<b>BASKETBALL COURT WING - MEZZANINE FLOOR</b>					
MZ-00	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
MZ-01	Male Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
MZ-02	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
MZ-03	Utility / Storage	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
MZ-04	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217

MZ-05	Female Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
MZ-06	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
MZ-07	Audio & Lighting Control Booth	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
<b>INDOOR COURT WING - LOWERGROUND FLOOR</b>					
LG-01	Male Toilet & Dressing Room	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
LG-02	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
LG-03	Badminton Court 1	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
LG-04	Badminton Court 2	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
LG-05	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
LG-06	Volleyball Court	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
LG-07	Bleachers	FF-03	50mm THK SMOOTH FINISH CONCRETE TOPPING WITH FLEXIBLE EPOXY PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
LG-08	Equipment Storage	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
LG-09	Utility	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
LG-10	Female Toilet & Dressing Room	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
<b>INDOOR COURT WING - GROUND FLOOR</b>					
GF-01	Female Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
GF-02	Male Toilet	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
GF-03	Admission Area	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
GF-04	Corridor	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
GF-05	Storage	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
GF-06	Dance Studio	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
GF-07	Audio Control Booth	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
GF-08	Storage	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
GF-09	Music Room/ Band Rehearsal/Recording Studio w/ Audio Control Booth	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
<b>INDOOR COURT WING - MEZZANINE FLOOR</b>					
MZ-01	Faculty Room	FF-01	600mm x 600mm x 10mm THK POLISHED HOMOGENOUS TILES by <b>GUANCO DEVELOPMENT CORP or approved equal</b>	EMY SAN DIEGO	0917-706-9076
MZ-02	Lecture Room 1	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594

MZ-03	Lecture Room 2	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
MZ-04	Lecture Room 3	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
MZ-05	Corridor	FF-04	50mm THK SMOOTH FINISH CONCRETE TOPPING (concrete hardener) by <b>ACQUAPROOF or approved equal</b>	BOCHI DOMANGCAS	0917-714-5594
MZ-06	Toilet (Faculty)	FF-02	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>TILE TRENDS or approved equal</b>	DANTE REY DULAY	0917-821-8149
<b>B. WALL FINISHES</b>					
<b>B.1 ALL TOILETS / RESTROOM</b>					
<i>Lower Ground to Mezzanine Floor</i>		WF-03	300mmX300mm HOMOGENOUS TILES (NON-SKID) by <b>GUANCO DEVELOPMENT CORP or approved equal</b>	DANTE REY DULAY	0917-821-8149
<b>B.2 BASKETBALL COURT WING</b>					
	<i>Bleachers</i>	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
	<i>Utility Rooms, Center/backstage areas, Basketball Court</i>	WF-02	PLAIN CEMENT PLASTER IN ELASTOMERIC PAINT EXTERIOR FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
<b>B.2 INDOOR COURT WING</b>					
	<i>General Areas/Rooms, Bleachers, Utility Rooms, etc.</i>	WF-01	PLAIN CEMENT PLASTER WALL IN SEMI-GLOSS LATEX PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
	<i>Bleachers, Badminton court, volleyball court,</i>	WF-02	PLAIN CEMENT PLASTER IN ELASTOMERIC PAINT EXTERIOR FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
<b>C. CEILING FINISHES</b>					
<i>Verify on ceiling plans</i>					
<b>C.1 BASKETBALL COURT WING</b>					
	<i>Basketball court, general areas, bleachers</i>	CF-01	12mm THK. GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX BASED PAINT FINISH by <b>KNAUF or approved equal</b>	AUGIE LIMBO	0917-899-6706
	<i>Toilets, Dressing rooms, Utility/Maintenance Room(LG-02)</i>	CF-02	12mm THK SAG-RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH by <b>KNAUF or approved equal</b>	AUGIE LIMBO	0917-899-6706
<b>C.1 INDOOR COURT WING</b>					
	<i>Toilets / Restroom Areas</i>	CF-01	12mm THK. GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX BASED PAINT FINISH by <b>KNAUF or approved equal</b>	AUGIE LIMBO	0917-899-6706
	<i>Toilets / Restroom Areas</i>	CF-02	12mm THK SAG-RESISTANT GYPSUM BOARD ON STEEL FURRING FRAMING IN FLAT LATEX PAINT FINISH by <b>KNAUF or approved equal</b>	AUGIE LIMBO	0917-899-6706
	<i>Storage, Corridors, Utility areas, etc.</i>	CF-03	SLAB SOFFIT IN LATEX PAINT FINISH by <b>BOYSEN or approved equal</b>	RAINIER PAYWAN	0917-5255217
<b>D. ROOFING &amp; ACCESSORIES</b>					
	<i>Baseboard</i>	BF-1	GLOSS ENAMEL PAINT, 150mm HIGH ZOCALLO		
	<i>Roofing</i>		GA#24 RIB TYPE G.I METAL ROOFING SHEET, FACTORY PRE-PAINTED LONG SPAN WITH 50mm ROCKWOOL INSULATION SYSTEM by <b>DN STEEL or approved equal</b>	MATET NICHOLAS	0905-441-6779

# **CONSULTING SERVICES FOR THE ARCHITECTURAL AND DETAILED ENGINEERING DESIGN FOR THE CONSTRUCTION OF ACADEMIC BUILDING II**

PHILIPPINE SCIENCE HIGH SCHOOL – MIMAROPA REGION CAMPUS  
Barangay Rizal, Odiongan, Romblon

## *TECHNICAL SPECIFICATIONS STRUCTURAL*

**CONTRACT DOCUMENTS**



# **TECHNICAL SPECIFICATIONS**

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4	Concrete Reinforcement
5	Cast In Place Concrete
6	Construction Joints
7	Concrete Repair Using Epoxy Resin Concrete, Grouts and Mortars
8	Formworks
9	Structural Steel
10	Welding Structural
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# SECTION 1

## PREPARATION OF SITE

### *PART 1 – GENERAL*

#### *1.1 SCOPE OF WORK*

The Work includes furnishing all labor, materials, tools and equipment required for the preparation of the Site prior to construction.

#### *1.2 SUBMITTALS*

A. Detailed working drawings.

#### *1.3 PROTECTION*

The Contractor shall exercise the greatest care in protecting existing structures and piping while proceeding with work under this Section. All repairs required because of damage from the Contractor's operations shall be at the expense of the Contractor and no claims for additional payment will be accepted.

### *PART 2 – PRODUCTS*

Not Used

### *PART 3 - EXECUTION*

#### *3.1 CLEARING, GRUBBING AND STRIPPING*

- A. Except as otherwise directed, cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots, paving and any other objectionable material within the construction limits shown on the Drawings. All stumps, brush and roots shall be grubbed and removed from the site.
- B. Protect the area beyond the limits of grading shown on the Drawings and any trees designated by the Engineer from damage by any construction operation by erecting suitable barriers or other approved means.
- C. Strip topsoil from all areas to be occupied by buildings, trenches, roadways, the sludge lagoons, and all other areas to be excavated or filled. Avoid mixing topsoil with subsoil and stockpile it in areas on the site as approved by the Engineer. Topsoil shall be stockpiled free from brush, trash, large stones and other extraneous material. Any topsoil remaining after all work is in place shall be disposed of by the Contractor as directed by the Engineer.



## **SECTION 2**

### **EXCAVATION, FILLING AND BACKFILLING**

#### **1.0 SCOPE**

The work includes all operations in connection with excavation, filling, backfilling and finish grading, complete.

#### **2.0 EXCAVATION**

2.1 Excavation shall be made to the depths indicated, reckoned from a pre-established datum. The indicated depth is the minimum requirement for excavation. However, if in the opinion of the Engineer, the soil bearing pressure is not attained at the indicated depth, the Contractor shall extend the excavation until the required soil bearing pressure will be obtained. No extra excavations shall be done without the written approval of the Engineer. In no case shall footings rest on fill.

2.2 All excavations shall extend to a sufficient distance from walls and footings to allow for the proper erection and dismantling of forms, installation of service lines and for inspection, unless firm rock is encountered wherein the Contractor shall have the option to pour against the excavation. In case suitable bearing materials area encountered at elevations other than those specified or shown on the drawings, the Engineer, at his discretion, may direct in writing the excavations above or below those indicted on the drawings. All excavations shall be inspected and approved by the Engineer before pouring any concrete. Laying underground services or placing backfill materials. The Contractor shall control the grading in the vicinity of all excavated areas to prevent surface drainage running into excavations. Water which accumulates in excavated areas shall be removed by pumping or by other approved methods, before filling or pouring concrete. All necessary shorings, sheet piles, rock anchors, rock nails or bolts, and/or other protective works to protect banks and adjacent pavings, structures and utilities shall be installed by the Contractor at his own expense. If necessary, the Contractor shall apply reinforced mortar, with adequate thickness on banks which are susceptible to erosion during heavy rainfall.

2.3 Excavation shall be shored and braced by members of suitable sizes where necessary to prevent danger to persons, injurious caving or erosions. Shoring bracing and sheating shall be removed as the excavations are backfilled, in a manner such as to prevent injurious caving. The Contractor shall keep all excavations free from water while construction is in progress.

#### **3.0 DESIGN OF SHORING, BRACING AND PROTECTION FOR EXCAVATION**

3.1 The Contractor shall be responsible of providing design of all shoring, bracing and protection works for excavation including protections of the existing adjacents buildings & structures. The design shall be done by a qualified Geotechnical Engineer and submitted to the Structural Engineer-of-Record for review. However, review of the design shall not relieve the Contractor of his responsibility in case of any failure or damage to the excavation a/or structures and utilities within and adjacent to property lines.

- 3.2 Indicated drawings for slope protection are for permit purposes only. The contractor must submit shop drawings showing construction methodology, slope protection design and details, etc. for Structural Engineers review and comments.
- 3.3 The Contractor shall be responsible for the monitoring requirements of the adjacent buildings. Any signs of failures or defects must be reported immediately to the Structural Engineers. It is further required that a joint inspection to document all existing defects of adjacent buildings be done prior to start of excavation.

#### 4.0 *BACKFILLING:*

- 4.1 After the forms are removed, all trash, wood chips and other debris shall be removed from areas to be backfilled. Backfill materials shall consist of approved site excavated materials and shall be free from brush, roots and other undesirable materials which would be detrimental to compaction requirements.
- 4.2 No backfill shall be placed against walls or other vertical surfaces until they have been inspected and backfilling is authorized.

#### 5.0 *MONITORING*

The Contractor shall notify the Engineer in the event of any change of soil materials encountered during excavation work other than what is indicated in the log of bore holes. If required, the Contractor shall make observations of elevations at the adjacent properties to determine any settlement as well as to determine any horizontal movements.

#### 6.0 *DISPOSAL OF EXCESS MATERIALS:*

Any excess materials resulting from the finish grading operations, not required or unsuitable for fill or backfill, shall be disposed of by the Contractor away from the project site, at his expense.

## SECTION 3

### GRADED AGGREGATE BASE COURSE

#### *PART 1 - GENERAL*

##### 1.1 *SUBMITTALS*

- a. Test Reports: Before delivery of materials submit following test reports to the Engineer for review and approval:
  - 1. Gradation
  - 2. Bearing Ration
  - 3. Atterberg Limits

##### 1.2 *DELIVERY AND STORAGE*

Inspect materials delivered to the site for any damage and store as to prevent segregation and contamination.

##### 1.3 *WEATHER LIMITATIONS*

Do not construct base course when rainfall or other weather conditions will detrimentally affect the quality of the finished course.

#### *PART 2 - PRODUCTS*

##### 2.1 *MATERIALS*

- a. Aggregates: Consist of durable and sound crushed gravel, crushed stone, free of lumps or balls of clay or other objectionable matter. Crushed stone and gravel shall be free from flat, elongated, soft or disintegrated pieces. Crushed aggregates retained on a No. 4 sieve shall have at least 90 percent by weight with at least two fractured faces and 100 percent by weight with at least one fractured face. Base course materials samples shall have a Bearing Ratio of at least 100 as determined by laboratory tests on a 4-day soaked specimen in accordance with ASTM D 1883. compact specimen in accordance with ASTM D 1557, Method D. Determine grain size in accordance ASTM C 136 and amount of material finer than 200 mesh sieve in accordance with ASTM C 117. Soil binder materials, that portion of material passing the No. 40 sieve, shall be of such composition that the composite material conforms to the requirements specified herein. It shall be of such nature that it can be compacted readily with watering and rolling to a firm, stable base. Aggregate shall conform to one of the following sizes.

Percentage By Weight Passing  
Square Mesh laboratory Sieves

Sieves	Size Numbers
2 – inch	100
1 1/2" inch	60 – 100
1 inch	30-65
½ inch	20-50
No. 4	20-50

No. 10	15-40
No. 40	5-25
No. 200	0-10

That portion of the material passing the No. 40 sieve shall have a liquid limit of not more than 25 and a plasticity index of not more than 5 as determined by ASTM D 4318. Prepare samples in accordance with ASTM D 2217, Procedure A.

## 2.2 CONSTRUCTION EQUIPMENT

Equipment shall be dependable and adequate for the purpose intended. Maintain equipment satisfactory and safe operating conditions. Subject to approval, special equipment dictated by local conditions may be used. Calibrated equipment, such as scales, spreaders and similar items, shall have been recalibrated and approved.

## PART 3 EXECUTION

### 3.1 BASE COURSE

Construct the graded aggregate base course on a prepared subgrade, as indicated. The base course shall consist of aggregates processed, deposited, spread, and compacted on a prepared surface. The Contractor shall be responsible for protection of completed areas against detrimental effects. Recondition, reshape, and recompact areas damaged by rainfall, other weather conditions or traffic.

### 3.2 MIXING OF MATERIALS

Mix aggregates in a stationary or traveling plant. Proportion aggregates by weight or volume in quantities to meet specified requirements are met after the base course has been placed and compacted. Incorporate, during the mixing operation, water in quantities sufficient to provide the necessary moisture content for the specified compaction. Mixing operations shall produce satisfactory, uniform blending and the method of discharging into trucks shall not produce segregation.

### 3.3 PLACING

Do not dump mixed materials in piles, but place on prepared subgrade in layers of uniform thickness with a spreader. When a compacted course 6 inch thick is required, place materials in a single layer. When a compacted course in excess of 6 inches is thick required, place materials in layers of equal thickness. Do not exceed 6 inches or have less than 3 inches in thickness for any compacted layer. Place layers so that when compacted, they will be true to grades or levels required with at least possible surface disturbance. Where the base course is constructed in more than one layer, clean the previously constructed layers of loose and foreign matter. Maintain material water content during the placing period to obtain the compaction specified. Make adjustments in placing procedures or equipment to obtain true grades, to minimize segregation and degradation to reduce or increase water content, and to insure as satisfactory base course.

### 3.4 *COMPACTING AND FINISHING*

Immediately following the placing, spread the finished mixture uniformly in a layer and bring to optimum moisture content. The loose thickness and the surface of the layer shall be such that the specified density and the required thickness shall be obtained after compaction. Compact the layer with steel-faced vibrating or pneumatic-tired rollers, or other suitable compacting equipment until the layer is compacted through the full depth to a field density of at least 100 percent of the maximum density at optimum moisture content tested in accordance with ASTM D 1557. In areas not accessible to rollers or compactors, compact the mixture with mechanical hand tampers. If the mixture is excessively moistened by rain, aerate by blade graders, or other suitable equipment. Aerate until the moisture content of the compacted material is the required density. Finish the surface of the layer by a combination of rolling and blading. Final surface shall be smooth and free from waves, irregularities, and from nuts of soft yielding spots.

### 3.5 *FINISHING AT EDGES OF BASE COURSE*

Place earth or other approved materials along the edges of the base course in such quantity that it will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, place material to the thickness of each layer. In each operation, allow at least a one foot width of the shoulder to be rolled and compacted simultaneously with the rolling and compacting of each layer.

### 3.6 *MAINTENANCE*

After construction is completed, maintain the base course throughout, except where portion of the succeeding course is under construction thereon. Maintenance includes drainage, rolling, shaping and watering, as necessary to maintain the course in proper condition. Correct deficiencies in thickness, composition, construction, smoothness, and density, which develop during the maintenance, to conform to be requirements specified herein. Maintain sufficient moisture by light sprinkling with water at the surface to prevent a dusty condition.

### 3.7 *FIELD SAMPLING AND TESTING*

Materials and materials sources shall be approved in advance of the use of such materials in the work. Replace base where samples are removed. Take duplicate samples at the same time and in the same manner as the original.

- a. **Aggregates at the Source:** Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75. Collect each sample by taking three incremental samples at random from the source material to make a composite sample of not less than 50 pounds. Repeat above sampling when source of material is change or when source of material is change or when unacceptable deficiencies or variations from specified grading or materials are found in testing.
- b. **During Construction:** Take on random sample from completed course material per day's run. Take samples in accordance with ASTM D 75.

- c. Testing:
1. Aggregates: Test each sample of base course material without delay. Make gradation tests from each sample in accordance with ASTM C136. Make sieve analysis on material passing the No. 200 sieve in accordance with ASSTM C117.
  2. laboratory Density Tests: IN accordance with ASTM D1557, Method D.

## SECTION 4

### CONCRETE REINFORCEMENT

#### *PART 1 - GENERAL*

##### *1.1 SUMMARY*

- A. Section Includes: Steel reinforcement, including fabrication and installation accessories, for precast shotcrete and cast-in-place concrete, and masonry.

##### *1.2 REFERENCE STANDARDS*

###### AMERICAN CONCRETE INSTITUTE (ACI)

- ACI 117            Standard Tolerances for Concrete Construction and Materials
- ACI 315            Manual of Standard Practice for Detailing Reinforced Concrete Structures
- ACI 318            Building Code Requirements for Reinforced Concrete

###### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM A 120        Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized Welded and Seamless, for Ordinary Uses.
- ASTM A 184        Fabricated Deformed Steel Bar Mats for concrete Reinforcement
- ASTM A 185        Welded Steel Wire Fabric for Concrete Reinforcement
- ASSTM A 497       Welded Deformed Steel Wire Fabric for Concrete Reinforcement
- ASTM A 499        Steel Bars and Shapes, Carbon Rolled from "T" rails
- ASTM A 615        Deformed and Plain Billet-Steel Bars for concrete Reinforcement

#### *PART 1*

##### *DELIVERY AND STORAGE*

- A Reinforcement and accessories shall be stored off the ground on. Platforms, skids, or other supports.

##### *PART 2 – PRODUCTS*

- A. Welded Wire Fabric: ASTM A185, wire in accordance with ASTM A496, mesh and wire sizes as noted on drawings
- B. Epoxy Grout: Epoxy grout shall be of type and manufacturers as indicated in drawings.
- C. Reinforcing Steel: Reinforcing steel shall be deformed bars in accordance with materials specified on the drawings in grades and sizes as indicated.
- D. Wire Ties: Wire ties shall be ASTM A82 16-gauge double annealed wire Provide corrosion resistant wire for precast concrete.

- E. Supports: Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 01 Class A, C or D or precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete blocks shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports shall be class C or D. Concrete supports used in concrete exposed to view shall be class C or D.

### 2.3 FABRICATION

- A. Steel Bar Reinforcement: Fabricate and detail to shapes and dimensions shown on drawings in accordance with ACI 315.
- B. Bending & Straightening: In accordance with ACI 318; Chapter 7, unless otherwise noted on drawings; no bending or straightening of reinforcement will be permitted after partial embedment in concrete; heating of reinforcement will be permitted only if entire operation is approved.
- C. Welding: Welding of reinforcing bars is not permitted unless specifically shown welded on Structural drawings. When welding of reinforcement is indicated and required, provide welds in accordance with AWS D1.4.
- D. Splicing:
  - 1. Reinforcing bars shall be lap spliced for tension unless otherwise noted on the drawings.
  - 2. At the Contractor's option, mechanical butt splicing using an exothermic welding process and high-strength sleeves or threaded splicing may be substituted for lap splices with prior approval. Butt welds, termite welds, and threaded splices shall be capable of developing in tension at least 125 percent of the specified yield strength (Fy) on the bar.
  - 3. Acceptable threaded splices shall be the Lenton rebar Splice or the Dayton Bar Grip or equivalent. Installation of threaded splices must conform to ICBO Report #3967 for Lenton and plastic bar protection must be provided at all times prior to actual splicing.
  - 4. Welding or tack welding of reinforcing bars to other bars or to plates, angles, etc., is prohibited, except where specifically detailed on the approved shop drawings. Where welding is approved, it shall be done by AWS Certified Welders using E99018 or approved electrodes. Welding procedures shall conform to the requirements of AWS D1.4.
- E. Welded Wire Fabric : In accordance with CRSI, Chapter 2, unless otherwise noted or indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General : Clean reinforcing steel free from loose rust, mud, oil and other foreign matter affecting bond. Install supports in accordance with CRSI Chapter 3 unless otherwise indicated.



- B. Placement of Bars: In accordance with ACI 318 and approved placement drawings. If bars are displaced, or if necessary to shift bars to avoid interference with other reinforcing or embedded items, and if bars are moved to locations exceeding allowable tolerances, obtain approval of the resulting arrangement prior to placing concrete.
- C. Allowable Tolerances: In accordance with the requirements of ACI 117, paragraph 6.1
- D. Cover: Allowable cover for reinforcement is indicated or noted on drawings, where no cover is indicated or noted allow minimum of 3 inches of cover.
- E. Tie Wires: After cutting tie wires, turn wires to the inside of section and bend so that concrete placement will not force ends to exposed concrete surfaces.
- F. Welded Wire Fabric: Place welded wire fabric reinforcing in accordance with requirements of ACI 315, unless otherwise noted or indicated. Place continuous between control and expansion joints; stop at expansion joints and cut ½ through at control joints unless noted otherwise. Extend fabric across beams and walls. Lap fabric a minimum of 1 ½: mesh minimum.

#### 3.4 DEFECTIVE WORK

- A. General: The following reinforcing steel work will be considered defective and shall be removed and replaced by the Contractor at no additional cost to the owner.
  - 1 Bars with kinks or bends not shown on drawings.
  - 2 Bars injured due to bending or straightening
  - 3 Bars heated for bending
  - 4 Reinforcement not placed in accordance with the drawings and/or specifications.

#### PART 4 - SAMPLING AND TESTING

- 4.1 General: All steel bars must be positively identified as to heat number and mill analysis.
  - a. All steel bars that cannot be identified by heat number and mill analysis shall have one tensile and one bend test made for each 2-1/2" tons or fraction thereof, of each size and kind of reinforcing steel.
  - b. Testing procedure shall conform to ASTM A615
- 4.2 Cost of Tests: Costs of initial services for testing and inspection personnel will be paid by the Owner.
  - a. If initial tests indicate non-compliance with Contract Document requirements, any subsequent testing or inspection shall be performed by the same personnel and paid for by the Owner and back charged to the Contractor.
  - b. Costs for additional test or inspection required because of change in materials being provided or change of source

or supply shall be paid for by the Owner and back charged to the Contractor.

- c. Additional costs of any testing or inspections which are performed outside normal working hours shall be borne by the Contractor.

## SECTION 5

### CAST-IN PLACE CONCRETE

#### PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition shall be applicable.
- 1.1.1 U.S. Army Corps of Engineers (COE) Waterways Experiment Station Publications
- |           |                                                                                 |
|-----------|---------------------------------------------------------------------------------|
| CRD-C-572 | Specifications for Polyvinylchloride Waterstop                                  |
| CRD-C-621 | Handbook for Concrete and Cement, Specification For Non shrink Grout, Volume II |
| PS-1      | Construction and Industrial Plywood                                             |
- 1.1.2 American Association of State Highway and Transportation Officials (AASHTO) Publication:
- |       |                                      |
|-------|--------------------------------------|
| M 182 | Burlap Cloth Made from Jute or Kenaf |
|-------|--------------------------------------|
- 1.1.3 American Concrete Institute (ACI) Publications:
- |       |                                                                                       |
|-------|---------------------------------------------------------------------------------------|
| 211.1 | Standard Practice for Selecting Proportions for Normal, heavyweight and Mass concrete |
| 301   | Specifications for Structural Concrete for Buildings                                  |
| 302   | Guide for Concrete Floor and Slab Construction                                        |
| 304   | Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.        |
| 305R  | Hot Weather Concreting                                                                |
| 315   | Details and Detailing of Concrete Reinforcement                                       |
| 347   | Recommended Practice for Concrete Formwork                                            |
- 1.1.4 American Society for Testing and materials (ASTM) Publications.
- |       |                                                               |
|-------|---------------------------------------------------------------|
| A 82  | Cold-Drawn Steel Wire for Concrete Reinforcement              |
| A 185 | Welded Steel Wire Fabric for Concrete Reinforcement           |
| A497  | Welded Deformed Steel Wire for Concrete Reinforcement         |
| A 615 | Deformed & Plain Billet-Steel Bars for Concrete Reinforcement |
| C 31  | making and Curing Concrete Test Specimens in the Field        |
| C 33  | Concrete Aggregates                                           |

C 39	Compressive Strength of Cylindrical Concrete Specimens
C 42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
C 94	Ready-Mixed Concrete
C 143	Slump of Portland Cement concrete
C 150	Portland Cement
C 171	Sheet Materials for Curing Concrete
C 172	Sampling Freshly Mixed Concrete
C 173	Air Content of Freshly Mixed concrete by the Volumetric Method
C 309	Liquid Membrane-Forming Compounds for Curing Concrete
C 494	Chemical Admixtures for Concrete
C 881	Epoxy-Resin-Base bonding Systems for Concrete
C 920	Elastomeric Joint Sealants
D 1190	Concrete joint Sealer, Hot-Poured Elastic Type
D 1751	Preformed Expansion Joint Filler for concrete paving and Structural Construction ( Non-extruding and Resilient Bituminous types)
D 1752	Preformed Sponge Rubber and Cork Expansion Joint Filler for Concrete Paving and Structural Construction
D 1850	Concrete Joint Sealer, Cold Application Type

#### 1.1.5 American Welding Society (AWS) Publication

D1.4	Structural Welding Code-Reinforcing Steel
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#### 1.2 *DESCRIPTION OF WORK:*

The work includes the provision of cast-in place concrete. In the ACI publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the work, shall has been substituted for should wherever it appears.

#### 1.3 *SUBMITTALS:*

1.3.1 Shop Drawings: Reproductions of contract drawings are unacceptable.

1.3.1.1 Shop Drawings for Reinforcing Steel: ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories and concrete

cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.3.2 Contractor Mix Design: Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Furnish a complete list of materials including type, brand, source and amount of cement, and admixtures, applicable reference specifications, and copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Provide fly ash and pozzolan test results performed within 6 months of submittal date. Obtain approval before concrete placement. Submit additional data regarding concrete aggregates if the source of aggregate changes.

1.3.3 Certificates of Compliance:

- a. Aggregates
- b. Admixtures
- c. Reinforcement
- d. Cement

1.3.4 Catalog Data:

- a. Waterstops
- b. Materials for Curing Concrete
- c. Joint Sealant
- d. Joint Filler
- e. Vapor Barrier
- f. Epoxy Bonding Agents

1.4 *DELIVERY*: Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement.

1.5 *STORAGE*: ACI 301 for jobsite storage of concrete aggregates. Store reinforcement of different sizes and shapes in separate piles of racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Provide for accurate identification after bundles are broken and tags removed.

## *PART 2 - PRODUCTS*

### *2.1 CONCRETE*

2.1.1 *Contractor-Furnished Mix Design* : ACI 211.1 and ACI 301. Concrete shall have a 28-day compressive strengths as specified or indicated on the drawings. Provide ASTM C 33 aggregate size no. 57 and 67. The maximum chloride content shall not exceed on percent.

#### *2.1.1.1 Slump Requirements:*

The allowable slump shall be as follows:

ELEMENT	SLUMP		(Inches)
	MINIMUM		MAXIMUM

Walls, columns, and grade beams	2	4
Floors, exterior slabs, and other bldgs.	1	3

## 2.2 MATERIALS

2.2.1 *Cement:* ASTM C 150, Type 1.

2.2.2 *Water:* Water shall be fresh, clean and potable.

2.2.3 *Aggregates:* ASTM C33, Class 1N or 2N, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalis in the cement. Aggregates shall consist of gravel, crushed gravel, or crushed stone conforming to the requirements of ASTM C 33. Submit test results as required in ASTM C 33.

2.2.4 *Nonshrink Grout:* COE CRD-C-621.

2.2.5 *Admixtures:* Water-reducing retarders shall be used in proportions recommended by the manufacturer. Trial mixes shall be made with the admixture and job materials at temperatures and humidities anticipated on the project. Sampling and testing shall be performed at no cost to the Owner, and with the supervision of the Project Inspector.

2.2.5.1 *Retarding:* ASTM C 494, Type B, D or G.

2.2.6 *Water Reducing:* ASTM C 474, Type A or F.

2.2.7 *Reinforcement:*

2.2.7.1 *Reinforcing Bars:* ACI 301 unless otherwise specified. ASTM 1615. Gr. 40 and 60.

2.2.7.2 *Mechanical Reinforcing Bar Connectors:* ACI 301, Provide 125 percent minimum yield strength of the reinforcement bar.

2.2.7.3 *Welded Wire Fabric:* ASTM A 185 or ASTM AA497

2.2.7.4 *Wire:* ASTM A 82 OR ASTM A 4996

2.2.8 *Vapor Barrier:* ASTM C 171 Polyethylene sheeting, minimum 6 mil thickness.

2.2.9 *Polyvinylchloride Waterstops:* COE CRD-C-572

2.2.10 *Materials for curing Concrete*

2.2.10.1 *Impervious Sheeting:* ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.2.10.2 *Impervious Sheeting:* AASHTO M 182

2.2.10.3 *Liquid Membrane- Forming Compound:* ASTM C 309, white-pigmented. Type 2 Class B, free of paraffin or petroleum.

- 2.2.10.4 *Liquid Chemical Sealer-hardener Compound*: Compound shall not contain petroleum resins or waxes. Compound shall not reduce the adhesion of resilient flooring, tile, paint, roofing waterproofing, or other material applied to concrete.
- 2.2.11 *Expansion/Contraction Joint Filler*: ASTM D 1751 or ASTM D 1752, ½-inch thick, unless otherwise indicated.
- 2.2.12 *Joint Sealants*
  - 2.2.12.1 *Horizontal Surfaces* ( 3 percent slope, maximum)
    - a. Outside buildings: ASTM D 1190
    - b. Inside Buildings: ASTM D 1190 or ASTM D 1850
  - 2.2.12.2 *Vertical Surfaces* (greater than 3 percent slope) ASTM C 920, Type M, Grade NS, Class 25, use T.
- 2.2.13 *Epoxy Bonding Compound* : ASTM C 881, Type I, II, Grade I, Class C. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces
- 2.2.14 *Lightweight Concrete*: Lightweight concrete shall consist of foam concrete or a mixture with the use of perlite aggregates. Foaming agent shall not contain any aluminum. Materials for lightweight concrete shall be proportioned to obtain a maximum density of 70 pounds per cubic foot for and 990 pounds per cubic foot for floors with 28-day compressive strength of 500 psi and 900 psi, respectively, unless otherwise indicated on the drawings.
- 2.2.15 *Integral Waterproofing*: 3CC System as manufactured by CEMENT AID or approved equal.

### PART 3 - EXECUTION

- 3.1 FORMS: ACI 301, Provide forms, shoring, and scaffolding for concrete placement unless indicated or specified otherwise. Concrete for footings may be placed in excavations without forms upon inspection and approval by the Engineer. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners or concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water shall be watertight.
  - 3.1.1 Coating: Before concrete placement, coat the contract surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms of surfaces to which adhesive, paint, or other finish material is to applied.
  - 3.1.2 Removal of Forms: Prevent concrete damage during form removal. After placing concrete, forms shall remain in place for the following minimum time period, not necessarily consecutive, where minimum temperatures specified in paragraph entitled "Curing Period and Minimum Temperatures" are maintained adjacent to the concrete and formwork. The minimum time period for removal of forms shall govern where it exceeds the minimum specified curing period . Where the formwork for

one element supports the formwork for another element, the greater time period shall apply to both elements.

ELEMENT	TIME PERIOD (Days Minimum)
Walls, columns, sides of beams, girders And slabs on grade	1
Pan joist forms (sides only):	
30 inches wide or less	3
Over 30 inches wide	4
Joist, beams, or girder soffits:	
Clear span between structural supports	
Under 10 feet	7
10 to 20 feet	14
Over 20 feet	21
One-way floor slabs: Clear span between Structural supports	
Under 10 feet	4
10 to 20 feet	7
Over 20 feet	10

3.1.2.1 Special Requirements for Reduced Time Period Prior to Form Removal  
Forms may be removed earlier than specified if ASTM C 39 test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached 85 percent (minimum) of the design strength.

3.1.3 *Reshoring*: Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Where columns, walls, or other load-bearing concrete members are placed in advance of other framing and forms are needed for future use, forms may be stripped after 2 days if loads are not applied to load-bearing members, and if members are cured as specified in paragraph entitled "Curing and Protection:". After forms are removed, slabs and beams over 10 feet in span and cantilevers over 4 feet shall be reshored for the remainder of the specified time period in paragraph entitled "Removal of Forms". Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Reshoring elements shall have the same load-carrying capabilities as original shoring and shall be spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.2 *PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS* ACI 301. Provide bars, wire, fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement shall not contain rust, scale, oil, grease, clay, and foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross sectional area or the nominal weight per foot of the reinforcement has been reduced to less than specified in paragraph



entitled "Reinforcing Bars". Removed loose rust prior to placing steel. Tack welding is prohibited.

- 3.2.1 Vapor Barrier: Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches. Remove torn, punctured, or damaged vapor barrier prior to placing concrete. Concrete placement shall not damage vapor barrier material.
- 3.2.2 Tolerances: Place reinforcement and secure with galvanized or noncorrodible chairs, spacers, or metal hangers. Use concrete or other non-corrodible material for supporting reinforcement on the ground.
- 3.2.3 Splicing: Splices shall be approved prior to use. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires. Plus 2 inches.
- 3.2.4 Future Bonding: Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Bolt threads shall match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt installed.
- 3.2.5 Cover: ACI 301 for minimum coverage, unless otherwise indicated.
- 3.2.6 Setting Miscellaneous Material: Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.
- 3.2.7 Construction Joints: Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.
- 3.2.8 Expansion Joints and Contraction Joints: For slabs on grade, provide at edges of interior floor slabs, adjacent to walls, and as indicated. Make expansion joints 0.50-inch wide except as indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a joint tool, to the indicated depth after the surface has been finished. Sawed joints shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.
- 3.2.9 Waterstop Splices: Fusion weld in the field. Form Ties and Accessories: The use of wire alone is prohibited. Form ties and accessories shall not reduce the effective cover of the reinforcement.
- 3.2.10 Integral Waterproofing: All concrete for basement walls, water reservoirs, and roof decks shall be waterproofed by the addition of Cemented 3CC or equal and approved hydrophobic ingredient at a rate of 15 liters per cubic meter or as recommended by the manufacturer. Admixtures shall not contain any chlorides. The supplier shall satisfy the Engineer that any admixture or ingredient used, or their combination, does not detrimentally affect the strength or other properties of the concrete.
- 3.3 MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE  
ASTM C94, ACI 301, ACI 302, 1R, and ACI 304, except as modified

herein ASTM C 94. provide mandatory batch ticket information for each load of ready mix concrete.

- 3.3.1 *Measuring:* Make moisture, weight, and air determination of intervals as specified in paragraph entitled "Sampling and Testing." Allowable tolerances for measuring cement and water shall be 1 percent, for aggregates, 2 percent, and for admixtures, 3 percent.
- 3.3.2 *Mixing:* ASTM C 94. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperatures is less than 85 degrees F. Reduce mixing time and place concrete within 60 specified maximum slump and water-cement ratio are not exceeded. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixtures throughout the batch.
- 3.3.3 *Transporting:* Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.
- 3.3.4 *Placing:* Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation, in uncovered areas during periods of precipitation, or in standing water. Prior to placing concrete, remove dirt, construction debris and water from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10-foot centers maximum in each direction when pouring interior slabs and on 20-foot centers maximum for exterior slabs.
  - 3.3.4.1 *Vibration:* ACI 301. Furnish a spare vibrator at the jobsite whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straight edge. Operate vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 18 inches apart. Penetrate the previously placed it with the vibrator when more than one lift is required. Place concrete in 18 inch maximum vertical lifts. External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.
  - 3.3.4.2 *Application of Epoxy bonding Compound:* Apply a think coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy-resins.
- 3.3.5 *Hot Weather:* ACI 305R. Provide and maintain required concrete temperature using figure 2.1.5 in ACI 305R to prevent the evaporation

rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where worksite is remote to water source to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect form from direct sunlight and add water to top of structure once concrete is set.

3.4 *SURFACE FINISHES (EXCEPT FLOOR, SLAB AND PAVEMENT FINISHES):*

- 3.4.1 *Defects:* Repair formed surfaces by removing minor honeycombs, pits greater than one square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb (including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified.
- 3.4.2 *Not Against Forms (Top of Walls);* Surfaces not otherwise specified shall be finished with wood floats to even surfaces. Finish shall match adjacent finishes.
- 3.4.3 *Formed surfaces:*
- 3.4.3.1 *As-Cast Rough Form (For Surfaces Exposed to Public View)* Remove fins and other projections exceeding 0.25 inch in height, level abrupt irregularities.
- 3.4.3.2 *As-Cast Smooth Form (For Surfaces Exposed to Public View):* Form facing material shall produce a smooth, hard, uniform texture on the concrete. Remove fins and other projections
- 3.4.4 *Rubbed Finish:* Provide concrete with a smooth form finish. Finish as follows:
- a. *Smooth rubbed:* Provide a newly hardened concrete within 24 hours following form removal. Wet surfaces and rub with an abrasive tool to produce uniform color and texture. Use only the cement paste drawn from the concrete rubbing process.
  - b. *Grout Cleaned:* Finishing operations shall not begin until adjacent surfaces to be cleaned are completed and accessible. Cleaning as the work progresses shall not be permitted. Mix one part cement and 1.5 parts fine sand with sufficient water to produce a grout with the consistency of thick paint. Substitute white cement for a part of the gray cement in order to produce a color matching the color of the surrounding concrete, determined by a trial patch. Wet the surface of

the concrete sufficiently to prevent absorption of water from the grout. Apply the grout uniformly with brushes or spray gun. Immediately after applying the grout, scrub the surface vigorously with cork float or stone to coat the surface and fill air bubbles and holes. Remove excess grout while still plastic by working the surface with a rubber float, sack, or other approved method. When dry, rub the surface vigorously with clean burlap. Keep damp for 36 hours minimum after final rubbing.

- 3.4.5 *Surface Finish Samples:* Provide a minimum of three samples concrete panels for each finish for each mix design, 3 feet by 3 feet, 3 inches thick. Use the approved concrete mix design(s). Provide sample panel on-site at location directed. Once approved, each set of panels shall be representative of each of the finishes specified and shall be representative of the workmanship and finishes required. Do not remove or destroy samples until directed by the Architect.
- 3.5 *FLOOR, SLAB AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION. ACI 302. 1R,* unless otherwise specified. Slope floors uniformly to drains where drains are provided. Depress the concrete base slab where quarry tile, ceramic tile, or marble tile are indicated. Provide interior floor slabs with a steel troweled finish. After troweling is completed. Apply a liquid chemical sealer-hardener compound on interior floor slabs that do not receive floor covering.
- 3.5.1 *Finish:* Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleed water appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleed water is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleed water.
- 3.5.1.1 *Floated:* Provide for machinery pads and other exterior slabs where not otherwise specified. Float the surface by hand with a wood or magnesium flat, or use a power-driven float. Floating or any one area shall be the minimum necessary to produce an even finish, level within ¼ inch in 10 feet for exterior work and level within 1/8 inch in 10 feet for interior work where floor drains are not provided.
- 3.5.1.2 *Steel Troweled:* First, provide a floated finish. When slab attains a proper set, trowel to a smooth, hard, dense finish. Finished surfaces shall be free of troweled marks, uniform in texture, and a true plane, flat within 0.01 foot (Approximately 1/8 inch) in 10 feet. Hand-finish portions of the slab no accessible to power finishing equipment (e.g., edges, corners) to match the remainder of the slab. Power trowel once and finally hand trowel where a finished floor covering (e.g., tile, carpet) is specified. Power trowel once and finally hand trowel where a finished floor covering (e.g., tile, carpet) is specified. Power trowel twice and finally hand trowel for exposed concrete floors.
- 3.5.1.3 *Broomed:* Provide for exterior walks, platforms, patios, and ramps, unless otherwise indicated. Provide a floated finish, then finish with a flexible bristle broom. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.
- 3.5.1.4 *Pavement:* Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus

of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straight edge to check slope and flatness, correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion, continue until a uniform but gritty nonslip surface is obtained. Round edges and joints with an edger having a radius of 1/8 inch.

3.5.2 *Concrete Walls:* Provide 4 inches thick minimum. Provide contraction joints spaced every linear feet unless otherwise indicated. Cut contraction joints 3/4-inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum apart. Provide walks with a broomed finish. Provide a transverse slope of 1/4 inch per foot. Limit variation in cross section to 1/4 inch in 5 feet.

3.5.3 *Pits and Trenches:* Place bottoms and walls monolithically or provide waterstops and keys.

3.5.4 *Curbs and Gutters:* Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Provide a pavement finish.

3.6 *CURING AND PROTECTION:* ACI 301 unless otherwise specified. Begin curing immediately following form removal. Protect concrete from injurious action by sun, rain, flowing water, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to coats shall be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Respray concrete surfaces subjected to rainfall within 3 hours after securing the compound application.

3.6.2.2 *Protection of treated Surfaces:* Prohibit foot and vehicular traffic and other sources of abrasion for not less than 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.6.2.3 *Liquid Chemical Sealer-hardener curing:* Provide for interior floors that do not receive a floor covering, or in lieu of liquid membrane-forming compound curing for other surfaces. Apply sealer-hardener in accordance with the manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer.

3.6.2.4 *Curing Period:*

TIME PERIOD  
(Days Minimum)

CONCRETE STRUCTURE  
OR CEMENT TYPE

7	ASTM C 150, type I or II, Either with or without fly ash, pozzolanl or ground slag; and ASTM C 595 cement for concrete not specified otherwise.
10	Retaining walls that will be subjected to deteriorating conditions; pavement not under a roof, chimneys.
14	Water tanks for potable and non-potable water; structures that will be in contact with water; decks and similar parts of water front structures over seawater that will not ordinarily be wetted by wet water

3.6.3.1 *Additional Curing:* Double the required curing period if either one of the average of both 7-day test cylinders indicate less than 90j percent of the strength specified (f'c).

3.7 *SAMPLING AND TESTING:*

3.7.1 *Sampling:* ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31 for making test specimens. Samples shall be collected at final discharge point.

3.7.2 *Testing:*

3.7.2.1 *Slump Tests:* ASTM C 143. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.

3.7.2.2 *Temperature Tests:* Test the concrete delivered and the concrete in the forms. Perform test for each batch (minimum) or every 10 cubic yards (maximum) of concrete, until the specified temperatures obtained, and whenever test cylinders and slump tests are made.

3.7.2.3 *Compressive Strength Tests:* ASTM C39, Sampling shall be in accordance with ASTM C31. Obtain cylinder samples for compressive strength tests at the rate of three (3) sets of five (5) samples per set for each days pour or for every 150 cubic meters of concrete poured or for every 500 square meters of area for slabs or walls, whichever is greater. Test two (2) cylinders at 7 days, one (1) cylinder at 14 days and one (1) Cylinder at 28 days, and hold one (1) cylinder in reserve.

If the average strength of the 28-day test cylinders is less than the specified f'c and a maximum of one single cylinder is less than f'c minus 500 psi, obtain core samples for compressive strength tests in accordance with

ASTM C 42 at the rate recommended in ACI 318. concrete 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  $f'_c$ . Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new, acceptable concrete. Repair core holes with nonshrink grout. Match color and of adjacent concrete.

- 3.7.2.4 *Air Content:* ASTM C 173 or ASTM C 231. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

## SECTION 6 CONSTRUCTION JOINT

### 1.4 SCOPE OF WORK

The Work includes furnishing all materials, labor, equipment and incidentals required to make all concrete joints tight as detailed on the Drawings.

### 1.5 RELATED SECTIONS

Other Sections of the Specifications shall also apply to the extent required for proper performance of this Work.

Section 33009	Concrete Reinforcement
Section 33010	Concrete Finishes

### 1.6 SPECIFICATIONS AND STANDARDS

Except as otherwise indicated, the current editions of the following Standards apply to the WORK of this Section:

ASTM D412	Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D746	Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2240	Rubber Property – Durometer Hardness

### 1.7 SUBMITTALS

- B. Detailed working drawings.
- C. Samples/test reports/certificates as required by the applicable Reference Standards.

### 1.8 QUALITY ASSURANCE

The Contractor is responsible for the performance of all tests and inspection required by this Standard Specification. However, the owner reserves the right to perform any or all prescribed tests and inspection where such is deemed necessary to ensure that delivered materials conform to the specifications, and to be paid for by the Contractor. The Contractor shall furnish the owner certified copies of records showing that each material has been pre-tested, and complied with all applicable requirements of this Standard. The Contractor shall, at his own expense, replace all rejected materials for failure to comply with this Specification.



PART 2 – PRODUCTS

2.1 MATERIALS

**A. Waterstops**

- Waterstops shall be extruded from an elastomeric Polyvinyl-Chloride compound containing the necessary plastizicers, resins, stabilizers and other materials necessary to meet the requirements of these specifications. No reclaimed or scrap material shall be used.
- The waterstop manufacturer shall furnish to the Engineer current test reports and a written certification that the material to be shipped to the jobsite meets the following physical requirements:

Physical Property	Value	ASTM Std.
<i>Sheet Materials</i>		
Tensile Strength - min. ( MPa )	12.4	D412, Die C
Ultimate Elongation - min. ( % )		D412, Die C
Low. Temp. Brittleness - max. ( °C )		D746
	350	
	-37	

Physical Property	Value	ASTM Std.
<u>Accelerated Extraction (CRD - C572 )</u>		
Tensile Strength - min. ( Mpa )	10.3	D412, Die C
Ultimate Elongation - min. ( % )	300	D412, Die C
<u>Effect of Alkalis ( CRD - C572 )</u>		
Change in Weight ( % )	+0.25/-0.10	--
Change in Durometer, Shore A	±5	D2240
<i>Finished Waterstop</i>		
Tensile Strength - min. ( Mpa )	9.65	D412, Die C
Ultimate Elongation - min. ( % )	280	D412, Die C

- Waterstops shall be 150 mm x 9mm thick for construction and control joints and 230 mm x 9 mm thick multi-rib type with center bulb for expansion joints.

**B. Expansion Joint Filler**

Expansion joint filler materials shall be premolded, self expanding cork type joint filler, approximately 20 mm thick, and conforming to the requirements of ASTM D1752, Type III.

**C. Joint Sealant**

- Joint sealant for concrete shall be an approved two component elastomeric synthetic rubber compound, of liquid polysulphide polymer base and shore hardness of at least 20 after a 7-day curing period. The shore hardness shall be as defined in ASTM D2240.

- Self-leveling type sealant shall be used in all horizontal joints in slabs.
- Non-sagging type sealant shall be used for all wall and overhead joints.
- Primer shall be as recommended by the sealant manufacturer.
- The bond breaker (non-liquid) between sealant and joint filler shall be polyethylene or other release material approved by the Engineer.

### *PART 3 - EXECUTION*

#### *3.1 INSTALLATION*

- Construction joints shall be provided as indicated on the Drawings. Unless otherwise indicated on the Drawings, bonding will be required at all horizontal joints in walls. Surfaces shall be prepared in accordance with Section 33010.
- Construction joints will be permitted at locations other than those indicated on the Drawings provided, a written permission from the Engineer is obtained.
- The surfaces of the groove for the rubber sealant shall not be coated with curing compound.
- Where indicated on the Drawings, joint sealant shall be placed in all joints to the depth shown. Cleaning of the grooves, priming, handling and application of the materials, including bond breaker, shall be as recommended by the manufacturer.
- Waterstops for all joints shall be continuous around the corners and intersections, either in horizontal or vertical direction, as indicated on the Drawings. Field splices and joints shall be made in accordance with the waterstop manufacturer's instructions, using a thermostatically controlled heating iron.
- Holes for steel tying wires shall be drilled in the waterstops as recommended by the manufacturer.
- Steel tying wire shall be as specified in Section 33009, Concrete Reinforcement.
- A sufficient number of wire ties shall be installed to ensure that the waterstops remain in their original position during the placement of concrete.

## SECTION 7

### CONCRETE REPAIR USING EPOXY RESIN CONCRETE, GROUTS, AND MORTARS

#### **PART 1 - GENERAL**

**1.1 APPLICABLE PUBLICATIONS:** the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

**1.1.2 Military Specification (Mil. Spec.):**

MIL-L-51149                      Liquid Polymer, Polysulfied

**1.1.3 American Society for Texting and material (ASTM) Publications:**

C 33-81	Concrete Aggregates
C 117-80	Material Finer than No. 200 Sieve In Mineral Aggregate by Washing
C 136-81	Sieve Analysis of Fine and Coarse Aggregates
C 144-81	Aggregate for Masonry Mortar
C 881-78 (T 83)	Epoxy-Resin-Base Bonding systems for concrete
D 1652-73 (R 1980)	Epoxy Content of Epoxy Resins
D 1824-66	Apparent Viscosity of Plastisols and Organosols at Low shear Rates by Bookfiel Viscometer.
D 1963-74	Specific Gravity of Drying Oils; Varnishes Resins, and Related Materials at 25/25 Degrees C.
D 2419-74 (R1982)	Sand Equivalent Value of Soils and find Aggregate
E 70-77	PH of Aqueous Solutions with the Glass Electrode

**1.2 SUBMITTALS:**

**1.2.1 Certified Test Reports:**

- a. Aggregates: Sieve analysis test in accordance with ASTM C 136 and ASTM C117.
- b. Epoxy Resin Binder: Conforming to ASTM C 881 and covering the following:
  1. Viscositiy
  2. Consistency
  3. Gel Time

4. Absorption
5. Shrinkage
6. Thermal Compatibility

c. *Epoxy Resin Binder*: Conforming to the two component epoxy resin binder type I specified hereinafter and covering the following

1. Epoxy Number
2. Epoxy Viscosity
3. Epoxy Specific Gravity
4. Polysulfide Viscosity
5. Polysulfide Specific Gravity
6. Polysulfide pH
7. Polysulfide Water Content
8. Polysulfide Sulfur Content

1.2.2 *Job Mix Formula*: Submit for approval at least 15 days before work commences a job-mix formula for each use of epoxy resin. Test reports shall accompany the mix design. Test reports shall accompany the mix design. The formula shall identify the proposed source of the materials and state the proportions of aggregates and epoxy resin. Samples of materials to be used on the job shall be used to determine the job mix.

1.2.3 *Samples*: Submit the following samples for approval:

- a. Not less than two sample epoxy concrete and epoxy mortar specimens for each mix design, 6-inches by 6-inches,  $\frac{3}{4}$  inches thick.
- b. Aggregates, 1-lb samples size, fine and coarse aggregates combined.
- c. Epoxy resin components, 1 pint each

1.2.4 *Equipment*: Submit descriptive information on the mixing and application equipment.

1.3 *DELIVERY AND STORAGE*: Inspect materials delivered to site for damage, unload and store with a minimum of handling. Deliver all epoxy resin components and aggregate materials to original sealed containers and store in dry covered area at temperatures below 90 degrees F.

1.4 *SAFETY PRECAUTIONS*: In addition to the clause of the GENERAL PROVISIONS entitled, 'Accident Preventions', the Contractor shall pay particular attention to the following requirements:

1. Provide Contractor personnel with and require them to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with uncured resin and components.
2. Place clothing contaminated with uncured resin components in closed containers for storage until it can be discarded or until provision is made for the removal of contaminants from the clothing.
3. Non-impervious clothing which becomes contaminated with uncured epoxy resin components shall be removed immediately and not

reworn until the contaminants is removed from the clothing.

4. Provide Contractor personnel with and require them to use splash proof safety goggles where there is any possibility of liquid resin contacting the eyes.
5. Where there is any possibility that Contractor personnel eyes may be exposed to liquid resin component, provide an eyewash fountain within the immediate work area for emergency use. For field use a Portable eyewash fountain is acceptable.
6. Skin that becomes contaminated with liquid resin components shall be immediately washed or showered with soap or mild detergent to remove any contaminants.
7. Do not permit eating and smoking in areas where resin components are handled, processed or stored.
8. Contractor personnel who handle uncured epoxy resin sha`



Fiber Voids; One sample unit of fiber voids prior to installation of the voids.

### *1.3 DESIGN*

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

### *1.4 STORAGE AND HANDLING*

Fiber voids shall be stored above ground level in a dry location. Fiber voids shall be kept dry until installed and overlaid with concrete.

## **PART 2 PRODUCTS**

### *2.1 FORM MATERIALS*

#### 2.1.1 Forms For Class A and Class B Finish

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

#### 2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA ANSI/AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

#### 2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

#### 2.1.4 Retain-In-Place Metal Forms

Retain-in-place metal forms for concrete slabs and roofs shall be as specified in Section STEEL DECKING.

#### 2.1.5 Pan-Form Units

Pan-form units for one-way or two-way concrete joist and slab construction shall be factory-fabricated units of the approximate section indicated. Units shall consist of steel or molded fiberglass concrete form pans. Closure units shall be furnished as required.

### 2.1.6 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 6 mm nor more than 25 mm deep and not more than 25 mm in diameter. Removable tie rods shall be not more than 38 mm in diameter.

### 2.1.7 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

### 2.1.8 Fiber Voids

Fiber voids shall be the product of a reputable manufacturer regularly engaged in the commercial production of fiber voids. The voids shall be constructed of double faced, corrugated fiberboard. The corrugated fiberboard shall be fabricated of [standard kraft] paper liners, impregnated with paraffin, and laminated with moisture resistant adhesive, and shall have a board strength of 20 kg per square centimeter (275 psi.) Voids which are impregnated with paraffin after construction, in lieu of being constructed with paraffin impregnated fiberboard, are acceptable. Voids shall be designed to support not less than 4900 kg per square meter (1000 psf). To prevent separation during concrete placement fiber voids shall be assembled with steel or plastic banding at 1.22 meters 4 feet on center maximum, or by adequate stapling or gluing as recommended by the manufacturer. Fiber voids placed under concrete slabs and that are 200 mm 8 inches in depth may be heavy duty "waffle box" type, constructed of paraffin impregnated corrugated fiberboard.

## 2.2 FIBER VOID RETAINERS

### 2.2.1 Polystyrene Rigid Insulation

Polystyrene rigid insulation shall conform to ASTM C 578, Type V, VI, or VII, square edged. Size shall be 38 mm (1-1/2 inches) thick by 400 mm (16 inches) in height by 1 meter (3 feet) in length, unless otherwise indicated.

### 2.2.2 Precast Concrete

Precast concrete units shall have a compressive strength of not less than 21 MPa 3000 psi, reinforced with 150 mm by 150 mm by W1.4 WWF 6 inch by 6 inch by W1.4 WWF wire mesh, and 300 mm (height) by 1 m (length) by 40 mm (thickness) 12 inches (height) by 3 feet (length) by 1-5/8 inches (thickness) in size unless indicated.

## **PART 3 EXECUTION**

### 3.1 INSTALLATION



### 3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

### 3.1.2 Fiber Voids

Voids shall be placed on a smooth firm dry bed of suitable material, to avoid being displaced vertically, and shall be set tight, with no buckled cartons, in order that horizontal displacement cannot take place. Each section of void shall have its ends sealed by dipping in paraffin, with any additional cutting of voids at the jobsite to be field dipped in the same type of sealer, unless liners and flutes are completely impregnated with paraffin. Prior to placing reinforcement, the entire formed area for slabs shall be covered with a 1.22 x 2.44 m 4 x 8 feet minimum flat sheets of fiber void corrugated fiberboard. Joints shall be sealed with a moisture resistant tape having a minimum width of 75 mm (3 inch) 3 inches. If voids are destroyed or damaged and are not capable of supporting the design load, they shall be replaced prior to placing of concrete.

### 3.1.3 Fiber Void Retainers

Fiber void retainers shall be installed, continuously, on both sides of fiber voids placed under grade beams in order to retain the cavity after the fiber voids biodegrade.

## 3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

## 3.3 COATING

Forms for Class A and Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

## 3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has

attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb: In any 3 m of length ----- 6 mm
  - a. In the lines and Maximum for entire length ----- 25 mm surfaces of columns, piers, walls and in arises
  - b. For exposed corner In any 6 m of length ----- 6 mm columns, control-joint grooves, and other Maximum for entire length 13 mm conspicuous lines
2. Variation from the In any 3 m of length ----- 6 mm level or from the In any bay or in any 6mm of grades indicated on length-----10mm the drawings:
  - a. In slab soffits, Maximum for entire length - 20 mm ceilings beam soffits, and in arises, measured before removal of supporting shores
  - b. In exposed lintels, In any bay or in any 6 m of sills, parapets, length ----- 6 mm horizontal grooves, Maximum for entire length ----- 13 mm and other conspicuous lines
3. Variation of the In any 6 m ----- 13 mm linear building Maximum ----- 25 mm lines from established position in plan
4. Variation of distance 6 mm per 3 m of distance, but between walls, columns, not more than 13 mm in any one partitions bay, and not more than 25 mm total variation
5. Variation in the sizes Minus -----6mm and locations of Plus ---13mm sleeves, floor openings, and wall opening
6. Variation in Minus ---6 mm cross-sectional Plus ----13 mm dimensions of columns and beams and in the thickness of slabs and walls
7. Footings:
  - a. Variation of Minus ----- 13 mm dimensions in Plus ----- 50 mm plan when formed or plus 75 mm when placed against unformed excavation
  - b. Misplacement of 2 percent of the footing width eccentricity in the direction of misplacement but not more than ----- 50 mm.
  - c. Reduction in Minus ----- 5 percent thickness of specified thickness

- 8. Variation in steps: Riser ----- 3 mm
  - a. In a flight of Tread -----6 mm stairs
  - b. In consecutive Riser ----- 2 mm steps  
Tread ----- 3 mm

TABLE 1

TOLERANCES FOR FORMED SURFACES

- 1. Variations from the In any 10 feet of plumb: length ----- 6mm
  - a. In the lines and Maximum for entire surfaces of columns, length ----25mm  
Piers, walls and in arises
  - b. For exposed corner In any 20 feet of columns, control-joint length --- 6mm  
grooves, and other Maximum for entire conspicuous lines length----- 13mm
- 2. Variation from the In any 10 feet of level or from the length----- mm grades  
Indicated In any bay or in any 20 on the drawings: feet of length----- 10mm
  - a. In slab soffits, Maximum for entire ceilings, beam soffits, length -----19mm  
and in arises, measured before removal of supporting shores
  - b. In exposed lintels, In any bay or in any 20 feet of sills, parapets, length 6mm  
horizontal grooves, Maximum for entire and other conspicuous length-----  
13mm lines
- 3. Variation of the linear In any (6.0m) ----- 13mm building lines from Maximum --25mm  
established position in plan
- 4. Variation of distance 6mm per 3m (1/4 inch per 10 feet) of distance, between walls,  
columns, but not more than 13mm (1/2 inch) in any partitions one bay, and not more  
than 25mm (1inch) total variation
- 5. Variation in the Minus ----- 6mm sizes and locations Plus ----- 13mm of  
sleeves, floor openings, and wall opening
- 6. Variation in Minus ---- 6mm cross-sectional Plus ----13mm dimensions of columns and  
beams and in the thickness of slabs and walls
- 7. Footings:
  - a. Variation of dimensions Minus ----- 13mm in plan Plus ----- 50mm  
when formed or plus 75mm when placed against unformed excavation
  - b. Misplacement of 2 percent of the footing eccentricity width in the direction of  
misplacement but not more than 2 inches
  - c. Reduction in thickness Minus ----- 5 percent of specified thickness
- 8. Variation in steps: Riser ----- 3mm
  - a. In a flight of stairs Tread ----- 6mm
  - b. In consecutive steps Riser ----- 2mm  
Tread ----- 3mm

## SECTION 9

### STRUCTURAL STEEL

#### **PART 1 – GENERAL**

##### *1.9 SCOPE OF WORK*

The Work includes providing all labor, materials, equipment and incidentals necessary to furnish and install all structural steel items including bearing plates and miscellaneous shapes and plates required for proper erection of structural materials as shown on the Drawings.

##### *1.10 RELATED SECTIONS*

Other sections of the Specifications shall also apply to the extent required for proper performance of this Work.

Section 33014	Miscellaneous Metals
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Section 33015	Painting
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##### *1.11 SPECIFICATIONS AND STANDARDS*

Except as otherwise indicated, the current editions of the following Standards apply to the WORK of this Section:

ASTM A36	Carbon Structural Steel
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ASTM A325	Structural Bolts, Steel, Heat Treated, 120/105 Ksi Minimum Tensile Strength
-----------	-----------------------------------------------------------------------------

ISO 261	ISO General Purpose Metric Screw Threads - General Plan
---------	---------------------------------------------------------

AWS A5.1	Mild Steel Covered Arc-Welding Electrodes
----------	-------------------------------------------

AWS D1.4	Structural Welding Code – Reinforcing Steel
----------	---------------------------------------------

ACI 315	Details and Detailing of Concrete Reinforcement
---------	-------------------------------------------------

ACI 318	Building Code Requirements for Reinforced Concrete
---------	----------------------------------------------------

##### *1.12 SUBMITTALS*

D. Detailed shop drawings of all structural steel items.

E. Samples as required by the applicable Reference Standards.

### 1.13 QUALITY ASSURANCE

The Contractor is responsible for the performance of all tests and inspection required by this Standard Specification. However, the owner reserves the right to perform any or all prescribed tests and inspection where such is deemed necessary to ensure that delivered materials conform to the specifications, and shall be paid for by the Contractor. The Contractor shall furnish the owner certified copies of records showing that each material has been pre-tested, and complied with all applicable requirements of this Standard. The Contractor shall, at his own expense, replace all rejected materials for failure to comply with this Specification.

## PART 2 – PRODUCTS

### 2.2 MATERIALS

- A. Structural shapes, plates and bars unless otherwise noted shall conform to the requirements of ASTM A36.
- B. Welding rods shall conform to AWS A5.1.
- C. High strength steel bolts shall conform to ASTM A325.

## PART 3 - EXECUTION

### 3.1 FABRICATION AND ERECTION

- A. Details of concrete reinforcement steel for fabrication and erection shall conform to ACI 315, unless otherwise specified.

All members shall fit closely together and shall be straight and true; the finished work shall be free from burrs, bends, twists and open joints.

Materials for welding shall be the best available as recommended by the manufacturer of the materials to be welded, and in accordance with AWS Standards.

- B. All holes, angles, supports, and braces shall be provided as required. Any unmatched holes in shop assembly of field connections shall be reamed and the pieces match marked before disassembly.

Drift pins shall be used only for bringing members into position and not to enlarge or distort holes.

Any piece weakened by reaming to compensate for eccentricity to a point where the strength of the joint is impaired will be rejected and a new and satisfactory piece shall be provided by the Contractor at his own expense.

Slotted holes and washers shall be provided for truing-up steel requiring accurate alignment.

- C. Anchor bolts shall be accurately located on the base plates and welded in position.

### 3.2 *FIELD CONNECTIONS*

Base plates where required shall be accurately placed in position.

Field connections shall be made by welding or high strength bolting.

### 3.3 *WELDING*

Welding of parts shall be in accordance with the Structural Welding Code D1.1 of the AWS and shall only be done by welders certified as to their ability to perform welding in accordance with the locally accepted requirements.

The Contractor may substitute field bolting where field welding is shown, provided bolting details have been approved by the Engineer.

### 3.4 *BOLTING*

High-strength bolts shall conform to ASTM A325.

Anchor bolts shall be of mild steel with hexagonal nuts. Threads shall be clean cut and conform to ISO 261. Anchor bolts shall be hot-dip galvanized and shall be accurately set before the concrete is poured unless specifically permitted otherwise by the Engineer. To facilitate the setting of anchor bolts, the Contractor shall use screed plates, or may substitute wooden templates instead of screed plates upon written approval of the Engineer.

Anchor bolts with pipe sleeves shall be in accordance with the details shown on the Drawings.

### 3.5 *PAINTING*

#### **A. Shop Painting**

All structural steel shall be shop primed in accordance with Section 33035 after fabrication and cleaning.

All steelwork shall be thoroughly cleaned of all loose mill scale, rust, and foreign matter before shop painting.

Each individual piece shall be painted before assembly. Paint shall be applied only to dry surfaces.

Edges where field welding is required shall not be painted.

#### **B. Field Painting**

After erection, the Contractor shall thoroughly prepare and clean the structural steel surfaces of all dirt, grease, rust or other foreign matter. The entire surface of all steel members shall be field painted.

## **SECTION 10**

### **WELDING, STRUCTURAL**

#### *PART 1 GENERAL*

##### *1.1 DEFINITIONS*

Definitions of welding terms are in accordance with AWS A3.0M/A3.0. The following classifications Class 1 (highest class) to Class 6 (lowest class) indicate the project's class(es) of weld joints.

##### *1.1.1 Class 1 Weld Joints*

This covers complete penetration weld joints only. These weld joints apply where failure would cause a loss of the system and/or be hazardous to personnel. Class 1 weld joints are highly stressed (dynamic and cyclic loading) and characterized as a single point of failure with no redundancy for the redistribution of stress into another member.

##### *1.1.2 Class 2 Weld Joints*

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would reduce the overall efficiency of a system but loss of the system or a hazard to personnel would not be experienced.

##### *1.1.3 Class 3 Weld Joints*

This covers both complete and partial penetration groove weld joints and fillet weld joints. These weld joints apply where failure would not affect the efficiency of a system nor create a hazard to personnel. Class 3 weld joints are connections of secondary members not subject to dynamic action and/or low stressed miscellaneous applications.

##### *1.1.4 Class 4 Weld Joints*

This covers weld joints applicable to welding reinforcing steel to primary structural members.

##### *1.1.5 Class 5 Weld Joints*

This covers weld joints applicable to welding concrete reinforcing steel splices (prestressing steel excepted), steel connection devices, and inserts and anchors required in concrete construction.

##### *1.1.6 Class 6 Weld Joints*

This covers plug and slot weld joints as applicable to the requirements of the project's code(s).

##### *1.2 SYSTEM DESCRIPTION*

Conform the design of welded connections to AISC 360, unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Perform welding as specified in this section, except where additional requirements are shown on the drawings or are

specified in other sections. Do not commence welding until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Perform all testing at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

#### 1.2.1 Pre-erection Conference

Hold a pre-erection conference prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using pre-qualified procedures). Mandatory attendance is required by all Contractor's welding production and inspection personnel and appropriate Government personnel. Include as items for discussion: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

#### 1.2.2 Mock-up Model

Perform first the field-welded connection designated as the mock-up model on the drawings. All welders, qualified and designated to perform field-welded groove joints, shall be present during the welding of the mock-up model connections and each one shall perform a part of the welding. Simulate with the mock-up test all physical and environmental conditions that will be encountered during the welding of all groove joints. Execute all inspection procedures required for groove welded joints, including NDE tests, on the mock-up model. All Contractor inspection and testing personnel designated to perform QC of groove welded joints shall be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection represents the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these groove welded joints.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

#### 1.3.1 Product Data

- Welding Procedure Qualifications
- Welder, Welding Operator Qualification
- Inspector Qualification
- Pre-qualified Procedures

#### 1.3.2 Test Reports

- Quality Control
- Nondestructive Examination



### 1.3.3 Certificates

Certified Welding Procedure Specifications (WPS)  
Certified Brazing Procedure Specifications (BPS)  
Certified Procedure Qualification Records (PQR)  
Certified Welder Performance Qualifications (WPQ)  
Certified Brazer Performance Qualifications (BPQ)

## 1.4 QUALITY ASSURANCE

Except for pre-qualified (in accordance with AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Conform welding procedure qualifications to AWS D1.1/D1.1M and to the specifications in this section. Submit for approval copies of the welding procedure specification and the results of the procedure qualification test records for each type of welding which requires procedure qualification and the welder, welding operator, or tacker qualification test records.. Approval of any procedure, however, does not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the specified requirements. Submit this information on the forms in Annex M of AWS D1.1/D1.1M. Individually identify and clearly reference on the detail drawings and erection drawings all welding procedure specifications, or suitably key them to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

### 1.4.1 General Requirements

To perform this work provide an organization certified in the following:

- a. For Structural Projects, provide documentation of the following:
  - (1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.
  - (2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.
  - (3) Reinforcing Steel: Qualification documents (WPS, PWR, and WPQ) in accordance with AWS D1.4/D1.4M.

### 1.4.2 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without re-qualification, upon receipt of the test results, if the following conditions are met:

- a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

### 1.4.3 Pre-qualified Procedures

Welding procedures which are considered pre-qualified as specified in AWS D1.1/D1.1M will be accepted without further qualification. Submit for approval a listing or an annotated drawing to indicate the joints not pre-qualified. Procedure qualification is mandatory for these joints.] [No pre-qualified welding procedures are allowed. Qualify the welding procedures and welders by tests prescribed in the applicable code or specification notwithstanding the fact the code or specification may allow pre-qualified procedures.

### 1.4.4 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, revise and re-qualify the procedure specification, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, submit all test results, including those of test welds that failed to meet the requirements, with the welding procedure.

### 1.4.5 Welder, Welding Operator, and Tacker Qualification

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

#### 1.4.5.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without re-qualification if all the following conditions are met:

- a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.
- b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

#### 1.4.5.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. State in the certification the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. Keep the certification current, on file, and furnish 3 copies.

#### 1.4.5.3 Renewal of Qualification

Re-qualification of a welder or welding operator is required under any of the following conditions:

- a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
- b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.
- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Submit as evidence of conformance all records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified.
- d. A tacker who passes the qualification test is considered eligible to perform tack welding indefinitely in the positions and with the processes for which he/she is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker is required to pass the prescribed tack welding test.

#### 1.4.6 Inspector Qualification

Inspector qualifications shall be in accordance with AWS D1.1/D1.1M. Qualify all nondestructive testing personnel in accordance with the requirements of ASNT SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

#### 1.4.7 Symbols and Safety

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated. Safe welding practices and safety precautions during welding shall conform to AWS Z49.1.

### *PART 2 PRODUCTS*

#### *2.1 WELDING EQUIPMENT AND MATERIALS*

Provide all welding equipment, electrodes, welding wire, and fluxes capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

### *PART 3 EXECUTION*

#### *3.1 WELDING OPERATIONS*

##### *3.1.1 Requirements*

Conform workmanship and techniques for welded construction to the requirements of AWS D1.1/D1.1M and AISC 360. When AWS D1.1/D1.1M and the AISC 360 specification conflict, the requirements of AWS D1.1/D1.1M govern.

##### *3.1.2 Identification*

Identify all welds in one of the following ways:

- a. Submit written records to indicate the location of welds made by each welder, welding operator, or tacker.
- b. Identify all work performed by each welder, welding operator, or tacker with an assigned number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. Place the identification mark for seam welds adjacent to the weld at 3 foot intervals. Identification with die stamps or electric etchers is not allowed.

### 3.2 *QUALITY CONTROL*

Perform testing using an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. Perform visual and ultrasonic inspections to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Conform procedures and techniques for inspection with applicable requirements of AWS D1.1/D1.1M. Submit a quality assurance plan and records of tests and inspections.

### 3.3 *STANDARDS OF ACCEPTANCE*

Conform dimensional tolerances for welded construction, details of welds, and quality of welds with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Perform nondestructive testing by visual inspection and ultrasonic. The minimum extent of nondestructive testing shall be random [60] percent of welds or joints, as indicated on the drawings.

#### 3.3.1 *Nondestructive Examination*

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

#### 3.3.2 *Destructive Tests*

Make all repairs when metallographic specimens are removed from any part of a structure. Employ only qualified welders or welding operators, and use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

### 3.4 *GOVERNMENT INSPECTION AND TESTING*

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

### 3.5 CORRECTIONS AND REPAIRS

If inspection or testing indicates defects in the weld joints, repair defective welds using a qualified welder or welding operator as applicable. Conduct corrections in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Repair all defects in accordance with the approved procedures. Repair defects discovered between passes before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, blend the affected area into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before re-welding, examine the area by suitable methods to ensure that the defect has been eliminated. Repaired welds shall meet the inspection requirements for the original welds. Any indication of a defect is regarded as a defect, unless re-evaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

-- End of Section --

## SECTION 11

### ROADWAYS AND PAVING

#### PART 1 – GENERAL

##### 1.1 SCOPE OF WORK

The Work includes furnishing all labor, materials, equipment and incidentals required to complete the concrete paved roadways, parking areas and gravel roadways as shown on the Drawings.

##### 1.2 SPECIFICATIONS AND STANDARDS

Except as otherwise indicated, the current editions of the following Standards apply to the WORK of this Section:

ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort
ASTM D1556	Density of Soil-in-Place by the Sand Cone Method
ASTM D1557	Laboratory Compaction Characteristics of Soil Using Modified Effort

##### 1.3 SUBMITTALS

- F. Detailed working drawings and schedules of all reinforcement.
- G. Samples as required by the applicable Reference Standards.

##### 1.4 QUALITY ASSURANCE

The Contractor is responsible for the performance of all tests and inspection required by this Standard Specification. However, the Owner reserves the right to perform any or all prescribed tests and inspection where such is deemed necessary to ensure that delivered materials conform to the specifications, and shall be paid for by the Contractor. The Contractor shall furnish the Owner certified copies of records showing that each material has been pre-tested, and complied with all applicable requirements of this Standard. The Contractor shall, at his own expense, replace all rejected materials for failure to comply with this Specification.

#### PART 2 – PRODUCTS

##### 2.1 MATERIALS

###### A. Gravel Base Material

1. These materials shall be used for gravel sub-base and gravel base for pavements and other locations indicated on the Drawings.

2. Sub-base and base course materials shall be graded crushed rock or granular material free of organic material, loam, wood, trash, and other objectionable material and shall be well-graded within the following limits:

Maximum Size, mm	Percentage by Weight Passing	
	Sub-base	Base Course
75 (3")	100	-
38 (1 1/2")	30-70	-
19 (3/4")	0-12	100
10 (3/8")	0-5	7-25

- B. Gravel surfacing material shall be clean and free from organic matter and other deleterious substances, and shall be such nature that in can be compacted readily with watering and rolling to form firm stable layer. At least 80% of the material retained on a 4.75 mm (No. 4) sieve shall have at least one fractured face.

The materials shall comply to the following grading requirements:

US Standard Sieve		Percent Passing by Weight
19 mm	( 3/4 - in )	85 – 100
4.5 mm	( 3/8 – in )	60 – 100
4.75 mm	( No. 4 )	50 – 85
2.0 mm	( No. 10 )	40 – 70
0.425 mm	( No. 40 )	25 – 45
0.075 mm	( No. 200 )	10 – 25

- C. Concrete shall meet the requirements for structural concrete specified in Section 33008.
- D. Reinforcement, where required, shall meet the requirements of Section 4.
- E. Joint sealer shall be as specified in Section 33011.

### *PART 3 – EXECUTION*

#### *3.1 INSTALLATION*

##### *A. SUBGRADE PREPARATION*

1. Following clearing, grubbing and stripping of topsoil, specified under Section 33001, the subgrade shall be prepared by sprinkling and rolling with a steel roller until the subgrade is compacted to 90 per cent of optimum density obtained from ASTM D698.
2. Areas in cut shall be filled with common fill to the grades shown on the Drawings and as specified.
3. Where existing subgrade materials have been disturbed, or are in the opinion of the Engineer unsuitable for subgrade, the materials shall be removed and replaced with common fill and shall be compacted in accordance with the requirements of Section 2.

#### *B. GRAVEL SUBBASE AND BASE MATERIALS*

Subbase and base course materials shall be placed as shown on the Drawings and compacted to 95% of modified proctor density (ASTM D1557, Method C).

#### *C. CONCRETE PAVEMENT*

1. Concrete pavement shall be poured in one course to the limits specified on the Drawings. Slabs shall be constructed in checkerboard order. Concrete curbs shall be installed as shown on the Drawings.
2. Concrete shall be so deposited and spread that segregation will not occur, and a uniform layer of concrete with thickness of approximately 20mm greater than that required for the finished pavement shall be produced.
3. To prevent the introduction of earth and other foreign materials into the concrete, concerned workers shall confine their movements to the area already covered with fresh concrete.

Whenever it become necessary for these men to step out of the concrete, their footwear shall be washed or thoroughly cleansed before returning to the concrete.

During the operation of striking off concrete, a uniform ridge of concrete at least 70mm in depth shall be maintained ahead of the strike-off screed for its entire length. Except when making a construction joint, the finishing shall not proceed beyond that point where this surplus can be maintained in front of the strike-off screed.

4. After the first operation of finishing, additional concrete shall be added to all low places and honeycombed spots and the concrete rescreeded. In any rescreeding, a uniform head of concrete shall be maintained ahead of the strike-off for its entire length. Honeycombed spots shall not be eliminated by tamping or grouting.
5. Workers on the job shall have mobile footbridges at their disposal so that they need not walk on the wet concrete.
6. In conjunction with the placing and spreading, the concrete shall be thoroughly spaded and vibrated along the forms, bulkheads, and joints.
7. The internal vibrators shall be of pneumatic, gas-driven, or electric type, and shall operate at frequency of not less than 3,200 pulsation per minute.



8. Whenever the placing of concrete is stopped or suspended for any reason, for a period of 30 minutes or longer, a suitable bulkhead shall be placed so as to produce a vertical transverse joint.

If an emergency stop occurs within 2.5 meters of a contraction or an expansion joint, the concrete shall be removed back to the joint. When placing of concrete is resumed, the bulkhead shall be removed; new concrete shall be placed and vibrated evenly and solidly against the face of previously deposited concrete.

Any concrete in excess of the amount needed to complete a given section, or that has been deposited outside the forms, shall not be used in the Work.

9. The Contractor must provide suitable equipment for protecting the fresh concrete in case of rain, such as screens which will cause the rainwater to run off beyond the edges of the paving, rainproof tarpaulins or other methods approved by the Engineer. The equipment must be sufficient to shelter from rain an area equal to that paved in two hours of work.
10. After the final pass of finishing is in place, and when the concrete has started to dry, the surface of the pavement shall be finally finished with an approved longitudinal float. The float may be operated either manually or by mechanical means. The float may be of either wood or metal, shall be straight and smooth, and light in weight so as not to displace or sink into the concrete surface.

To be effective, the float shall be at least 300mm wide and 3 meters long. When manually operated, the float shall be moved from edge to edge with a wiping motion and advance 1 meter or more. The succeeding trip shall overlap the previous trip. A light smoothing lute at least 3 meters long may be used when approved by the Engineer.

11. Before final belting, the surface of the pavement shall be tested by the Contractor with an approved standard straight-edge 3 meters in length. Irregularities so detected shall be corrected immediately.

Special attention must be given to the concrete adjacent to transverse joints to insure that the edges thereof are not above the grade specified, or the adjacent concrete below grade. All depressions or projections discovered shall be corrected before any initial set has developed in the concrete.

12. After the concrete has been brought to the required grade, contour, and smoothness, it shall be finished by passing over the concrete a drag of one or two burlap cloths, to give the surface the required roughness. The vehicle used to carry these cloths may be independent of the concrete-laying machine or may be incorporated with it, and may be operated either by hand or mechanically.
13. As soon as the concrete has attained its initial set, the edges of the pavement, longitudinal joints, construction, dummy and expansion joints not sawn shall be carefully finished with an edging tool having a radius of at least 5 millimeters.

The tools, the special accessories for cutting impressed joints, and the methods of workmanship shall be such as will produce a joint whose edges are of the same quality of concrete as the other portions of the pavement.

Methods and workmanship which make use of excess mortar or grout in this area shall not be allowed. Unnecessary tool marks shall be eliminated during construction and the edges left smooth and true to line.

14. Forms shall remain in place at least 12 hours after the concrete has been placed. Any damage to concrete resulting from form removal shall be repaired promptly by the Contractor as directed by the Engineer without additional payment.
15. Curing of concrete shall be in accordance with Section 5.
16. Joints shall be as detailed on the Drawings. All joints shall be filled with a rubber joint sealer as specified in Section 33011.
17. Concrete pavement shall not be opened to traffic for 10 days or as directed by the Engineer.

*D. GRAVEL ROADWAYS*

Following preparation of subgrade and placement of the gravel subbase, the gravel surfacing shall be placed as shown on the Drawings and compacted as required for structural fill as specified in Section 3.

# **PROPOSED ACADEMIC BUILDING II/MULTI-PURPOSE GYMNASIUM**

Recommending : -  
Approval

Approved By : -

Location : -

## **TECHNICAL SPECIFICATIONS FOR ELECTRICAL WORKS**

Submitted by:

**MANUEL V. PANIS**

Professional Electrical Engineer

REG. NO. : 1210

TIN : 132 – 466 - 222

PTR. NO. : 7731829

DATE : 01 – 04 - 2021

PLACE ISSUED : ANTIPOLO CITY

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## **SECTION 26 00 00 ELECTRICAL GENERAL REQUIREMENTS**

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### **PART 1 - GENERAL**

#### **1.1 GENERAL DESCRIPTION:**

- A. The work to be done under this division of the specification consists of the fabrication, furnishing, delivery and installation, complete in all details of the electrical system, at the project premises and all work materials incidental to the proper completion of the other. All work shall be in accordance with the governing Codes and Regulations and with the specifications, except those were same shall conflict with such Codes, etc., which latter shall then govern. The requirements with regards to materials and workmanship, specify the required standard for furnishing of all labour, materials, and appliances necessary for complete installations are intended to provide a broad outline of the required equipment, and are not intended to include all details of design and construction.

#### **1.2 SITE OF WORK**

The work shall be located at BRGY. RIZAL ODIONGAN, ROMBLON.

#### **1.3 SCOPE OF WORK**

- A. Under this section of specifications, provide all labour, materials and equipment and perform all the work necessary for the complete execution of all the Electrical System as shown on Electrical Drawings. Scope of work shall include but not limited to the following principal items of work:
1. Furnish and install service lateral conduits including Power Utility, PLDT and other auxiliary system service boxes, pull boxes, concrete pads, encasements and manholes/handholes of incoming Power Utility & PLDT service lines related supports, concrete inserts, concreting and civil works.
  2. Furnish and install complete wiring and conduit system for lighting and power including feeder cables, branch circuits, contactors, transient voltage surge suppressions, outlets and taps.
  3. Furnish and install all lighting fixtures, wiring devices, junction/pull boxes, wiring gutters and wiring supports necessary for the complete electrical system.
  4. Furnish and installation of electrical equipment, including meter centers, busbar gutters, breaker gutters, disconnect switches, circuit breakers, ATS, low voltage switchgears and panelboards.
  5. Furnish and install power supply for motor wiring and conduits, up to overcurrent device only.
  6. Furnish and install a complete grounding (equipment and system) that will comply with the plans and PEC requirement.
  7. Furnish and install complete Telephone and Data System to include devices, conduits, wires, MDF, MTC, TTC cabinet, cable trays, terminal blocks, grounding and necessary accessories.
  8. Furnish and install conduits, wirings, boxes and supports for Fire Detection and Alarm System, CCTV and PABGM Systems.
  9. Furnish and install Fire Detection and Alarm System, CCTV and PABGM Systems equipment for complete operation of the mentioned communications and auxiliary systems.
  10. Painting of all exposed electrical conduits, enclosures and equipment.
  11. Perform all termination of Electrical Power and Telephone Systems.

12. Complete testing and commissioning of Electrical and Communications, including all auxiliary systems.
13. Storage and handling of Owner Supplied materials and equipment that were properly turned-over to this contract.
14. Installation of Owner Supplied materials and equipment.
15. Supply and installation of all pertinent paraphernalia to complete the installation and proper operations of Owner Supplied materials and equipment.
16. Preparation of all As-built plans and submittal.
17. The contractor shall provide GI pull wires of appropriate size for empty conduits and/or conduits to be used by specialty contractors.
18. The owner has the option to supply the Contractor some of the major materials (OSM) and equipment and same shall be installed by Contractor.
19. All other items necessary for the completion of Electrical and Auxiliary systems.
20. If anything has been omitted on any item of work or materials, usually furnished, which are necessary for the completion of the electrical work as outlined herein before, then such items shall be and hereby included in this Division of the Work.
21. Supply of generator set including Low Voltage Switchgear, Main Distribution Panel, etc.

#### **1.4 WORK NOT INCLUDED**

- A. The following are not included in the scope of work and will be done by others:
  1. Supply and installation of Power Utility Metering instruments such as C.T., relays for metering.

END OF SECTION 26 00 00

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**SECTION 26 05 00 COMMON WORK RESULTS FOR ELECTRICAL**

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**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, the following section of Division 26 and Division 1 Specification Sections, apply to this Section.
  - 1. 26 05 48 – Vibration Control for Electrical Systems
  - 2. 26 05 33 – Raceway and Boxes for Electrical Systems
  - 3. 26 05 19 – Low Voltage Electrical Power Conductors and Cables
  - 4. 26 28 16 – Enclosed Switches and Circuit Breakers
  - 5. 26 24 16 – Panelboards

**1.2 SUMMARY**

- A. This section includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Sleeve seals.
  - 4. Grout.
  - 5. Common electrical installation requirements.

**1.3 DEFINITIONS**

- A. EPDM: Ethylene-propylene-dieneter polymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

**1.4 SUBMITTALS**

- A. Product Data: For sleeve seals.

**1.5 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames." D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section 078413 "Penetration Firestopping".

## **PART 2 – PRODUCTS**

### **2.1 SLEEVES FOR RACEWAYS AND CABLES**

- A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - 1.1 For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    - 1.2 For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

### **2.2 SLEEVE SEALS**

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
  - 1. Sealing Elements: EPDM, NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
  - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

### **2.3 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

## **PART 3 – EXECUTION**

### **3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. 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.
- E. Right of Way: Give to piping systems installed at a required slope.



### **3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 7 Section 07900 "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 7 Section 07841 "Through-Penetration Firestop Systems."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### **3.3 SLEEVE-SEAL INSTALLATION**

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.4 FIRESTOPPING**

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section 07841 "Through-Penetration Firestop Systems."

END OF SECTION 26 05 00

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**SECTION 26 05 19 LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

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**PART 1 - GENERAL**

**1.1 GENERAL DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

**1.2 SUMMARY**

- A. This section includes:
  - 1. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

**1.3 DEFINITIONS**

- A. VFC: Variable frequency controller.

**1.4 SUBMITTALS**

- A. Product Data: For each type of cable.
- B. Shop Drawings:
  - 1. Submit sufficient information to demonstrate compliance with drawings and specifications.
  - 2. Submit the following data for approval:
    - 2.1 Electrical ratings and insulation type for each conductor and cable.
    - 2.2 Splicing materials and pulling lubricant.
- C. Certifications:
  - 1. Qualification Data: For testing agency.
  - 2. Material Certificates: For each type of cable and accessory.
  - 3. Field quality-control reports.

**PART 2 – PRODUCTS**

**2.1 MANUFACTURERS**

- A. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

**2.2 SYSTEM DESCRIPTION**

- A. 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.
- B. Comply with NFPA 70.

## **2.3 CONDUCTORS AND CABLES**

- A. Cable shall be in accordance with ASTM, IEEE, NEC, PEC, NEMA and UL, and as shown on the drawings.
- B. Conductor: Copper.
- C. Single Conductor and Cables:
  - 1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
  - 2. No. 8 AWG and larger: Stranded.
  - 3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
  - 4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

## **2.4 CONNECTORS AND SPLICES**

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## **PART 3 – EXECUTION**

### **3.1 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders in Cable Tray: Type THHN-2-THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- H. Branch Circuits in Cable Tray: Type THHN-2-THWN-2, single conductors in raceway.
- I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

### **3.2 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

### **3.3 CONNECTIONS**

- A. 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 UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 300 mm of slack.

### **3.4 IDENTIFICATION**

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### **3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.6 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

### **3.2 FIELD QUALITY TEST**

- 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:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - 2.1 Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
    - 2.2 Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - 2.3 Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  
- D. Test and Inspection Reports: Prepare a written report to record the following:
  - 1. Procedures used.
  - 2. Results that comply with requirements.
  - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
  
- E. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 05 19

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**SECTION 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

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**PART 1 - GENERAL**

**1.1 GENERAL DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC and PEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

**1.2 SUMMARY**

- A. This section includes:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

**1.3 SUBMITTALS**

- A. Product Data: For each type of cable.
- B. Shop Drawings:
  - 1. Submit sufficient information to demonstrate compliance with drawings and specifications.
  - 2. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
- C. Certifications:
  - 1. Qualification Data: For testing agency and testing agency's field supervisor.
  - 2. Certification by the Contractor that the grounding equipment has been properly installed and tested.
  - 3. Field quality-control reports.
- D. As-built Data
  - 1. Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
    - 1.1 Test wells.
    - 1.2 Ground rods.
    - 1.3 Ground rings.
    - 1.4 Grounding arrangements and connections for separately derived systems.

## **PART 2 – PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. 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.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### **2.2 CONDUCTORS**

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 6 mm in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 41 mm wide and 1.6 mm thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 41 mm wide and 1.6 mm thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 6.3 by 100 mm in cross section, with 7.14-mm holes spaced 28 mm apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

### **2.3 CONNECTORS**

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless [compression] [exothermic]-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

### **2.4 GROUNDING ELECTRODES**

- A. Ground Rods: Copper-clad steel 19 mm by 3 m.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
- C. Termination: Factory-attached No. 1/0 AWG bare conductor at least 1200 mm long.
- D. Backfill Material: Electrode manufacturer's recommended material.



## **PART 3 – EXECUTION**

### **3.1 APPLICATIONS**

- A. Conductors: Install solid conductor for No. 8 > AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 1/0 AWG minimum.
  - 1. Bury at least 600 mm below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 300 mm above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 25 mm minimum from wall, 150 mm above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### **3.2 GROUNDING AT THE SERVICE**

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### **3.3 GROUNDING SEPARATELY DERIVED SYSTEMS**

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

### **3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS**

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 100 mm will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 50 mm above to 150 mm below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded,

hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 150 mm from the foundation.

### **3.5 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
  8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. Metallic Fences: Comply with requirements of IEEE C2.

### 3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 50 mm below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least twice of one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 300 mm deep, with cover.
  - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 18 m apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod, extending around the perimeter of building.
  - 1. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to building steel.
  - 2. Bury ground ring not less than 600 mm from building's foundation.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 6 m of bare copper conductor not smaller than No. 4 AWG.
  - 1. If concrete foundation is less than 6 m long, coil excess conductor within base of foundation.
  - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 6.0 m long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

### 3.7 FIELD QUALITY TEST

- 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:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
    - 3.1 Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - 3.2 Perform tests by fall-of-potential method according to IEEE 81.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Report measured ground resistances that exceed the following values:
- G. Cables will be considered defective if they do not pass tests and inspections.
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5 ohms.
  - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 5 ohms.

4. Power Distribution Units or Panelboards Serving Electronic Equipment: 5 ohms.
  5. Substations and Pad-Mounted Equipment: 5 ohms.
  6. Manhole Grounds: 5 ohms.
  7. Grounding network: less than 1 ohm.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

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**SECTION 26 05 29 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

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**PART 1 - GENERAL**

**1.1 GENERAL DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. "Grounding electrode system" refers to grounding electrode conductors and all electrodes required or allowed by NEC and PEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms "connect" and "bond" are used interchangeably in this section and have the same meaning.

**1.2 SUMMARY**

- A. This section includes:
  - 1. Underground distribution grounding.
  - 2. Ground bonding common with lightning protection system.
  - 3. Foundation steel electrodes.

**1.3 SUBMITTALS**

- A. Product Data: For each type of cable.
- B. Shop Drawings:
  - 1. Submit sufficient information to demonstrate compliance with drawings and specifications.
  - 2. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
- C. Certifications:
  - 1. Qualification Data: For testing agency and testing agency's field supervisor.
  - 2. Certification by the Contractor that the grounding equipment has been properly installed and tested.
  - 3. Field quality-control reports.
- D. As-built Data
  - 1. Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
    - 1.1 Test wells.
    - 1.2 Ground rods.
    - 1.3 Ground rings.
    - 1.4 Grounding arrangements and connections for separately derived systems.

## **PART 2 – PRODUCTS**

### **2.1 SYSTEM DESCRIPTION**

- A. 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.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

### **2.2 CONDUCTORS**

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 6 mm in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 41 mm wide and 1.6 mm thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 41 mm wide and 1.6 mm thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 6.3 by 100 mm in cross section, with 7.14-mm holes spaced 28 mm apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

### **2.3 CONNECTORS**

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless [compression] [exothermic]-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

### **2.4 GROUNDING ELECTRODES**

- A. Ground Rods: Copper-clad steel 19 mm by 3 m.
- B. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.
- C. Termination: Factory-attached No. 1/0 AWG bare conductor at least 1200 mm long.
- D. Backfill Material: Electrode manufacturer's recommended material.

## **PART 3 – EXECUTION**

### **3.1 APPLICATIONS**

- A. Conductors: Install solid conductor for No. 8 > AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 1/0 AWG minimum.
  - 1. Bury at least 600 mm below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 300 mm above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 25 mm minimum from wall, 150 mm above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### **3.2 GROUNDING AT THE SERVICE**

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### **3.3 GROUNDING SEPARATELY DERIVED SYSTEMS**

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

### **3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS**

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 100 mm will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 50 mm above to 150 mm below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded,



hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 150 mm from the foundation.

### **3.5 EQUIPMENT GROUNDING**

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
1. Feeders and branch circuits.
  2. Lighting circuits.
  3. Receptacle circuits.
  4. Single-phase motor and appliance branch circuits.
  5. Three-phase motor and appliance branch circuits.
  6. Flexible raceway runs.
  7. Armored and metal-clad cable runs.
  8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. Metallic Fences: Comply with requirements of IEEE C2.

### 3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 50 mm below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least twice of one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 300 mm deep, with cover.
  - 1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 18 m apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod, extending around the perimeter of building.
  - 1. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to building steel.
  - 2. Bury ground ring not less than 600 mm from building's foundation.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of 6 m of bare copper conductor not smaller than No. 4 AWG.
  - 1. If concrete foundation is less than 6 m long, coil excess conductor within base of foundation.
  - 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 6.0 m long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

### 3.7 FIELD QUALITY TEST

- 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:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.
    - 3.1 Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - 3.2 Perform tests by fall-of-potential method according to IEEE 81.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Report measured ground resistances that exceed the following values:
- G. Cables will be considered defective if they do not pass tests and inspections.
  - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5 ohms.
  - 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  - 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 5 ohms.

4. Power Distribution Units or Panelboards Serving Electronic Equipment: 5 ohms.
  5. Substations and Pad-Mounted Equipment: 5 ohms.
  6. Manhole Grounds: 5 ohms.
  7. Grounding network: less than 1 ohm.
- H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 29

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**SECTION 26 05 33 RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

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**PART 1 - GENERAL**

**1.1 GENERAL DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.

**1.2 SUMMARY**

- A. This section includes:
1. Metal conduits, tubing, and fittings.
  2. Nonmetal conduits, tubing, and fittings.
  3. Metal wireways and auxiliary gutters.
  4. Nonmetal wireways and auxiliary gutters.
  5. Surface raceways.
  6. Boxes, enclosures, and cabinets.
  7. Handholes and boxes for exterior underground cabling.

**1.3 DEFINITIONS**

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

**1.3 SUBMITTALS**

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings:
1. Size and location of main feeders.
  2. Size and location of panels and pull-boxes.
  3. Layout of required conduit penetrations through structural elements.
  4. Submit the following data for approval:
    - 4.1 Raceway types and sizes.
    - 4.2 Conduit bodies, connectors and fittings.
    - 4.3 Junction and pull boxes, types and sizes.
- C. Samples: For wireways, non-metallic wireways and surface raceways and for each color and texture specified, 300 mm long.
- D. Certifications:
1. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.

2. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.
  3. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
  4. Field quality-control reports.
- E. Coordination Drawings:
1. Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
    - 1.1 Structural members in paths of conduit groups with common supports.
    - 1.2 HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

## **PART 2 – PRODUCTS**

### **2.1 METAL CONDUITS, TUBING, AND FITTINGS**

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. ARC: Comply with ANSI C80.5 and UL 6A.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. PVC-Coated Steel Conduit: PVC-coated IMC.
  1. Comply with NEMA RN 1.
  2. Coating Thickness: 1 mm, minimum.
- F. EMT: Comply with ANSI C80.3 and UL 797.
- G. FMC: Comply with UL 1; zinc-coated steel.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  2. Fittings for EMT:
    - 2.1 Material: Steel or die cast.
    - 2.2 Type: Setscrew.
  3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
  4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## **2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS**

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ENT: Comply with NEMA TC 13 and UL 1653.
- C. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- D. LFNC: Comply with UL 1660.
- E. Rigid HDPE: Comply with UL 651A.
- F. Continuous HDPE: Comply with UL 651B.
- G. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.
- H. RTRC: Comply with UL 1684A and NEMA TC 14.
- I. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- J. Fittings for LFNC: Comply with UL 514B.
- K. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- L. Solvent cements and adhesive primers 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."

## **2.3 METAL WIREWAYS AND AUXILIARY GUTTERS**

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- C. Wireway Covers: Screw-cover type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

## **2.4 BOXES, ENCLOSURES, AND CABINETS**

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- E. Metal Floor Boxes:
  - 1. Material: Cast metal.
  - 2. Type: Semi-adjustable.
  - 3. Shape: Rectangular.
  - 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- F. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
  - 1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 23 kg. Outlet boxes designed for attachment of luminaires weighing more than 23 kg shall be listed and marked for the maximum allowable weight.
- H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 32 kg.
  - 1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.
- K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- L. Device Box Dimensions: 100 mm by 60 mm by 60 mm deep.
- M. Gangable boxes are allowed.
- N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Nonmetallic Enclosures: Plastic.
  - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- O. Cabinets:
  - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.



6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## **2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING**

- A. General Requirements for Handholes and Boxes:
  1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
  2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
  1. Standard: Comply with SCTE 77.
  2. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
  3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  5. Cover Legend: Molded lettering, "ELECTRIC."
  6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
  7. Handholes 300 mm Wide by 600 mm Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## **2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES**

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  1. Tests of materials shall be performed by an independent testing agency.
  2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## **PART 3 – EXECUTION**

### **3.1 PENETRATIONS**

- A. Cutting or Holes:
  1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the structural engineer/consultant/designer prior to drilling through structural elements.

### **3.2 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  1. Exposed Conduit: IMC.
  2. Concealed Conduit, Aboveground: IMC/EMT.

3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried/concrete encased.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
  5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed, Not Subject to Severe Physical Damage: EMT.
  3. Exposed and Subject to Severe Physical Damage: IMC. Raceway locations include the following:
    - 3.1 Loading dock.
    - 3.2 Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - 3.3 Mechanical rooms.
  4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  6. Damp or Wet Locations: IMC.
  7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 16-mm trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
  4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 49 deg C.

### **3.3 INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 150 mm away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 300 mm of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 300 mm of enclosures to which attached.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 27-mm trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 3-m intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 50 mm of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from ENT to IMC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 35mm trade size and insulated throat metal bushings on 41-mm trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

- Q. Cut conduit perpendicular to the length. For conduits 53-mm trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 90-kg tensile strength. Leave at least 300 mm of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
1. Install surface raceway with a minimum 50-mm radius control at bend points.
  2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 1200 mm and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service raceway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 17 deg C and that has straight-run length that exceeds 7.6 m. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 55 deg C and that has straight-run length that exceeds 30 m.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - 2.1 Outdoor Locations Not Exposed to Direct Sunlight: 70 deg C > temperature change.
    - 2.2 Outdoor Locations Exposed to Direct Sunlight: 86 deg C temperature change.
    - 2.3 Indoor Spaces Connected with Outdoors without Physical Separation: 70 deg C temperature change.
  3. Install fitting(s) that provide expansion and contraction for at 0.06 mm per meter of length of straight run per deg C of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.0115 mm per meter of length of straight run per deg C of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 1830 mm of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
  - 1. Use LFMC in damp or wet locations subject to severe physical damage.
  - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- EE. Set metal floor boxes level and flush with finished floor surface.
- FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### **3.4 INSTALLATION OF UNDERGROUND CONDUIT**

- A. Direct-Buried Conduit:
  - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 150 mm in nominal diameter.
  - 2. Install backfill as specified in Section 312000 "Earth Moving."
  - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 300 mm of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
  - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
  - 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
    - 5.1 Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 75 mm of concrete for a minimum of 300 mm on each side of the coupling.
    - 5.2 For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 1500 mm from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 300 mm above direct-buried conduits but a minimum of 150 mm below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### **3.5 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES**

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### **3.6 FIRESTOPPING**

- A. Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, "Firestopping".
- B. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### **3.7 PROTECTION**

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

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**SECTION 26 05 36 CABLE TRAY FOR ELECTRICAL SYSTEMS**

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**PART 1 - GENERAL**

**1.1 GENERAL DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of cable trays and accessories to form complete, coordinated, grounded cable tray systems.

**1.2 SUMMARY**

- A. This section includes:
1. Ladder cable trays.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
1. Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.
- C. Certifications:
1. Seismic Qualification Certificates: For cable trays, accessories, and components, from manufacturer.
  2. Field quality-control reports.
- D. Delegated-Design Submittal: For seismic restraints.
1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in the state where Project is located, who is responsible for their preparation.
  2. Design Calculations: Calculate requirements for selecting seismic restraints.
  3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.
- E. Coordination Drawings:
1. Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
    - 1.1 Include scaled cable tray layout and relationships between components and adjacent structural, electrical, and mechanical elements.
    - 1.2 Vertical and horizontal offsets and transitions.
    - 1.3 Clearances for access above and to side of cable trays.
    - 1.4 Vertical elevation of cable trays above the floor or below bottom of ceiling structure.

## **PART 2 – PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cable tray supports and seismic bracing.
- B. Seismic Performance: Cable trays and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  - 1. The term "withstand" means "cable trays will remain in place without separation of any parts when subjected to the seismic forces specified."
  - 2. Component Importance Factor: 1.5.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes in cable tray installed outdoors.
  - 1. Temperature Change: 67 deg C, ambient; 100 deg C, material surfaces.

### **2.2 GENERAL REQUIREMENTS FOR CABLE TRAYS**

- A. Cable Trays and Accessories: Identified as defined in NFPA 70 and marked for intended location, application, and grounding.
  - 1. Source Limitations: Obtain cable trays and components from single manufacturer.
- B. Sizes and Configurations: See the Cable Tray Schedule on Drawings for specific requirements for types, materials, sizes, and configurations.
- C. Structural Performance: See articles on individual cable tray types for specific values for the following parameters:
  - 1. Uniform Load Distribution: Capable of supporting a uniformly distributed load on the indicated support span when supported as a simple span and tested according to NEMA VE 1.
  - 2. Concentrated Load: A load applied at midpoint of span and centerline of tray.
  - 3. Load and Safety Factors: Applicable to both side rails and rung capacities.

### **2.3 LADDER CABLE TRAYS**

- A. Description:
  - 1. Configuration: Two I-beam side rails with transverse rungs welded to side rails.
  - 2. Rung Spacing: 225 mm on center.
  - 3. Radius-Fitting Rung Spacing: 225 mm at center of tray's width.
  - 4. Minimum Cable-Bearing Surface for Rungs: 22-mm width with radius edges.
  - 5. No portion of the rungs shall protrude below the bottom plane of side rails.
  - 6. Structural Performance of Each Rung: Capable of supporting a maximum cable load, with a safety factor of 1.5, plus a 90-kg concentrated load, when tested according to NEMA VE 1.
  - 7. Straight Section Lengths: 3 m except where shorter lengths are required to facilitate tray assembly.
  - 8. Width: 300 mm unless otherwise indicated on Drawings.
  - 9. Class Designation: Comply with NEMA VE 1, Class 20C.
  - 10. Splicing Assemblies: Bolted type using serrated flange locknuts.
  - 11. Hardware and Fasteners: Steel, zinc plated according to ASTM B 633.



12. Splice Plate Capacity: Splices located within support span shall not diminish rated loading capacity of cable tray.

## **2.4 MATERIALS AND FINISHES**

### **A. Steel:**

1. Straight Section and Fitting Side Rails and Rungs: Steel complies with the minimum mechanical properties of ASTM A 1011/A 1011M, SS, Grade 33.
2. Steel Tray Splice Plates: ASTM A 1011/A 1011M, HSLAS, Grade 50, Class 1.
3. Fasteners: Steel complies with the minimum mechanical properties of ASTM A 510/A 510M, Grade 1008.
4. Finish: Mill galvanized before fabrication.
  - 4.1 Standard: Comply with ASTM A 653/A 653M, Z275.
  - 4.2 Hardware: Galvanized, ASTM B 633.
5. Finish: Electrogalvanized before fabrication.
  - 5.1 Standard: Comply with ASTM B 633.
  - 5.2 Hardware: Galvanized, ASTM B 633.
6. Finish: Hot-dip galvanized after fabrication.
  - 6.1 Standard: Comply with ASTM A123/A123 M, Class B2.
  - 6.2 Hardware: Chromium-zinc plated, ASTM F 1136.
7. Finish: Powder-coat enamel paint.
  - 7.1 Powder-Coat Enamel: Cable tray manufacturer's recommended primer and corrosion-inhibiting treatment, with factory-applied powder-coat paint.
  - 7.2 Epoxy-Resin Prime Coat: Cold-curing epoxy primer, MPI# 101.
  - 7.3 Epoxy-Resin Topcoat: Epoxy, cold-cured, gloss, MPI# 77.
  - 7.4 Hardware: Chromium-zinc plated. ASTM F 1136.
8. Finish: Factory-standard primer, ready for field painting, with chromium-zinc-plated hardware according to ASTM F 1136.
9. Finish: Black oxide finish for support accessories and miscellaneous hardware according to ASTM D 769.

## **2.5 CABLE TRAY ACCESSORIES**

- A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.
- B. Covers: Solid type made of same materials and with same finishes as cable tray.
- C. Barrier Strips: Same materials and finishes as for cable tray.
- D. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

## **2.6 WARNING SIGNS**

- A. Lettering: 40-mm high, black letters on yellow background with legend "Warning! Not To Be Used as Walkway, Ladder, or Support for Ladders or Personnel."
- B. Comply with requirements for fasteners in Section 260553 "Identification for Electrical Systems."

## **PART 3 – EXECUTION**

### **3.1 CABLE TRAY INSTALLATION**

- A. Install cable trays according to NEMA VE 2.
- B. Install cable trays as a complete system, including fasteners, hold-down clips, support systems, barrier strips, adjustable horizontal and vertical splice plates, elbows, reducers, tees, crosses, cable dropouts, adapters, covers, and bonding.
- C. Install cable trays so that the tray is accessible for cable installation and all splices are accessible for inspection and adjustment.
- D. Remove burrs and sharp edges from cable trays.
- E. Join aluminum cable tray with splice plates; use four square-neck carriage bolts and locknuts.
- F. Fasten cable tray supports to building structure and install seismic restraints.
- G. Design fasteners and supports to carry cable tray, the cables, and a concentrated load of 90 kg. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems." Comply with seismic-restraint details according to Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- H. Place supports so that spans do not exceed maximum spans on schedules and provide clearances shown on Drawings. Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.
- I. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
- J. Support bus assembly to prevent twisting from eccentric loading.
- K. Install center-hung supports for single-rail trays designed for 60 versus 40 percent eccentric loading condition, with a safety factor of 3.
- L. Locate and install supports according to NEMA VE 2. Do not install more than one cable tray splice between supports.
- M. Make connections to equipment with flanged fittings fastened to cable trays and to equipment. Support cable trays independent of fittings. Do not carry weight of cable trays on equipment enclosure.
- N. Install expansion connectors where cable trays cross building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA VE 2. Space connectors and set gaps according to applicable standard.
- O. Make changes in direction and elevation using manufacturer's recommended fittings.
- P. Make cable tray connections using manufacturer's recommended fittings.
- Q. Seal penetrations through fire and smoke barriers. Comply with requirements in Section 078413 "Penetration Firestopping."

- R. Install capped metal sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.
- S. Install cable trays with enough workspace to permit access for installing cables.
- T. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.
- U. Install permanent covers, if used, after installing cable. Install cover clamps according to NEMA VE 2.
- V. Clamp covers on cable trays installed outdoors with heavy-duty clamps.
- W. Install warning signs in visible locations on or near cable trays after cable tray installation.

### **3.2 CABLE TRAY GROUNDING**

- A. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Cable trays with electrical power conductors shall be bonded together with splice plates listed for grounding purposes or with listed bonding jumpers.
- C. Cable trays with single-conductor power conductors shall be bonded together with a grounding conductor run in the tray along with the power conductors and bonded to the tray at 1800-mm intervals. The grounding conductor shall be sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors," and Article 392, "Cable Trays."
- D. When using epoxy- or powder-coat painted cable trays as a grounding conductor, completely remove coating at all splice contact points or ground connector attachment. After completing splice-to-grounding-bolt attachment, repair the coated surfaces with coating materials recommended by cable tray manufacturer.
- E. Bond cable trays to power source for cables contained within with bonding conductors sized according to NFPA 70, Article 250.122, "Size of Equipment Grounding Conductors."

### **3.3 CABLE INSTALLATION**

- A. Install cables only when each cable tray run has been completed and inspected.
- B. Fasten cables on horizontal runs with cable clamps or cable ties according to NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.
- C. Fasten cables on vertical runs to cable trays every 450 mm.
- D. Fasten and support cables that pass from one cable tray to another or drop from cable trays to equipment enclosures. Fasten cables to the cable tray at the point of exit and support cables independent of the enclosure. The cable length between cable trays or between cable tray and enclosure shall be no more than 1800 mm.
- E. Tie MI cables down every 900 mm where required to provide a 2-hour fire rating and every 1800 mm elsewhere.
- F. In existing construction, remove inactive or dead cables from cable trays.

### **3.4 CONNECTIONS**

- A. Remove paint from all connection points before making connections. Repair paint after the connections are completed.
- B. Connect raceways to cable trays according to requirements in NEMA VE 2 and NEMA FG 1.

### **3.5 FIELD QUALITY TEST**

- A. Perform the following tests and inspections:
  - 1. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements.
  - 2. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable trays, vibrations, and thermal expansion and contraction conditions, which may cause or have caused damage.
  - 3. Verify that the number, size, and voltage of cables in cable trays do not exceed that permitted by NFPA 70. Verify that communications or data-processing circuits are separated from power circuits by barriers or are installed in separate cable trays.
  - 4. Verify that there are no intruding items such as pipes, hangers, or other equipment in the cable tray.
  - 5. Remove dust deposits, industrial process materials, trash of any description, and any blockage of tray ventilation.
  - 6. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
  - 7. Check for improperly sized or installed bonding jumpers.
  - 8. Check for missing, incorrect, or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
  - 9. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable trays. Test entire cable tray system for continuity. Maximum allowable resistance is 1 ohm.
- B. Prepare test and inspection reports.

### **3.6 PROTECTION**

- A. Protect installed cable trays and cables.
  - 1. Install temporary protection for cables in open trays to safeguard exposed cables against falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials and shall remain in place until the risk of damage is over.
  - 2. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
  - 3. Repair damage to paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 26 05 36

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**SECTION 26 05 73    OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY**

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**PART 1 - GENERAL**

**1.1 GENERAL DESCRIPTION**

- A. This section specifies the overcurrent protective device coordination study, related calculations and analysis, indicated as the study in this section.
- B. A short-circuit and selective coordination study, and arc flash calculations and analysis shall be prepared for the electrical overcurrent devices to be installed under this project.
- C. The study shall present a well-coordinated time current analysis of each overcurrent protective device from the individual device up to the utility source and the on-site generator sources.

**1.2 SUMMARY**

- A. This section includes:
  - 1. Computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study.
  - 2. Coordination of series-rated devices is permitted where indicated on Drawings.

**1.3 SUBMITTALS**

- A. Product Data: For computer software program to be used for studies
  - 1. Software shall be in mainstream use in the industry, shall provide device settings and ratings, and shall show selective coordination by time-current drawings.
- B. Other Action Submittals:
  - 1. The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form.
    - 1.1 Coordination-study input data, including completed computer program input data sheets.
    - 1.2 Study and Equipment Evaluation Reports.
    - 1.3 Coordination-Study Report.
- C. Certifications:
  - 1. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

**PART 2 – PRODUCTS**

**2.1 COMPUTER SOFTWARE PROGRAM REQUIREMENTS**

- A. Comply with IEEE 399.

- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
  - 1.1 Optional Features:
    - 1.1a Arcing faults.
    - 1.1b Simultaneous faults.
    - 1.1c Explicit negative sequence.
    - 1.1d Mutual coupling in zero sequence.

## **PART 3 – EXECUTION**

### **3.1 EXAMINATION**

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
  - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

### **3.2 POWER SYSTEM DATA**

- A. Gather and tabulate the following input data to support coordination study:
  - 1. Product Data for overcurrent protective devices specified in other electrical Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  - 2. Impedance of utility service entrance.
  - 3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
    - 3.1 Circuit-breaker and fuse-current ratings and types.
    - 3.2 Relays and associated power and current transformer ratings and ratios.
    - 3.3 Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    - 3.4 Generator kilovolt amperes, size, voltage, and source impedance.
    - 3.5 Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    - 3.6 Busway ampacity and impedance.
    - 3.7 Motor horsepower and code letter designation according to NEMA MG 1.
  - 4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
    - 4.1 Special load considerations, including starting inrush currents and frequent starting and stopping.
    - 4.2 Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    - 4.3 Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

- 4.4 Generator thermal-damage curve.
- 4.5 Ratings, types, and settings of utility company's overcurrent protective devices.
- 4.6 Special overcurrent protective device settings or types stipulated by utility company.
- 4.7 Time-current-characteristic curves of devices indicated to be coordinated.
- 4.8 Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- 4.9 Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- 4.10 Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

### **3.3 FAULT-CURRENT STUDY**

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
  1. Switchgear and switchboard bus.
  2. Medium-voltage controller.
  3. Motor-control center.
  4. Distribution panelboard.
  5. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 241 and IEEE 242.
  1. Transformers:
    - 1.1 ANSI C57.12.10.
    - 1.2 ANSI C57.12.22.
    - 1.3 ANSI C57.12.40.
    - 1.4 IEEE C57.12.00.
    - 1.5 IEEE C57.96.
  2. Medium-Voltage Circuit Breakers: IEEE C37.010.
  3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
  4. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
  1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
  2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
- F. Equipment Evaluation Report:
  1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

### 3.4 COORDINATION STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
  1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
  2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
  3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 241 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
  1. Device shall not operate in response to the following:
    - 1.1 Inrush current when first energized.
    - 1.2 Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - 1.3 Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.
- E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
  1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
    - 1.1 Device tag.
    - 1.2 Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
    - 1.3 Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
    - 1.4 Fuse-current rating and type.
    - 1.5 Ground-fault relay-pickup and time-delay settings.
  2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
    - 2.1 Device tag.
    - 2.2 Voltage and current ratio for curves.



- 2.3 Three-phase and single-phase damage points for each transformer.
- 2.4 No damage, melting, and clearing curves for fuses.
- 2.5 Cable damage curves.
- 2.6 Transformer inrush points.
- 2.7 Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective devices.

### **3.5 ADJUSTMENTS, SETTINGS, AND MODIFICATIONS**

- A. Final field settings and minor modifications of the overcurrent protective devices shall be made to conform with the study, without additional cost.

END OF SECTION 26 05 73

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**SECTION 26 24 16 PANELBOARDS**

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**PART 1 - GENERAL**

**1.1 GENERAL DESCRIPTION**

- A. This section specifies the furnishing, installation, and connection of panelboards.

**1.2 SUMMARY**

- A. This section includes:
1. Distribution panelboards.
  2. Lighting and appliance branch-circuit panelboards.
  3. Load centers.
  4. Electronic-grade panelboards.

**1.3 SUBMITTALS**

- A. Product Data:
1. For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings:
1. For each panelboard and related equipment, submit sufficient information to demonstrate compliance with drawings and specifications.
  2. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  3. Detail enclosure types and details for types other than NEMA 250, Type 1.
  4. Detail bus configuration, current, and voltage ratings.
  5. Short-circuit current rating of panelboards and overcurrent protective devices.
  6. Include evidence of NRTL listing for series rating of installed devices.
  7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
  8. Include wiring diagrams for power, signal, and control wiring.
  9. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
- C. Certifications:
1. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
  2. A. Qualification Data: For qualified testing agency.
- D. Field Quality-Control Reports:
1. Test procedures used.
  2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," 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 that allows adjustments.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NECA 407 or NEMA PB 1.

#### **1.5 PROJECT CONDITIONS**

- A. Environmental Limitations:
  1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
  2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
    - 2.1 Ambient Temperature: Not exceeding minus 5 deg C to plus 40 deg C.
    - 2.2 Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  1. Ambient temperatures within limits specified.
  2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
  1. Notify Construction Manager/Owner no fewer than two days in advance of proposed interruption of electric service.
  2. Do not proceed with interruption of electric service without Construction Manager/Owner's written permission.
  3. Comply with NFPA 70E.

#### **1.6 COORDINATION**

- A. 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, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

## 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 – PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush and surface-mounted cabinets.
1. Rated for environmental conditions at installed location.
    - 1.1 Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - 1.2 Outdoor Locations: NEMA 250, Type 3R.
    - 1.3 Kitchen/Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
    - 1.4 Other Wet or Damp Indoor Locations: NEMA 250, Type 4>.
    - 1.5 Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
  2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
  4. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  5. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  6. Finishes:
    - 6.1 Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - 6.2 Back Boxes: Same finish as panels and trim.
    - 6.3 Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.
  7. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top or Bottom.
- D. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
  5. Split Bus: Vertical buses divided into individual vertical sections.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Main and Neutral Lugs: Mechanical type.
  3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.
- I. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

## **2.2 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
1. 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."

## **2.3 DISTRIBUTION PANELBOARDS**

- A. Panelboards: NEMA PB 1, power and feeder distribution type.
- B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 914 mm high, provide two latches, keyed alike.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- F. Branch Overcurrent Protective Devices: Fused switches.
- G. Contactors in Main Bus: NEMA ICS 2, Class A, electrically or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 230-V branch circuit, 24-V control circuit.

#### **2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit breaker.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Contactors in Main Bus: NEMA ICS 2, Class A, electrically or mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
  1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
  2. External Control-Power Source: 230-V branch circuit, 24-V control circuit.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

#### **2.5 LOAD CENTERS**

- A. Load Centers: Comply with UL 67.
- B. Mains: Circuit breaker.
- C. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- D. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

#### **2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES**

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with to meet available fault currents.
  1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
  3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
    - 3.1 Instantaneous trip.
    - 3.2 Long- and short-time pickup levels.
    - 3.3 Long- and short-time time adjustments.
    - 3.4 Ground-fault pickup level, time delay, and I<sup>2</sup>t response.
  4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
  6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
  7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
  8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    - 8.1 Standard frame sizes, trip ratings, and number of poles.
    - 8.2 Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
    - 8.3 Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
    - 8.4 Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    - 8.5 Communication Capability: Circuit-breaker-mounted, Universal-mounted, Integral or Din-rail-mounted communication module with functions and features compatible with power monitoring and control system specified in Section 260913 "Electrical Power Monitoring and Control."
    - 8.6 Shunt Trip: 230-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
    - 8.7 Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
    - 8.8 Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
    - 8.9 Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
    - 8.10 Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
    - 8.11 Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
    - 8.12 Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
    - 8.13 Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
    - 8.14 Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
  2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.
  3. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

## 2.7 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## **PART 3 – EXECUTION**

### **3.1 EXAMINATION**

- A. Receive, inspect, handle, and store panelboards according to NECA 407 or NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install panelboards and accessories according to NECA 407 or NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 100-mm nominal thickness. Comply with requirements for concrete base specified in [Section 033000 "Cast-in-Place Concrete."
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 450-mm centers around full perimeter of base.
  - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
  - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim 2286 mm above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- G. Install overcurrent protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.
- I. Stub four 27-GRC empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 27-GRC empty conduits into raised floor space or below slab not on grade.
- J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- K. Comply with NECA 1.



### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY TEST

- 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 inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- E. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - 3.1 Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - 3.2 Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
    - 3.3 Instruments and Equipment:
      - 3.3a Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- F. Panelboards will be considered defective if they do not pass tests and inspections.

- G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### **3.5 ADJUSTING**

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573 "Overcurrent Protective Device Coordination Study."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
  - 1. Measure as directed during period of normal system loading.
  - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### **3.6 PROTECTION**

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

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**SECTION 26 27 26 WIRING DEVICES**

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**PART 1 - GENERAL**

**1.1 GENERAL DESCRIPTION**

- A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

**1.2 SUMMARY**

- A. This section includes:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Twist-locking receptacles.
  - 3. Weather-resistant receptacles.
  - 4. Wall-switch and exterior occupancy sensors.
  - 5. Communications outlets.
  - 6. Pendant cord-connector devices.
  - 7. Cord and plug sets.
  - 8. Floor service outlets, poke-through assemblies, service poles, and multi-outlet assemblies

**1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Submit sufficient information to demonstrate compliance with drawings and specifications.
  - 2. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field Quality-Control Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.

3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

## **PART 2 – PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

### **2.2 GENERAL WIRING-DEVICE REQUIREMENTS**

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:
  1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
  2. Devices shall comply with the requirements in this Section.

### **2.3 STRAIGHT-BLADE RECEPTACLES**

- A. Convenience Receptacles, 230 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

### **2.4 GFCI RECEPTACLES**

- A. General Description:
  1. Straight blade, feed-through type.
  2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
  3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 230 V, 15 A:

### **2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES**

- A. Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

### **2.6 TWIST-LOCKING RECEPTACLES**

- A. Single Convenience Receptacles, 230 V, 15 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

### **2.7 PENDANT CORD-CONNECTOR DEVICES**

- A. Description:
  1. Matching, locking-type plug and receptacle body connector.

2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

## **2.8 CORD AND PLUG SETS**

### **A. Description:**

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## **2.9 TOGGLE SWITCHES**

### **A. Comply with NEMA WD 1, UL 20, and FS W-S-896.**

### **B. Switches, 230 V, 15 A:**

1. Products: Refer to Part 2.1 (Manufacturers) for the list of the approved manufacturers for the following devices:
  - 1.1 Single Pole.
  - 1.2 Two Pole.
  - 1.3 Three-Way
  - 1.4 Four-Way.

### **C. Pilot-Light Switches, 20 A:**

1. Products: Refer to Part 2.1 (Manufacturers) for the list of the approved manufacturers.
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

## **2.10 WALL-BOX DIMMERS**

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider, toggle switch or rotary knob; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
  1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "off."
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

### **2.11 WALL PLATES**

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: Smooth, high-impact.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

### **2.12 FLOOR SERVICE FITTINGS**

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular with satin finish.
- D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Section 271500 "Communications Horizontal Cabling."

### **2.13 POKE-THROUGH ASSEMBLIES**

- A. Description:
  - 1. Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
  - 2. Comply with UL 514 scrub water exclusion requirements.
  - 3. Service-Outlet Assembly: Flush type with two simplex receptacles and space for two RJ-45 jacks complying with requirements in Section 271500 "Communications Horizontal Cabling."
  - 4. Size: Selected to fit nominal 100-mm cored holes in floor and matched to floor thickness.
  - 5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
  - 6. Closure Plug: Arranged to close unused 100-mm cored openings and reestablish fire rating of floor.
  - 7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables that comply with requirements in Section 271500 "Communications Horizontal Cabling."

### **2.14 PREFABRICATED MULTIOUTLET ASSEMBLIES**

- A. Description:
  - 1. Two-piece surface metal raceway, with factory-wired multi-outlet harness.
  - 2. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish or PVC whichever is applicable.

C. Multioutlet Harness:

1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
2. Receptacle Spacing: 150 mm.
3. Wiring: No. 12 AWG solid, Type THHN copper.

## 2.15 SERVICE POLES

A. Description:

1. Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
2. Poles: Nominal 65-mm square cross section, with height adequate to extend from floor to at least 150 mm above ceiling, and with separate channels for power wiring and voice and data communication cabling.
3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
4. Finishes: Manufacturer's standard painted finish and trim combination.
5. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, four-pair, Category 3 or Category 5 voice and data communication cables.
6. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.
7. Voice and Data Communication Outlets: Two RJ-45 jacks complying with requirements in Section 271500 "Communications Horizontal Cabling."

## 2.16 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: Orange.

B. Wall Plate Color: For plastic covers, match device color.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - 4.1 Cut back and pigtail, or replace all damaged conductors.
  - 4.2 Straighten conductors that remain and remove corrosion and foreign matter.
  - 4.3 Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install horizontally mounted receptacles with the ground pin to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.



### **3.2 GFCI RECEPTACLES**

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### **3.3 IDENTIFICATION**

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes

### **3.4 FIELD QUALITY TEST**

- A. Perform the following tests and inspections:
  - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
  - 2. Test Instruments: Use instruments that comply with UL 1436.
  - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 115 g.
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

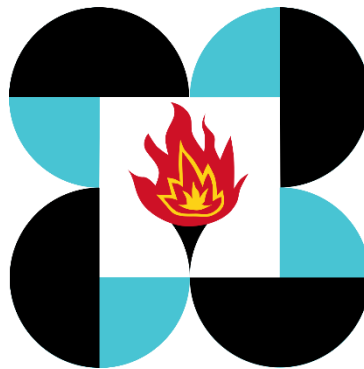
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# CONSULTING SERVICES FOR THE ARCHITECTURAL AND DETAILED ENGINEERING DESIGN FOR THE CONSTRUCTION OF MULTI-PURPOSE GYMNASIUM AND CONSTRUCTION OF ACADEMIC BUILDING II

PHILIPPINE SCIENCE HIGH SCHOOL – MIMAROPA REGION CAMPUS  
Barangay Rizal, Odiongan, Romblon

## *TECHNICAL SPECIFICATIONS PLUMBING AND SANITARY WORKS*

### CONTRACT DOCUMENTS



PREPARED BY:



IN JOINT  
VENTURE  
WITH



**VICTORIA P. ADECER  
SANITARY ENGINEER**

PRC No. : 1927  
PTR No. : 4580635  
DATE : January 7, 2021  
PLACE : Pasay City

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## TECHNICAL SPECIFICATIONS

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### PLUMBING & SANITARY WORKS

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#### GENERAL REQUIREMENTS

##### 1.01 GENERAL CONDITIONS

- A. The General Conditions form a part of these Specifications and Contract.
- B. The Sub-contractor for the Plumbing Works is designated as the Contractor in this Division.

C. Names of some suppliers were indicated herein for the reason that Approved Budget Cost for Plumbing & Sanitary Works were based from quotations from them. This is for the General Contractor to consider the prevailing market cost of the items quoted and avoid putting lower prices and later on will proposed to downgrade the materials.

##### 1.02 SCOPE OF WORK

A. Unless otherwise specified, the Contractor or his sub-contractor shall furnish all materials, tools, equipment, apparatus, appliances, accessories, transportation, labor and supervision required for the complete installation and testing of the Plumbing System ready for use in accordance with the best practice of the Plumbing Trade for the satisfactory completion of the works

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

1. The Plumbing Contractor is required to refer to all architectural, structural, mechanical, fire protection and electrical plans and investigate all possible interference and conditions affecting his work.

2. All work shall comply with the pertinent provisions of the Uniform Plumbing Code of the Philippines, the National Plumbing Code of the Philippines, the Code on Sanitation of the Philippines and/or the rules and regulations of concerned city or municipality.

3. Site Utilities of plumbing works, complete with appurtenances and accessories for the satisfactory completion of the system:

3.1 Supply and installation of main 40Ø ID (water meter and water service connection line up to the proposed underground cistern water tank including tapping of service connection from existing main water line stub-out at site.

3.2 Domestic waste and sewage collection system including construction and tapping to septic tank at natural grade level.

3.3 Exterior storm drainage system of the building including supply and installation of Drainage Pipe, Drainage Junction Box (DJB), Drainage Manhole (DMH) including construction of central oil interceptor and tapping of drainage line up to existing main public drainage line at site.

3.4 Waste drainage system of the building equipment and facilities including mechanical AHU, pumps, fan coil units (FCU), air conditioning units (ACU) and cistern up to the nearest storm drainage system at site.

#### 4. Interior Building Utilities

4.1 Cold water risers, Cold water distribution up to building plumbing fixtures unit including supply, installation and roughing-in of gate valves, cold water lines, risers, fittings, hangers, support trim and its accessories.

4.2 Sewer and vents system up to the connection point including supply, installation and roughing-in of floor drains (FD), floor/ ceiling cleanout, sewer and vent lines, p-traps, stacks, fittings, hangers, trims and its accessories.

4.3 Storm drainage system up to the connection point including supply, installation and roughing-in downspout, drainage lines, fittings, hangers, supports, trims and its accessories.

4.4 Waste drainage system of mechanical equipment up to connection point including supply, installation and roughing-in of ACU / FCU drains, waste lines, pipe insulations, waste stack, fittings, hangers, supports, trims and its accessories.

4.5 Installation of plumbing fixtures (water closets, urinal, shower, lavatory, etc.) refer to Architectural specifications.

5. Supply and installation of plumbing equipment complete with controller, breakers, starters, pressure switch and its appurtenances including trims and its accessories to complete the system of the following:

5.1 Constant pressure system complete with controllers. Accessories will include electrical wiring from pumps to motor controllers.

5.2 Start-up, testing and commissioning

6. Miscellaneous stainless steel metal works of the plumbing utilities and its appurtenances including, ladder rungs, sleeves, manhole cover, vents, drains trims and its accessories of the following:

6.1 Potable Water Tank - Domestic (On-Ground at Ground Floor for Gymnasium)

6.3 Septic Tank (Underground)

6.4 Elevated Water Tank - Domestic (On-Deck at Roof Deck for Academic)

7. Testing for leakages of all building drains, waste, sewer, venting system including pressure testing and disinfection of the water supply and distribution system also leak test and disinfection of rainwater storage tank.

8. Excavation, trenching and backfilling including provision of pipe sleeves and block-outs pipe line punches / cross through walls, beams and slabs provided with fire-stopping materials for the satisfactory completion of the works shall be included.

9. Miscellaneous items and other accessories required for the satisfactory completion of the plumbing works.

10. Securing and payments of all permits, licenses and bonds construction purposes as required.

11. Contingency to include furnishing of written one (1) year warranty on the plumbing system.

12. Preparation and submission of as-built drawings in producible sheets including two (2) white prints copies at no cost to the Owner(s).

13. Securing and payments of all contractor's taxes, VAT, etc.

### **1.02 WORK NOT INCLUDED**

A. All electrical power wirings, except that furnished as an integral part of factory assembled equipment except otherwise specified herein, shall be by Electrical Contractor.

B. Painting except as required by the Plumbing Code and as specified herein shall be by General Contractor.

### **1.03 NOTES ON DRAWINGS**

A. The Drawings show the general arrangement of all piping. However, where local and/or actual conditions at the jobsite necessitate a deviation or rearrangement, the Contractor shall prepare and submit the new arrangement / shop drawing for the Architect's / Engineers approval.

B. Small scale drawings do not possibly indicate all offset, fittings and other parts of the system required. The Contractor shall arrange such work accordingly, furnishing such fittings, traps valves and accessories as may be required to meet such conditions.

### **1.04 APPLICABLE SPECIFICATION CODES, ORDINANCES, PERMITS AND FEES**

A. The work covered in this contract it to be installed according to the specification codes, ordinances and requirement of the following:

1. Uniform Plumbing Code of the Philippines
2. National Plumbing Code of the Philippines
3. The Code on Sanitation of the Philippines
4. Rules and Ordinances of Concerned City or Municipality

C. All construction permits and fees required for the work shall be obtained by and at the expense of the contractor. The contractor shall furnish the Owner final certificates of inspection after the completion of the work.

### **1.05 WORKMANSHIP AND COORDINATION WITH TRADES**

A. All work shall be performed in first class and neat workmanship by mechanics skilled in their work shall be satisfactory to the Engineer.

B. The Plumbing Contractor is required to refer to the General Conditions and to all architectural, structural, electrical, mechanical and fire protection plans and specification.

### **1.06 PRODUCT**

#### **GENERAL**

1. Except as specified, the Contractor shall submit for the Engineers approval, four (4) copies of complete materials he proposes to use, within thirty (30) days after award of contract.
2. The Contractor shall assume the cost of and the entire responsibility for any change in the work as shown on contract drawings, which may be occasioned by approval of materials other than those specified.

#### **B. PIPES AND FITTINGS SCHEDULE**

1. **Cold Water Lines** – All water risers and main downfeed exposed at roof deck shall be shall be galvanized steel /or iron, (G.I.) pipe, Schedule 40 standard, conforming to ASTM A-53, with class 300 fittings, flanged connection for 65Ø and larger sizes for all joints connection. For 50Ø and below shall be Schedule 40 standard, conforming to ASTM A-120-69, with class 250 fittings, screwed / threaded for all joints connection,

### **PLUMBING & SANITARY SYSTEM**

"**SUPREME PIPES**" or approved equal brand. Fittings shall be malleable iron, conforming to ASTM-A197/A, 197M-87 or approved equal.

All Roughing-ins of toilets and lateral distribution lines shall be high density PPRC (Polypropylene Random Copolymer) PN16 Polypropylene pipe materials. Fittings shall be fusion weld type, imported conforming to German technology DIN 8077-8078 and ASTM 1281-93 similar to "**EMERALD**", "**GEBERIT**", "**ATLANTA**" or approved equal brand.

When buried underground, tapping from water lines from water main to building toilet /or supply line shall be galvanized iron (G.I.) pipe schedule 40 wrapped burlap or PPRC, standard conforming to ASTM-A-120-69 "**SUPREME**", brand or approved equal provided with corrosion protection "**DESBO**" brand and approved equal.

**For Pumps Piping Layout** – shall be galvanized steel /or iron, (G.I.) pipe, Schedule 40 standard, conforming to ASTM A-53, with class 300 fittings, flanged connection for 65Ø and larger sizes for all joints connection. For 50Ø and below shall be Schedule 40 standard, conforming to ASTM A-120-69, with class 250 fittings, screwed / threaded for all joints connection "**SUPREME PIPES**" or approved equal brand. Fittings shall be malleable iron, conforming to ASTM-A197/A, 197M-87 or approved equal.

**For Submerged pipe at water tank** – shall be stainless steel pipe (304), Schedule 40 standard, conforming to ASTM A-53, with class 300 fittings, flanged connection for 50Ø and larger sizes for all joints connection. For 50Ø and below shall be Schedule 40 standard, conforming to ASTM A-120-69, with class 250 fittings, screwed / threaded for all joints connection. Fittings shall be malleable iron, conforming to ASTM-A197/A, 197M-87.

2. **Sewer and Kitchen Waste Lines** – All stacks, main collector lines, laterals & branch sewer shall be unplasticized polyvinyl chloride pipes (uPVC) pipes s1000, conforming to DIN standards, "**EMERALD**", "**CROWN ASIA**", "**ATLANTA**" or approved equal brand. Pipes and fittings shall be through electro-welding connection.

3. **Vent Lines** – All stacks and branch vent Lines for sanitary sewer system shall be polyvinyl chloride pipes (PVC) series 1000 by "**EMERALD**", "**CROWN ASIA**", "**ATLANTA**" brand or approved equal.

4. **AHU/ACU/FCU Waste Lines** - All lateral & branch waste lines from 25 to 40 mmØ shall be polyvinyl chloride class 150 and 50 mmØ and larger, shall be unplasticized polyvinyl chloride pipes (uPVC) series 1000 by "**EMERALD**", "**CROWN ASIA**", "**ATLANTA**" brand or approved equal. All exposed FCU/AHU drains lines shall be provided with ½" thick elastomeric thermal insulation "**K-FLEX**" brand.

**6. Drainage Lines and Downspouts** - All lateral and branch drain / waste lines shall be unplasticized polyvinyl chloride pipes (uPVC) series 1000, conforming to DIN standards, "**EMERALD**", "**ATLANTA**" "**GEBERIT**" Brand. Pipes and fittings shall be through electrowelding connection.

All downspouts and main collector lines – shall be shall be unplasticized polyvinyl chloride pipes (uPVC) series 1000, conforming to DIN standards, "**EMERALD**", "**ATLANTA**" "**GEBERIT**" Brand. Pipes and fittings shall be through electro-welding connection.

Outside Building - shall be reinforced concrete drain pipe (RCDP), Tongue & groove, mortar joints reinforced for 300mmØ and larger locally manufactured.

## C. VALVES

1. **Gate Valve** - 50 mm and larger, shall be rising stem outside screw and yoke (OS & Y) flanged connection and shall be iron body with bronze trim, minimum of 200 psig working pressure. For 40 mm and smaller sizes, shall be rising stem /or non-rising stem inside screw female threaded and shall be bronze finished minimum of 200 psig working pressure. Approved brand shall be, "**HONEYWELL**", "**SIAM**", "**UNIVALVE**" or approved equal brand - by Amici, FISI or by other legit suppliers.

## PLUMBING & SANITARY SYSTEM

2. **Angle Valve Strainer** - strainer pattern shall be "Y" or angle strainer body and cover shall be cast iron, nuts and bolts shall be galvanized steel, basket and basket latch shall be stainless steel, body and plug O-Ring-Buna N or Piston "**Bermad AF 70F Strainer**" or approved equal brand - by Amici, FISI or by other legit suppliers.

#### D. OTHER MATERIALS

1. **Drains** – as indicated on drawings:
  - a. Roof Drain (RD) – Dome Type Strainer (Jaman)  
- "**JAMAN**" or approved equal brand - by JPI or by other legit suppliers.
  - b. Deck Drain (DD) Dome Type Strainer (Jaman)  
- "**JAMAN**" or approved equal brand - by JPI or by other legit suppliers.
  - c. Floor Drain @ Toilet and common area (FD)
  - d. Floor/Wall Cleanout (FCO/WCO)  
- "**JAMAN**" or approved equal brand - by JPI or by other legit suppliers.
  - e. Trench Drain (TD)  
- "**JAMAN**" or approved equal brand - by JPI or by other legit suppliers.
  - f. Trench Grating (design shall be approved by designer & end-user)  
- "**JAMAN**" or approved equal brand - by JPI or by other legit suppliers
  - g. Area Drain (AD)(300mm x 300mm)
5. **Water Meter** – (size indicated on plan) "**ARAD**", "**SAPPEL**", "**E-JET**" or approved equal for main meter. For sub-water meter "**ARAD**", "**E-JET**", "**SAPPEL**" or approved equal brand - by FISI or by other legit suppliers. Water meter should be BMS compatible, wireless & capable of transferring data for central reading.
6. **Hose Bibbs** – 20 mm standard hose connection, male tapered threads, polished chromium plated.

#### E. OUTDOORS UTILITIES APPURTENANCES:

1. **Drainage Junction Boxes** – 140 kg/cm<sup>3</sup> reinforced concrete with pre - cast reinforced concrete cover.
2. **Drainage Manhole** - 140 kg/cm<sup>3</sup> reinforced concrete with pre-cast reinforced concrete cover.
3. **Sewer Manhole** – 140 kg/cm<sup>3</sup> reinforced concrete with C.I. grating cover "**UNILEX**", "**JAMAN** or approved equal brand - by JPI or by other legit suppliers
4. **Street Inlet/Catch Basin** - 140 kg/cm<sup>3</sup> reinforced concrete with C.I. side inlet grating.
5. **Area Drain** - 140 kg/cm<sup>3</sup> reinforced concrete with C.I. grating cover model U 923 for traffic area and model U 822 for pedestrian area "**UNILEX**", "**JAMAN**" or approved equal brand - by JPI or by other legit suppliers
6. **Catch Basin** - 140 kg/cm<sup>3</sup> reinforced concrete with pre-cast reinforced concrete cover.
7. **Rainwater Tank** - 210 kg/cm<sup>3</sup> reinforced concrete with stainless steel access manhole cover.
8. **Thrust Blocks** - 140 kg/cm<sup>3</sup> plain concrete.

## **F. JOINTING / FITTINGS**

1. **Flanged Joint Gasket** – Garlock or equal.
2. **Screwed Joints** - U.S. Federal Specifications GG-P-251.
3. **PVC Pipes and Fittings** - PVC cement or as per the Manufacture’s recommendations.
4. **Polypropylene Random Copolymer Polypropylene Pipe** – fusion welded type.
5. **Polyethylene Composite Pipes** – compression type (push on type) brass coated fittings.
6. **Dissimilar Pipes** - Adaptor fittings shall be used.
7. **Concrete Drain Pipe** - Cement mortar.

### **1.07 IDENTIFICATION AND APPROVAL OF MATERIALS**

- A. Each length pipe, fittings, traps, fixtures and device used in the Plumbing System shall have cast, tamped or marked on it, the manufacturer’s trade mark or name, the weight, type and classes of product when so required by the Standard.
- B. Within thirty (30) days after award of the Contract, the Contractor shall submit for the Architect’s approval, the names of suppliers and materials proposed including trade names and/or samples of the materials if deemed necessary.
- C. Brand names mentioned in these Specifications are only for the purposes of indicating the desired quality and design.

### **1.08 SUBSTITUTION AND TESTING OF MATERIALS**

- A. Materials intended to be substituted for these originally specified shall be accepted only after a formal request for substitution, accompanied by:
  1. Reasons for substitutions.
  2. Certificate of test indicating quality, compared to those originally specified.
  3. Cost comparisons with material originally specified. Requests shall be submitted to the Architect for evaluation at least 15 working days.
- B. Cost of testing of materials, whether on originally specified items or on substitutions, shall be to the account of the Contractor.
- C. Results of tests shall be submitted to the Architect for evaluation at least 15 days before the material is due for installation on the Jobsite.

### **1.09 SEWER, WASTE, DRAIN AND VENT PIPES**

- A. GENERAL
  1. Underground sewer, waste and drain pipes and fittings shall be unplasticized polyvinyl chloride (uPVC) s1000 pipes, unless specifically noted. Soil and waste pipe above ground shall be unplasticized polyvinyl chloride pipes for laterals, stacks and main collector pipes. Waste pipes above ground shall be uPVC pipes. Fittings for soil and waste piping above ground shall be sleeve type coupling and gasket joints and uPVC fitting or as specified.
  2. All sewer, soil and drainage pipes shall be pitched 6 mm per 300 mm but in no case flatter than 3 mm per 300 mm.



**B. SUPPORTS**

1. Horizontal lines shall be supported by well secured length heavy duty strap hangers or floor chairs as required. Vertical lines shall be secured strongly by hooks to the building frame and a suitable bracket or chairs shall be provided at the floors from which they start.
2. PVC pipes in trenches under the ground shall be laid true to line and grade on a stable and suitably prepared foundation, each section of the pipe being properly bedded.
3. In soft ground liable to settlement, a gravel base 300 mm deep and twice the width of the pipe shall be rolled or tamped. Backfilling shall be carefully placed and tamped for the purpose, in such a manner that the pipe lines or connections are not disturbed.

**C. TRAPS**

1. Every plumbing fixture shall be separately trapped by a vented water sealed trap as close to the fixture outlets as the conditions allow, but in no case at a distance greater than 600 mm. In case of the upper or the only fixture on a soil extended full size through the roof, a vent shall not be required when said fixture has its center stack. Traps shall be of the same diameter as the waste pipes from the fixtures, which they shall serve, all traps shall have a water seal of at least 32 millimeters with a brass thumbscrew cleanout at the bottom of the seal.

**D. VENT**

1. Vent shall be taken from the crown of the fixtures, except for water closet traps, in which case, the branch line shall be vented below and trap and above all small waste inlets, so connected as to prevent obstructions. Each vent pipe shall be run separately above the fixtures into the adjacent soil pipes, a distance not more than 1.50 meters. If more than this distance, the vent shall run independently through the roof.
2. A vent line shall be wherever practicable, directs extension of a soil or waste line.
3. Main vent risers at 4.5 meters along or more shall be connected at the roof with the main water or soil pipes below the lowest vent outlet with a forty-five degree (45°) connection.
4. All vertical soil or vent pipes shall be carried up at least 600 mm above the roof of the building and the open side ends are to be entirely and securely covered with gals. 16 mesh copper cloth.
5. Vent pipes in roof spaces shall be run as close as possible to the underside of roof with horizontal piping pitched down to stacks without forming traps. Where an end or circuit vent pipe from fixtures it shall be connected into the main vent or vent stack.

**E. ROUGHING - IN**

1. Roughing - in for pipes and fixtures shall be carried along with the building construction. Correctly located openings of proper sizes shall be provided where required in the walls and floors for the passage of pipes all items to be embedded in concrete shall be thoroughly clean and free from all rust, scale and paint.

**F. FITTINGS**

1. All changes in pipes sizes on sewer, waste and drain lines shall be made with reducing fittings or reducers. All changes in direction shall be made by the appropriated use of forty-five degrees (45°) wyes, or long sweep bends, except that sanitary tees may be used on vertical stacks. Short quarter bends or elbows may be used in soil and waste lines where the change in direction is from the horizontal to the vertical and on the discharge from the water closet.

## **G. JOINTS AND CONNECTIONS**

1. All joints shall be air and water tight. For joining pipes, the following shall be used:
  - 1.1 Hub-less cast iron soil and waste pipes and fittings, sleeve coupling gasket joints. Bell and spigot shall be oakum and lead
  - 1.2 Galvanized wrought iron or steel pipe, screwed or threaded joints, use Teflon tape.
  - 1.3 Lead to cast iron pipes : Adaptor fittings, screwed and hubless coupling gasket joints.
  - 1.4 Concrete pipes : bell and spigot or tongue and groove.
  - 1.5 Polyvinyl chloride (PVC) pipes, socket type with PVC cement.
  - 1.6 Polypropylene pipes, fusion weld type.
  - 1.7 Cross-link composite aluminum pipe- compression type (push-on type) brass coated fittings.

### **1.11 WATER DISTRIBUTION SYSTEM**

#### **A. INSTALLATION**

1. The piping shall be extended to all fixtures, outlets and equipment from the gate valves installed in the branch near the riser.
2. Unions shall be provided where required for disconnection.
3. All pipes shall be cut accurately to measurements and shall be worked into place without springing or facing. Care shall be taken so as not to weaken the structural portions of the building.
4. All service pipes valves and fittings shall be kept at sufficient distance from work to permit finished covering not less than 15 mm from such work or from finished covering on the different service.
5. Changes in pipes shall be made with reducing fittings.
6. Accessible contraction-expansion joints shall be made wherein necessary. Horizontal runs of pipe over 15 m. in the length shall be anchored to wall or the supporting structure midway on the run to force expansion and contraction equally towards the ends.

#### **B. HOSE BIBBS**

1. All hose bibbs within offices, rentable spaces shall be 15mmØ with male tapered threads standard hose connection, polished chromium plated finished provided with escutcheon plate.
2. All hose bibbs general area (parking, planters, deck, etc.) shall be 20mmØ with male tapered threads standard hose connection brass finished.

#### **C. WATER DISTRIBUTION LINES**

1. Installation
  - a. The cold water piping system shall be pitched toward fixtures and riser for proper air relief. Provide drain cocks at low points for drainage system. Pitch line 25 mm x 7.6 m.
  - b. Horizontal runs of pipe 15 m in length shall be anchored to the supporting structure midway on the run to give allowances for equal expansion and contraction of pipes.

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- c. Unions and approved threaded connector shall be provided where required for connection and tapping for other types of cold water lines materials to main distribution lines and risers.

**1.12 EXCAVATION, PIPE LAYING AND BACKFILLING**

**A. EXCAVATION / TRENCHES**

- 1. Trenches for all underground pipe lines shall be excavated to the required depths and grades. Bell holes shall be provided so that pipe will rest on well-tamped solid ground for its entire length. Where rock is encountered, excavation shall extend to a depth 150 mm below the pipe bottom and other approved filling materials.

- 2. Materials

- a. Pipe Laying

Do not lay damaged or defective pipe. Laying of pipe shall proceed upgrade beginning at lower end of the pipeline. Pipe shall not laid in water or when the trench conditions or weather is unsuitable for such works. Remove water from trenches by sump pumping or other approved methods. Lay pipe to be established grade line. Orient perforations on the bottom half of the pipe. Lay bell and spigot or tongue and groove type pipe with the bell or groove end upstream. Obtain approval for pipe in place before backfilling.

- b. Jointing - Porous Concrete Pipes installed with mortar joints.

- c. Materials for backfilling shall be free of debris or big rocks. Backfill shall be placed in horizontal layers, properly moistened and compacted to an optimum density that will prevent excessive settlement and shrinkage.

**B. COMPACTION**

Compact each layer or lift of material specified so that the in-place density tested is not less than percentage of maximum density.

**TABLE I**  
**Percent ASTM D1557**  
**Maximum Density**

<b>FILL, EMBANKMENT and BACKFILL</b>	Cohesive Material	Cohesionless Material
General Fill and General backfill	85	90
Under sidewalks and grease areas	85	90
General Backfill and General Fill besides structures	90	95
Under Roadway, top 300 mm Sub-grade (Top of fill backfill or cut)	95	100
Under sidewalks to 300 mm	93	98

**C. CONCRETE PROTECTION**

All pipes laid and installed underground at 1.0 ft (300 mm) and below natural grade level shall be protected with Class B concrete casing, a minimum or 100 mm around the pipe perimeter and 250 mm below the finish grade.

**D. OPERATION (SITE GRADING)**

Grade to finish indicated within 30 mm grade areas to drain water away from structures and to provide suitable surfaces for moving machines. Existing grades which are to remain but are disturbed by the Contractor’s operation shall be restored as specified herein.

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### **1.13 MISCELLANEOUS**

#### **A. CLEANOUTS**

Cleanouts shall be of the same size as the pipe, the location of which is extended to an easily accessible place.

#### **B. TRAPS**

1. Every plumbing fixtures of equipment requiring connections to the drainage system shall be equipped with a trap.
2. Each trap shall be placed as near as possible to the fixture. No fixture shall be double - trapped.

#### **C. VALVES AND HOSE BIBBS**

1. Valves shall be provided on all water supplies to fixtures as specified.
2. Hose bibbs shall be made of brass with 15 mm male inlet thread hexagon shoulders and 20 mm connections.

#### **D. PIPE HANGERS INSERTS AND SUPPORTS**

1. Horizontal runs of pipe shall be hung with adjustable wrought iron or malleable iron pipe hangers spaced not over 3 m apart, except hub and spigot soil pipes which shall have hangers spaced not over 1.52 m apart and located near the hub.
2. Hangers shall have short turn buckles or other approved means of adjustment.
3. Inserts shall be of cast steel and shall be of type to received machine bolt or nut after installation.
4. Vertical runs of pipes shall be supported by wrought iron clamps or collars spaced not more than 9 m apart.
5. Water and Vent Pipes - 65 mm and larger; band type 6.4 mm x 25 mm flat mild steel or black iron with 15 mm round rod with plates and nuts; 50 mm and smaller split ring type with 10 mm iron rods with inserts plates; toggle bolts, clamps or expansion shield.

#### **E. PIPES SLEEVES**

1. Pipes sleeves shall be installed and properly secured in place at all points where pipes pass through masonry or concrete.
2. Pipe sleeves shall be of sufficient diameter to provide approximately 6.1 mm clearance around the pipe of insulation.
3. Pipe sleeves in walls and partitions shall be of cast iron, wrought iron or steel pipe. Pipes sleeves in concrete beams or concrete slabs shall be wrought iron or steel pipe.
4. Pipe sleeves on footings shall be cast iron or steel and shall be not less than 100 mm larger in diameter than the pipe to be installed.
5. Where pipes pass through waterproofing membrane, the sleeves shall be provided with an integral flange or clamping device to which a flashing shield can be soldered.
6. The space between the pipes and sleeves shall be made water tight by inserting and filling approved filler material and the remaining void space shall be provided with approved fire rated sealer /or fire stopping materials thoroughly.

## **1.14 FIRESTOPPING MATERIALS**

### **A. MATERIALS**

1. Firestop compounds and damming materials shall be UL listed and shall conform to the requirements of qualified designers or manufacturers approved modifications, as supported by engineering reports. Similar to "Metacaulk" or approved equal brand - by Amici, FISI or by other legit suppliers.
2. The penetration seal materials must be unaffected by moisture and must maintain the integrity of the wall or floor assembly for its rated time period when tested in accordance with ASTM E814 (UL 1479). The system shall be UL listed classified for up to and including 3 hours.
3. Fire stopping materials shall be asbestos and lead free and shall not incorporate oil and does not require the use of hazardous solvents.
4. All fire stopping materials shall be manufactured by one manufacturer throughout the completion of the project.
5. Do not proceed with installation of fire stop materials when temperatures exceeded the manufacturer recommendation limitations for installations.

### **B. PREPARATIONS**

1. Clean substrate of dirt, dust, grease, oil, loose materials, rust or other matter that may affect proper Fittings or adhesion of the fire-stopping materials.
2. Clean metal and glass surfaces with a non-alcohol solvent.

### **C. INSTALLATION**

1. Installation of fire-stops shall be performed by an applicator / installer qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detail installation procedures.
2. Apply fire-stops in accordance with fire test reports, fire resistance requirements, acceptable sample installation and manufacturer's recommendations.
3. Unless specified and approved all insulation used in conjunction with through penetrations shall remain intact and undamaged and may not be removed.
3. Seal holes and penetrations to ensure an effective smoke seal.
4. Within areas of high traffic, protect fire-stopping materials from damaged. If the opening is large, install fire-stopping materials capable of supporting the weight of a human load.
5. Insulation types specified in other sections shall not be installed in lieu of fire-stopping materials specified herein.
6. All combustible penetrants (e.g. non-metallic or insulated metallic pipes) shall be fire-stopping using products and system tested in a configuration representative of the field condition.
7. When required to properly contain fire-stopping materials within opening, damming or packing materials may be utilized. Combustible damming material must be move after appropriate curing. Non-combustible damming materials may be left as permanent components of the fire-stop system.

#### **D. CLEANING**

1. Remove spilled and excess materials adjacent to fire-stopping without damaging adjacent surface.
2. Leave finished work in neat, clean condition with no evidence of spill over or damage to adjacent surfaces.

#### **1.15 PLUMBING FIXTURES, FITTINGS, AND ACCESSORIES**

Refer to Architectural Specifications.

#### **1.16 PUMPS**

##### **A. GENERAL**

1. All equipment shall be supplied from reputable firms engaged in the manufacture of each particular item similar to "GRUNDFOS" "GOULDS" or approved equal brand - by Eastman or by other legit suppliers. The entire assembly as installed shall be given a start - up and test run to prove that all the specifications have been met before acceptance by the Owner. Before buying the pump to be used, it shall be first approved by the designer through a writer letter with attached pump curves and specifications. The test duration shall be 24 hours. Submittal of the Certificate of Test to the Owners shall be a condition of final payment.
2. The Specifications herein stated are basic guide only. Other items not so indicated but which are obviously necessary for the proper operation of system as intended shall be supplied in accordance with accepted engineering standards.
3. The equipment shall be guaranteed for a period of at least one (1) year of trouble free operation. The supplier of equipment shall certify to the availability of spare parts locally and service in case of system breakdowns within a period of at least three (3) years. Manuals of operation and maintenance & lists of spare parts shall be supplied together with the equipment. Submittal of Warranty Certificate shall be on condition to the final payment.
4. The supplier shall submit at least two (2) copies of pumps performances curves showing among others, the pump rating and pump efficiency, properly marked thereon.
5. Accessories to be supplied for each group shall include one non- slam type check valve, and two (2) gate valves, of size equal to the size of pump discharge and suction and rated minimum of 300 psig for transfer pump and 150 psig for booster pumps. Also, one pressure gauge for each set of pumps and pipe fittings necessary for complete installation shall be provided. The pressure gauge shall be 100 mm face diameter and shall be reading from 0 psi (or 0 kg/cm) to 100 psi (or 7 kg/cm).
6. Price quoted shall include cost delivery of all quoted items to the jobsite. Pump and motor installation dimension drawings shall be submitted together with the quotation.
7. The brands, names and place of manufacture of pump, motor, valves, controls & all accessories where applicable shall be indicated in the quotation. Also, a description of pump impellers being offered shall be included.
8. A metal nameplate indicating in indelible letters the correct specifications of the pump and motor shall be properly attached to the assembly at a location such that the information written thereon can be conveniently read by all concerned.

9. A separate price shall be quoted for installation work and preparation submittal of as installed drawings.

### **C. CONSTANT PRESSURE (BOOSTER) PUMPS**

1. Numbers of Units: Three Sets of Two (2) units Duplex Constant Pressure pumps.

- A. Constant Pressure System (CPS) System Requirements:

Booster Pump System 1 (For Academic Building)

Main Pump No. 1 : **80 GPM vs. 100 FT. TDH, 5.0 HP**

Main Pump No. 2 : **80 GPM vs. 100 FT. TDH, 5.0 HP**

Booster Pump System 2 (For Multi-Purpose Gymnasium)

Main Pump No. 1 : **80 GPM vs. 100 FT. TDH, 5.0 HP**

Main Pump No. 2 : **80 GPM vs. 100 FT. TDH, 5.0 HP**

2.Type of Pump: Duplex Type Horizontal Suction, Multi Stage Pump with stainless steel impeller, shaft and intermediate chamber, cast iron pump head and base, coupled to electric vertical motor.

3. Electric Motor Drive: shall be variable speed motor for variable frequency drive operation, 230 volts (verify EE consultant), 3-phase, 60 cycles.

4. Motor Controls:

There shall be factory wired and programmed UL labeled control panel with NEMA 4 enclosure. Components within the panel shall include; molded case circuit breaker per motor, magnetic starters with three-coil thermal overload protection, H-O-A switches, one control circuit protection thermal detection test button, control circuit relays, standby pumps relay, flow switch indicating light, pump failure light, duty pump reset & pump alternator components mounted in gauge, one suction-pressure gauge & two discharge pressure gauge. The relometer flow switch shall be factory mounted for approval prior to installation.

5. Operation:

The system lead pump is designed to operate continuously to furnish the system demand between flow zero and pumps designated lead capacity at the desired system pressure, a pressure switch shall automatically start the second pump. Whichever is operating shall share the system demand and shall remain in operation until the system demand drops below a point at which the lead pump alone can handle the flow. At this point an accurate relometer flow switch shall stop the bigger pump leaving the lead in operation to supply the system. Automatic means shall be furnished for alternating the second and the third.

The system shall be designed that should the main pump 1 fail to start for any reason, the second pump will automatically start. Should the demand exceed the capacity of the first pump (or second pump), the first pump (or second pump) through a pressure switch, shall automatically start and the second pumps shall share the system demand. And 100% system flow will supply pump shut off in reverse order. A warning light shall be furnished to indicate failure of the lead pump to start. The relometer flow switch furnished shall be calibrate in gallons per second and shall be field adjustable. A stainless steel orifice plate shall be furnished by the manufacturer as the primary flow switch element suitable for mounting between 300 lb. ASA flanges.

A 38 mm Auxiliary Control Valve shall be furnished with 250 lbs., ASA screwed connection for each pump. The pressure reducing and non-slam check type with adjustable flow control device for modulating valve action at flows; have a cast iron body with bronze trim; have a range adjustment suitable to the system and be present by the manufacturer for the desired system pressure.

A thermal sensing and thermal purge system detector shall be furnished to prevent overheating of the pump. The thermal purge mounting in the discharge line between the pumps and the control valve. Either temperature switch shall automatically open the purge valve at approximately 1000 F and purge the pump of all warm water. Upon sufficient pipe in temperature, the temperature switch shall be connected through the control and operation of the purge valve. The purge valve shall be screwed connections and designed for 400 volts, 60 hertz, A.C. operation.

The system shall also be furnished with an automatically start to provide water at constant pressure.

6. Accessories:

Vibration insulating hose connections at suction and discharge line, electrode type water level control or equal to prevent pumps from running dry.

**D. SUBMERSIBLE NON-CLOG DEWATERING SUMP PUMP FOR ELEVATOR PIT:**

1. Number of Units: One (1) unit for elevator pit.

2. Capacity: One unit of **25 GPM vs. 40 FT. TDH, 1.0 HP**

3. Types of Pump:

The pump and motor shall be submersible pump, complete with pump bowl assembly and riser pipes and to be installed inside the elevator pit and shall be settled for about the sump depth (subject to adjustment in the field) and suitable for pumping waste supply from sump and complete with controls and accessories.

4. Electric Motor Drive: **230** volts, **3**-Phase, **60** cycles, **1750** rpm, open drip proof. (Note: Subject to verification of the PEE Consultant/Designer)

5. Motor Controls:

Reduced wye delta voltage magnetic starter, H-O-A switches, overload relays, and alternators, soft start and stop. (Note: Subject to verification of the PEE Consultant/Designer)

6. Accessories:

Vibration insulation at pump base, flexible connector /or victaulic coupling, y-strainer, non-slam type with opening and closing speed controls check valves, diaphragm type surge pressure relief valves, hydraulically operated pressure sustaining valves, pressure gauges and gate valves at discharge lines, electrode type water level control at cistern or equal to prevent pumps from running dry and electrode type water level switch at elevated tank to pump's controller.

**1.17 WATER RESERVOIR**

**A. ON-GROUND & ELEVATED ONGROUND TANKS**

1. Specification and requirements

a. 100% USFDA Approved Food Grade Polyethylene Material with UV protection water storage tank, refer to Structural Consultant Engineer for reinforcement



details. Item is similar to "Potaglas" "Sekisui" or approved equal brand - by Amici, Bestank, FISI or by other legit suppliers

b. Furnish necessary piping and equipment and perform all labor required for the satisfactory completion of the system.

c. Total storage tank capacities;

Potable  
Water Tank: = **25600.00 L (Usable)**

Location: Roof Deck Level for Academic Building

Potable  
Water Tank: = **25600.00 L (Usable)**

Location: Ground Floor Level for Multi-Purpose Gymnasium

d. All structural design analysis shall conform to the latest Building Codes and National Structural Codes of the Philippines (NSCP) or refer to the Structural Consultant Engineer.

## 2. Piping, Fittings and Miscellaneous metal works

a. Furnish and install all pipes fittings, valves, specials, pipe supports, miscellaneous metal work and all required appurtenances. All materials installed shall be stainless steel unless otherwise noted and a product of a reputable Manufacturer all throughout the project and shall be installed as shown on the plans complete with its accessories for the satisfactory completion of the entire system.

b. All materials furnished and installed shall be new and guaranteed free from defect in design, materials and workmanship.

c. Adequate protective measures shall be provided to protect pipes, fittings, valves and all

d. Other materials from damage or injury during storage and installation.

## 8. Flanges, Gaskets and Bolts

a. Flanges shall be a product of a reputable Manufacturer all throughout the Project. Material shall be stainless steel and conform in dimensions and drilling to ASA B-16.1 Class 125.

b. Gaskets shall be a product of a reputable Manufacturer all throughout the project. Ring-type shall be by "JOHN MANSVILLE" or approved equal brand - by Amici, FISI or by other legit suppliers.

c. Bolts shall be standard square head machine bolts with heavy, hot, pressed hexagon nuts. Threads shall conform to ASA B-1.1, coarse thread series, Class 2 fit.

## 4. Manholes, Frames and Cover

a. All casting for manhole frames shall be a product of a reputable Manufacturer all throughout the Project. Material shall be stainless steel free from warps, cracks, holes, swells and cold shuts and approximately 3 mm thick.

b. All casting shall conform to the requirements of AWWA-D-100-67 or approved

5. Ladder Rungs

- a. Ladder Rungs shall be a product of a reputable Manufacturer's all throughout the project. Material shall be of 20 mm diameter round stainless steel bar mounted on the walls or as shown on drawings or as specified.

**B. ACCESSORIES**

1. Vent Pipe - On roof, bend downward with insect wire screen, stainless steel pipe, schedule 40.
2. Overflow and Drain Pipe - Stainless steel pipe, schedule 40 inside tank and to be connected to the nearest discharge pipe of the water tank or to be tap to building main drain line or downspout or refer to the plans /or drawings.
3. Liquid Level Controls - "B/W" Electrode type liquid level controls type or equal.
4. Water Level Indicator - To be at tank exterior side with marks printed on the exterior face of the tank.
5. Type of Pipe Connection - Screwed /or Flanged

**C. INSTALLATION**

1. All pipes shall be carefully placed and supported at the proper lines and grade where possible shall be sloped to permit complete draining.
2. Piping runs shown on Drawing shall be followed as closely as possible, except for minor adjustments to avoid adverse-effect on architectural and/or structural features. If major relocations are required, they shall be subjected to the approval of the Engineer/Designer.
3. Carefully inspect all pipe and fittings before installation. Inspection of pipe shall include light tapping with a hammer to detect cracks or defects. No pipe fittings or valves which are cracked or shown defects shall be used.
4. Piping shall be properly supported by suitable anchors, brackets, or hangers. Vertical pipes shall be anchored by suitable galvanized steel straps. Pipe supports shall be provided as shown on the Plans and whenever else necessary to prevent stain on joints or to facilitate taking down pipe.
5. Piping through the Walls - Where the pipe passes through walls, care shall be exercised to insure these joints are watertight.

**D. TEST FOR WATER**

1. Tightness of Completed Tank - The completed reinforced concrete ground and elevated water tanks shall be tested for water-tightness by filling it up with clean water after cleaning out all dirt and debris inside the tank. The water shall be allowed to stand for a minimum period of twenty four (24) hours reckoned from the time the free -board line was reached during filling up. After the 24 hours period there shall be no drop in water level in the tank more than 40 mm, otherwise, the leaks shall be located and plugged properly and test for water - tightness be repeated.

**E. DEFECTIVE WORK**

1. If the inspection or test shows any defect, such defective work or material shall be replaced and the test shall be repeated until satisfactory to the Owner.
2. All repairs to piping shall be made with new material at the expense of the Contractor.
3. No caulking of screwed joints of holes will be accepted.

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## **F. TEST CERTIFICATE**

Test Certificate shall be filled out and signed by the Owner's representative.

### **1.21 WATER METERS**

- A. Furnish and install where indicated on the drawings water meter as required. The main water meter and sub - water meters with sizes as shown on drawings, shall be B-METER brand authority approved or approved equal.

### **1.22 SITE PLUMBING UTILITIES**

#### **A. GENERAL**

1. The entire site plumbing utilities system shall be laid out and installed consistent throughout with the given slopes in the plans. Pipe joints and connections to area drains, catch basin and junction boxes shall possess such leak proof and seepage proof integrity achievable with the works called for under this particular section of the Specifications.
  2. Junction Boxes for storms and sanitary (sewer) drainage lines outside the building shall be cast-in place reinforced concrete sections and pre-cast concrete cover.
  3. Trench excavation and backfilling shall be as specified in excavation, trenching and backfilling for utility system.
4. Exterior Drainage Pipe
- a. Material: Pipe shall be unplasticized polyvinyl chloride pipes (uPVC) series 1000 conforming to DIN standards "EMERALD", "ATLANTA" "GEBERIT" or approved equal brand.
  - b. INSTALLATION:
    - 1) Bedding surfaces shall provide a firm foundation, carefully shaped through to line and grade.
    - 2) Concrete pipe shall be laid carefully with hubs up grade and ends carefully and closely joints. Joints shall be cement mortar. Cement mortar shall consist of one part Portland Cement and 1½ parts clean sharp sand with only enough water for work-ability for the cement before being placed and rammed. The joint shall be completely filled with cement mortar and rammed thoroughly with a wooden caulking tool. The joint shall then be overfilled and finished to a smooth level outside.

#### **B. EXCAVATION FOR STORM AND SANITARY (SEWER DRAINAGE SYSTEM)**

1. General: The Contractor shall do all excavation of whatever substances encountered below depth shown on drawings. Excavated materials not required for fill or backfill shall be removed of by the Contractor. Excavation for accessories to have 300 mm minimum and 60 mm maximum clearance in all side. Excavation shall not be carried below the required depth. Excess excavation below required level shall be backfilled at the Contractor's expense with earth, sand, gravel, or concrete, as directed by Engineer, and thoroughly tamped unstable soil shall be removed and replaced with gravel or crushed stone, which shall be thoroughly tamped.

The Engineer shall determine the depth of removal of unstable soil. Ground adjacent to all excavation shall be graded to prevent water running. The Contractor shall remove by pumping or other means approved by the Engineer any water accumulated in excavation and keep trench un-watered until the bedding is complete.

2. Trench Excavation: Banks of trenches shall be vertical. Soft materials shall be reported to the Engineer. In rock, excavation shall be carried 200 mm below bottom of pipe.

## **PLUMBING & SANITARY SYSTEM**

Loose earth or gravel shall be used for backfill, and tamped thoroughly and rounded to be received pipe as above.

3. Rock Excavation: Rock excavation shall include removal of boulders larger than ½ m<sup>3</sup> in volume and ledge rock concrete or masonry structures that required drilling in volume and ledge rock concrete.
4. Bracing and Shoring: The Contractor shall do all bracing sheathing and shoring necessary to perform and protect all excavation as indicated on the plans, as required for safety, as directed by the Engineer, or to conform to governing laws.

### **C. TESTING**

Test: Test for workmanship on utility lines shall be conducted in accordance with the applicable utility specification before backfilling.

### **D. BACKFILLING**

1. Backfilling: After pipes have been tested and approved, backfilling shall be done with approved material free for large clods or stones.
  - a. Trenches Backfill material; shall be placed evenly and carefully around and over pipe in 150 mm maximum layers. Each layer shall be thoroughly and carefully tamped until 300 mm of cover exists over pipe. The remainder of backfill material shall be placed, moistened and compacted. Water settling will not be permitted in clay soils. It may be required at the option of the Engineer in sandy soils.
  - b. Trench under areas to be paved; Material shall be placed in 200 mm maximum layer after filling 300 mm above pipe as previously described. Each layer shall be compacted to density equal to that of adjacent original material so that pavement can be placed immediately.
  - c. Structures; All forms, trash, and debris shall be removed and cleared away. Approved backfill material may be from excavation or borrow, it shall be free from rock, lumber or debris. Backfill material shall be placed symmetrically on all side in eight inch maximum layers. Each layer shall be moistened and compacted with mechanical or brand tampers. In area to be paved, each layer shall be compacted to density equal to that of adjacent materials so that pavement can be placed immediately.
2. Maintenance: The Contractor shall refill for settlement of all backfilled areas.
3. Clean-up: The Contractor shall clean-up and dispose of all excess materials, trash wood forms and other debris.

## **1.23 TESTING AND DISINFECTIONS**

### **A. DRAINAGE SYSTEM TEST**

1. The entire sewer, waste and storm drainage and venting systems shall have all necessary openings which can be plugged to permit the entire system to be filled with water to the level of the highest stack vent/or vent stack above the roof.
2. The system shall hold this water for a full sixty (60) minutes during which time there shall be no drop more than 100 mm.
3. Each section of pipeline shall be slowly be filled with water and the specified test pressure, measured at the point of lowest elevation shall be supplied by means of satisfactory to the Engineers. During the filling of the pipe in and before applying the test pressure, all air shall be expelled from the pipe line. To accomplish this type shall be made, if necessary, at point of highest elevation, and after completion of the test the taps shall be tightly plugged unless otherwise specified.

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During the test; all expose pipes, fittings, valves joints and couplings will be carefully examined. If found to be cracked or detective, they shall be removed and replaced by the contractor with sound materials at his own expense. The test shall be repeated until satisfactory results have been obtained.

#### B. PRESSURE TESTS FOR WATER LINES

1. After the pipe have been installed, the joints completed and with joints exposed for examination, all newly installed pipe or any valve section therefore, shall be subjected to hydrostatic pressure 1 ½ the designed working pressure of the system or as specified by the Engineer.
2. The duration of each pressure test shall be at least two (2) hours unless otherwise specified by the Engineer.
3. Each section of pipeline shall be slowly filled water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. During the filling of the pipe and before applying the test pressure, all air shall be expelled from the pipe line. To accomplish this type shall be made, if necessary, at point of highest elevation, and after completion of the test the taps shall be tightly plugged unless otherwise specified. During the test, all exposed pipes, fittings, valves, joints and couplings will be carefully examined. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound materials at his expense. The test shall then be repeated until satisfactory results are obtained.

#### C. DEFECTIVE WORK

1. If the inspection or test shows any defect, such defective work or material shall be replaced and the test shall be repeated until satisfactory to the Architect /or Engineer.
2. All repairs to piping shall be made with new material at the expense of the contractor.
3. No caulking of screwed joints of holes will be accepted.

#### D. DISINFECTION OF WATER DISTRIBUTION SYSTEM AND WATER TANKS (as per AWWA C-601)

1. The entire water system shall be thoroughly flushed and disinfected with chlorine before it is placed on operation. Water tanks shall be washed and swabbed.
2. Chlorination materials shall be liquid chlorine or hypochlorite, as specified and shall be introduced into the water line in a manner approved by the Engineer. Tanks shall be thoroughly cleaned of all debris, dirt or dust before swabbing.
3. The chlorine dosage shall be such as to provide not less than fifty parts per million (50 PPM) or available chlorine.
4. Following a contact period of not less than sixteen (16) hours, the heavily chlorinated water shall be flushed from the system with clean water until the residual chlorine content is not greater than two tenth (.20 PPM). All valves in water lines being sterilized shall be opened and closed several times during the sixteen (16) hour chlorinating period.

#### 1.24 CLEANING

- A. All exposed metal surface shall be free of grease dirt or other foreign materials.
- B. Chrome or nickel plated piping, fittings and trimmings shall be polished upon completion.

- C. All plumbing fixtures shall be properly protected from use and damage during the construction stage. The fixtures shall be cleaned to the satisfaction of the Architect /or Engineer upon completion and prior to acceptance of work.
- D. All equipment, pipes, valves and fittings shall be cleaned of grease and sludge which may have accumulated. Any clogging, discoloration or damage to other parts of the building due to the system shall be repaired by the Contractor.

**1.25 PAINTING AND PROTECTIONS**

- A. All exterior of piping to be installed in or through concrete floor fill or fill floors and underground shall be given one coat of acid resisting paint having a bituminous base.
- B. Pipe hanger supports and all other iron work in concealed spaces shall be painted with one coat of asphalt.
- C. Exposed galvanized iron pipes and fittings that are asphalt coated shall be given two coats of shellac prior to application of two coats of all paint as directed by the Architect of his authorized representative.

**1.26 COLOR CODE FOR EXPOSED PIPES**

- A. All exposed piping shall be adequately and durably identified by distinctive colored paints as follows:

<b>ITEM</b>	<b>COLOR CODE</b>
Cold Water Pipe	Blue
Storm Water Pipe	Aluminum
Sewage Pipe	Black
Vent Pipe	Green
Waste Pipe	Gray
FCU / AHU drain pipe	Gray w/ white band @ 1.0m O.C.

**1.27 WARRANTY AND "AS-BUILT" PLANS**

- A. All works, equipment and fixtures shall be guaranteed by the Contractor for satisfactory service for a minimum period for one (1) year.
- B. The Contractor shall submit to the Owner, in reproducible form plus three (3) sets of white prints, the complete plans of the entire system as actually built. The cost of those shall be borne by the Contractor. Submittal of "AS-BUILT" Plans shall be a condition to final payment.
- C. Equipment that should have the Owner (s) your minimum guaranteed against defective designs, materials and workmanship.

**1.28 RESPONSIBILITY**

- A. The Contractor shall provide temporary fire protection system during the construction period. This shall be of sufficient capacity to put any fire that may break out due to construction operations. This is in addition to temporary fire extinguisher required.
- B. The Contractor's shall identify and save the Owner, the Architect and the Consulting Engineer Harmless from and against all liabilities for damage to property occasioned by any or omission of this Contractor's on any of this Sub-contractors including any and all expenses, legal or otherwise which may be insured by the Owner, the Architect or the Consulting Engineer, in the defense of any claims, action or suits.
- C. The General Contractor shall be responsible for the coordination among the different trades on the jobsite in order to finish the Works in the least possible time, in strict compliance and in accordance with the Plans and Specifications.

- D. Throughout the construction period open ends of all installed drainage, sewer and vents lines, water lines and other related piping shall be kept closed by temporary plugs.
- E. All installed drainage, sewer and vents lines, water lines and other related piping shall not be used to conduct dirty construction wash water especially those with cement mixes to avoid possible clogging.
- F. A temporary potable water supply shall be made available to construction workers as construction progresses.
- G. A temporary human excreta disposal system shall be provided by the Contractor to serve the Workers during the construction period.

### **1.29 RELATED CODES/REFERENCES/STANDARDS**

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

#### **1.29.1 American National Standards Institute (ANSI)**

- ANSI A112.21.2M (1983) Roof Drains
- ANSI A112.36.2M (1991; R 1998) Cleanouts

#### **1.29.2 American Society of Mechanical Engineers (ASME)**

- ASME A112.18.1M (1996) Plumbing Fixture Fittings
- ASME A112.19.2M (1998) Vitreous China Plumbing Fixtures
- ASME A112.19.5 (1979; R 1998) Trim for Water-Closet Bowls, Tanks, and Urinals
- ASME A112.21.1M (1991; R 1998) Floor Drains
- ASME/ANSI B16.1 (1989) Cast Iron Pipe Flanges and Flanged Fittings
- ANSI/ASME B16.3 (1992) Malleable Iron Threaded Fittings

#### **1.29.3 American Society of Sanitary Engineering (ASSE)**

- ASSE 1003 (1993; Errata 1993) Water Pressure Reducing Valves

#### **1.29.4 American Society for Testing and Materials (ASTM)**

- ASTM A120-80 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated (Galvanized) Welded and Seamless
- ASTM A888-90 No-Hub Cast Iron Soil Pipe (CISP) and Fittings
- ASTM C564-04 Rubber Gasket for Joining Cast Iron Soil Pipe and Fittings
- ASTM A74-75 Cast Iron Soil Pipe and Fittings
- ASTM D2665 Polyvinyl Chloride (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- ASTM D2729 Standard Specifications for Poly (Vinyl Chloride) PVC Sewer Pipe and Fittings

1.29.5 DIN Standards (German Institute for Standardization)

DIN 8077	Polypropylene (PP) Pipes – PP-H, PP-B, PP-R, PP-RCT – Dimensions
DIN 8078	Polypropylene (PP) pipes – PP-H, PP-B, PP-R, PP-RCT – General Quality Requirements and Testing
DIN 16962	Pipe Joints and Fittings for Pressure Systems of Polypropylene (PP) pipes
DIN EN 1519	Plastic Piping System for Soil and Waste Discharge (Low and High Temperature) within Building Structure
DIN 19535-10	High-Density Polyethylene (PE-HD) Pipes and Fittings for Hot Water Resistant Waste and Soil Discharge Systems (HT) inside Buildings – Part. 10 Fire Behavior, Quality Control and Installation Recommendations
DIN 19537	Pipes and Fittings of High-Density PE for Drainage and Sewerage
DIN EN 12666	Plastic Piping Systems for Non-Pressure Underground Drainage and Sewerage – Polyethylene (PE)

1.29.6 American Water Works Association (AWWA)

AWWA C500	(1993; Addendum 1995) Metal-Seated Gate Valves for Water Supply Service
AWWA C651	(1992) Disinfecting Water Mains
AWWA C701	(1988) Cold-Water Meters - Turbine Type, for Customer Service
AWWA C900	(2016) Polyvinyl Chloride (PVC) Pressure Pipe & Fabricated Fittings, (100mm Through 1500mm) for Water Transmissions & Distribution

1.29.7 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1990) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves Flanged and Threaded Ends

1.29.8 Plumbing and Drainage Institute (PDI)

PDI G101	(1985) Testing and Rating Procedure for Grease Interceptors
PDI WH201	(1992) Water Hammer Arresters

**- - - END OF SPECIFICATIONS - - -**



# **PROPOSED ACADEMIC BUILDING II**

Barangay Rizal, Odiongan Romblon

## **TECHNICAL SPECIFICATIONS FOR MECHANICAL WORKS**

Submitted by:

**MELITON A. NAGUE**  
Professional Mechanical Engineer

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PLACE ISSUED: : MAKATI CITY

# TECHNICAL SPECIFICATIONS

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## MECHANICAL WORKS

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### SECTION 1500 MECHANICAL GENERAL REQUIREMENTS

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#### 1.01 GENERAL DESCRIPTION:

- A. The work to be done under this Specification consists of the fabrication, furnishing, delivery and installation, complete in all details, testing and commissioning of this subcontract, at the subject premises and all work materials incidental to the proper completion of the installation, except those where same shall conflict with Codes, etc., which latter shall then govern. The requirements with regard to materials and workmanship specify the required standard for the furnishing of all labor, materials, and appliances necessary for complete installation of the work specified herein and indicated in the drawings. The Specifications are intended to provide a broad outline of the required equipment, but are not intended to include all details of design and construction.

The term “**Contractor**” in this specification means “Sub-contractor” unless otherwise specified.

#### B. SCOPE OF WORK

Under this section of the specifications, provide all labor, materials and equipment and perform all the work necessary for the complete execution of all the work as shown on Drawings and Specified in this specification.

Scope of work shall include but not be limited to the following principal items of work for Air-Conditioning and Mechanical Ventilation System

1. Supply and installation of air conditioning ductwork and accessories such as dampers, diffusers, test holes, access panels.
2. Supply and installation of ventilation ductwork and accessories such as dampers access panel diffusers.
3. Supply and installation of insulation for ductwork and refrigerant pipe work.
4. Supply and installation of air conditioning and ventilation equipment including VRF outdoor unit, fan coil units, Air Handling Units (AHU), DX-split units, Precision Type Air Conditioning Unit (PACU) motor controls and starters, fans and blowers.

5. Testing balancing and commissioning
6. Free maintenance for a period of 12 months (or better) after practical completion
7. Supply of manufacturer's recommended spare parts.
8. Furnishing and installation of instruction and identifications boards, charts, signs and markers, to include operating methods and instructions.
9. Priming and finish painting of cladded and exposed refrigerant pipes.
10. Miscellaneous items and other related materials required for the satisfactory completion of the air conditioning and ventilation system to include metal works, hangers, supports, anchors, bolts, bracing, vibration isolators, equipment concrete pads, and its accessories.
11. Securing and payment of permits, licenses and bonds for construction purposes, including approval from local government unit.
12. Contingency to include the furnishing of written one (1) year warranty upon completion works.
13. Securing and payments of all Contractor's taxes, VAT, etc.
14. Miscellaneous items and other related materials required for the satisfactory completion of the air conditioning and ventilation system to include metal works, hangers, supports, anchors, bolts, bracing, vibration isolators, equipment concrete pads, and its accessories.
15. Preparation and submission of As-Built drawings in reproducible sheets including two (2) white prints copies at no cost to the Owner(s).

**C. WORK NOT INCLUDED:**

1. All builder's work,
2. All cutting and patching of concrete openings.
3. Electric power terminating to disconnect.
4. Water supply to equipment connection.

**D. BUILDING PROVISION**

Certain provisions have been made in the Building for the accommodation of the installation. These provisions include space allocation, holes through beams and structural slabs, etc. the provisions so made are shown on the Drawings. Before proceeding with the Works, the Sub-Contractor is to check and confirm that the provisions are satisfactory for the Works, and where necessary, additional information and requirements is to be furnished.

It is the Sub-Contractor's responsibility to ensure that the Main Contractor is informed of all holes and any other provision requested in the structure.

Any subsequent structural openings required due to negligence in providing sleeves beforehand shall be at the expense of the Sub-Contractor unless they are covered on a duly authorized variation order issued by the Project Manager.

All pipe sleeves shall be supplied and installed by the Sub-Contractor. The Main Contractor shall ensure that the fixing are good and the sleeves will not be shifted or moved by concreting or by the trades.

It is also the Contractor's responsibility to check and ensure that all holes, openings etc., are provided correctly during construction of the building.

## **PART 2.00**

### **2.01 OTHER APPLICABLE STANDARD OR CODE FOR TGIS SUB-CONTRACT:**

#### **A. CODE:**

1. Applicable local ordinances of Municipal Government.
2. Philippine Mechanical Engineering Code 2012
3. Philippine Plumbing Code.
4. National Electrical Code.
5. Philippine Electrical Code.

#### **B. STANDARD:**

1. Underwriters Laboratories (UL)
2. American Society of Testing and Material (ASTM)
3. American National Standard Institute (ANSI)
4. National Electrical Manufacturer's Association (NEMA)
5. American Society of Mechanical Engineers (ASME)
6. Factory Material Engineering Corporation (FM)
7. National Fire Protection Association (NFPA)
8. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
9. American Refrigeration Institute (ARI)

Proof of conformance shall be submitted to the Project Manager for approval.

Nothing contained in these specifications or shown on the drawings shall be constructed as to conflict with national and local ordinances or laws of the Philippines. All such laws and ordinance form part of this specification.

**2.02 SERVICE AND MAINTENANCE DURING DEFECTS: LIABILITY PERIOD:**

- A. During the Defects Liability Period, in addition to requirements included in applicable specifications, the sub-contractor shall be entirely responsible for:
  - 1. Carrying out regular inspections and full servicing of all plant installed under this specification.
  - 2. Providing a “call-out” service for breakdowns, at any time during the “Plant Operating Hours” specified below.
  
- B. If, during the Defects Liability Period any item of equipment should fail as a result of lack of proper servicing, faulty materials or workmanship, or defective equipment design, then promptly replace all such equipment at no cost and with minimum inconvenience to the Owner.
  - 1. Allow to work overtime to meet the requirements.
  - 2. Where overseas equipment is involved, allow to airfreight any parts needed.
  - 3. If, during the Defects Liability Period, system and/or equipment cease to operate within the design parameters for the Work, then promptly attend to such deficiencies and rectify them without delay.
  - 4. The cost of providing the above service shall be included in the bid.
  
- C. The sub-contractor’s order for all equipment shall include the warranty service for same, for the duration of the specified Defects Liability Period. This is to ensure that the manufacturer or supplier’s agent is responsible for the servicing of his own equipment.

**D. MAINTENANCE WORK – GENERAL**

Perform the minimum maintenance work specified herein, and any additional work needed to keep the plant and systems in sound condition and operating satisfactorily, including work recommended by the manufacturers of items of plant and accessories, leaving all of the plant and system installed under this specification in perfect operating condition at the end of the Maintenance Period.

**2.03 PAINTING:**

- 1. All works except steel with chrome plated finish, aluminum, copper or stainless steel shall be primed and painted unless otherwise approved by the Project Manager.

2. Before painting, the surface of the metal works shall be completely clean and free from rust, scale and grease.
3. Non-galvanized surfaces other than nuts, bolts and washers that may have to be removed for maintenance purpose, shall receive painting comprising the primary coat of rust inhibiting paint, three coats of the finished color. If the Project Manager consider painting not satisfactory, more coating shall be applied without extra cost.
4. Painting of cased electrical equipment, electrical accessories, and electrical fittings to meet the color requirements, stipulated in this specification, is not allowed.
5. All exposed metal parts such as cover plates for any pipe fittings, conduit and accessories, etc. shall be painted with a suitable color to match the interior finish of a particular location as approved by the Project Manager.
6. Submit color samples and material of the finishing coats to the Project Manager for approval prior to any painting.
7. Paints of synthetic material such as PVC or plastic shall be chemically compatible with the material being painted.
8. Paints of synthetic materials shall be as recommended by the material manufacturers.
9. Paints for special materials shall be as recommended by the material manufacturers.
10. Rubber and neoprene products shall not be painted.
11. Non-galvanized metal work fabricated on site inside false ceiling and pipe duct shall be painted with minimum two (2) coats of primer and rust inhabiting coat. Overcoat finish is not required. Manufacture Product in false ceiling and pipe duct such as pipes, air handling unit, fan coil unit, light fittings, electrical panels shall be painted as specified unless it is complete with galvanized surface.

**2.04 LONG-TERM GUARANTEES:**

- A. All long-term guarantees extending beyond Defects Liability Period shall be turned over to Owner at Final Completion. These shall be assigned in favor of the Owner.

**2.05 BASIC SUBMITTAL ITEMS:**

The following states the basic submittal which shall be included in additional to these specified elsewhere:

**A. MANUFACTURER'S DATA:**

1. VRF
2. AHU
3. Fan Coil Unit

4. Electric Motor Controls
5. Motors
6. Automatic Control
7. Insulation
8. Valves
9. Fittings
10. Electrical switchgear, cables, starters, etc.
11. Motor control centers and control panels.
12. Filters
13. Diffusers and air fittings
14. Valves and water side fitting and gas side fitting
15. Automatic temperature controls (Direct Digital Controls)
16. Fire rated sealant

**B. SHOP DRAWINGS:**

1. VRF outdoor unit installation
2. VRF indoor unit installation
3. Air handling unit installation
4. Fan coil unit installation
5. Fuel and gas installation
6. Automatic Control Schematic
7. Mimic Supervisory panel
8. Plans related to latest false ceiling plans
9. Ductwork and pipe work installation

**C. CERTIFICATE OF COMPLIANCE:**

1. Insulation
2. Adhesive
3. Sheet metal
4. Pipe material
5. Electrical Accessories
6. Controls
7. Fire rated sealant

**D. TYPE TEST CERTIFICATE:**

1. All motor control centers
2. Electrical switchgears and starters

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**SECTION 15100 AIR HANDLING AND DISTRIBUTION EQUIPMENT**

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**1.01 GENERAL REQUIREMENTS**

Section 15000, "General Requirements, Mechanical," with the additions and modifications specified herein, applies.

**1.02 SUBMITTALS: SUBMIT THE FOLLOWING:**

- A. MANUFACTURERS DATA
  - 1. Fans and Blowers
- B. STANDARD COMPLIANCE AND MANUALS
  - 1. Fans and Blowers
- C. CERTIFIED TEST REPORT

Provide for corrosion protection

1. Corrosion Protection

The affected equipment shall be protected by the manufacturer with corrosion-inhibiting coating or paint system that has proved capable of satisfactorily withstanding corrosion in accordance with ASTM B 117. Test period shall be 125 hours for equipment installation indoors and 500 hours for equipment installed outdoors or otherwise subjected to a marine atmosphere. Each specimen shall have a standard scratch as defined in ASTM D 1654. Electro-plated zinc coating shall not be less than 0.0127 mm average.

2. Corrosion Criteria

Upon completion of exposure, coating or paint shall show no indication of deterioration or loss of adhesion nor, shall there be indication of rust or corrosion extending further than 3mm on either side of original scratch.

3. Thickness of Coating:

Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimen with respect to materials, condition of application, and dry film thickness.

**2.01 FANS:**

All fans shall be complete with motor and vibration elimination mounting and for centrifugal fans, with belt drive, pulleys, guards, starter panels of type approved by the Project Manager.

AMCA 99 statically and dynamically balanced, with air capacities, brake horsepower, fan types, fan arrangement, noise level (sound power level) and pressure ratings as indicated. Fans shall sound-rated in accordance with AMCA 300. Fan bearing life shall be minimum 200,000 hours at operating conditions. Provide bird screens for outdoor inlet and outlets. Equip backdraft dampers (for connection to outdoor louvers and at location as shown on drawings. Wire guards shall be provided for exposed pulleys and belts (i.e not inside air duct or housing mounting). Have thermal overload protection in the operating disconnect switches starter, etc. for centrifugal fans and 3-phase motor within the building. Housing and fan wheel shall be aluminum or steel except as specified otherwise. Explosion proof fans shall have non-metallic blower.

Motor speed shall not exceed 1750rpm. Fan shall be of highly efficiency at duty point and low noise.

The fan resistances indicated on equipment schedule and drawings are for reference only. The Sub-Contractor shall check the exact resistance with calculation submitted for approval before



ordering. Any required modification to the system (e.g fan size, motor, switchgears, and cables) to meet the specified duty and space condition shall be entirely at the Sub-Contractor's expenses.

**A. CENTRIFUGAL FANS-FORWARD CURVE, AIRFOIL AND BACKWARDLY INCLINED:**

Centrifugal type fan units complete with motors and drive equipment shall be installed where shown on the drawings. Fan wheels for the kitchen exhaust fan and fans having **air flow rate exceeding 10,000 cfm shall have backwardly-inclined or airfoil continuous welded blades**. For fan having airflow rate not exceeding 10,000 cfm shall have forward curved with belt drive as scheduled unless otherwise specified. Impellers are to be hot dipped galvanized after fabrication. For small fans less than 2,000 cfm, blades may be of extruded aluminum riveted to the rim. All fans shall be driven by means of multiple "vee" belts. Each drive shall be enclosed in a suitable guard approved by the Project Manager. Belt speed shall not exceed 5,000 fpm. The fans shall be of bright steel and shall be of ample proportions so that outlet velocities will not exceed those indicated and shall be equipped with removable angles and bolts for attaching canvas or other flexible connections. All large fans scrolls shall be provided with drain plugs and access panel.

All pulleys shall be variable pitch pulleys.

**B. PROPELLER FANS**

Propeller fans shall furnish complete with single or and belt drive motor (as scheduled) drive equipment and fan guards. Fans and motor shall be mounted on resilient supports and a heavy metal frame. Provide angles/or plates required to mount the fans and dampers in the openings provided.

Belt driven fans shall have pitch pulley.

Motor shall be totally enclosed construction with permanently lubricated ball bearings. Impeller shall be made of steel while hub is made of steel aluminum.

Propeller fans shall be provided with rain hood duct constructed to galvanized sheet US Gauge #24 or better.

**C. IN-LINE TUBULAR/CABINET TYPE CENTRIFUGAL FANS:**

AMCA 210 tested and rated, with welded cabinet or tubular steel casings, tubular centrifugal backward-inclined blades, stationary discharged conversion vanes, belt guards, and adjustable motor-mounts and variable pitch pulleys for belt driven fans. Provide slip-fit or flanged connection between fan casings and ductwork. Air shall enter and leave fans axially. Inlet shall be streamlined with conversion vanes and bell mouth. Enclose and isolate fan bearings and drive shafts from air stream. Treatment and painting shall be manufacturer's standard. TEAO motors shall be direct drive. Drip proof motors mounted out of air stream shall be guarded V-belt drives. Provide fan supports and vibration isolators as indicated.

**D. CENTRIFUGAL FAN FOR KITCHEN EXHJAUST:**

The centrifugal fan for kitchen exhaust shall have the following features:

1. Suitable for discharge of hot greasy moist kitchen range hood exhaust air up to **200°C** which is slightly laden with detergent vapour.
2. The fan shall be SISW or DIDW, as specified backward curve with continuous welded, impeller construction guide inlet vane controller capable of automatic reduction of fan capacity to 45% of the specified duty. The inlet guide vane shall be suitable for the gases to be handled.
3. Fan belts, pulley and bearing shall be rated for duty up to **200°C**. Pulley shall be variable pitch.
4. Fan and belts shall be continuously welded heavy gauge, with internal duct flanges to prevent grease and moisture leakage.
5. The fan wheel shall be of the non-overloading backward incline centrifugal type. Wheels shall be statically and dynamically balanced grade. Wheels shall be constructed with half-welded and half riveted aluminum with a maximum pressure capability of 2.5 inches W.G.
6. Motors to be NEMA frame, 1,800 or 3600 rpm, Open Drip Proof, Totally Enclosed Fan Cooled (TEFC).
7. Due to limited ceiling void space for the location of ventilating fans, it is advisable that the contractors take note of the dimension of the fans to be installed

## **2.02 FACTORY FABRICATED AIR HANDLERS (AIR HANDLING UNIT):**

ARI 430, single zone draw thru type with arrangement and pressure rating as indicated. Air handler shall be sound-rated in accordance with ASHRAE 68. Sound rating shall not exceed specified dBA ratings. Submit sound power data in all octave-band center frequencies. Such data shall apply to the minimum noise area of the performance curve. Units shall consist of damper section, supply blower section, filter box, and coil section. All bolts, screws and washers shall be cadmium plated steel.

### **A. CASING:**

Construct casings of double skinned galvanized steel. Provide removable panels securely bolted or locked on independent structural frame and reinforced to avoid drumming to form rigid and durable construction and access doors for inspection and access for internal parts. Surface of steel parts which are not zinc-coated and all surfaces exposed to the weather shall be protected against corrosion by paint or coating system. Reinforce point of support for mounting units. Make airtight joints. Insulate casing with 50mm polyurethane foam insulation meeting NFPA 90 requirements. All panel joints and connection shall be gasketed to prevent cold bridges.

### **B. DAMPER SECTIONS:**

Permanently secure damper blades on a single shaft with sintered bronze or nylon bearings. Connect damper shafts together by one continuous linkage bar, which may be

cut in field to separate the damper openings, with grouping as required. Discharge air vertically or horizontally.

**C. DIDW SUPPLY BLOWER (FAN) SECTIONS:**

Centrifugal fan of backward-inclined for duty exceeding 10,000 cfm, forward curve or airfoil Type for duty less than 10,000 cfm and VAV air handling units unless otherwise specified with V-belt drives motor, adjustable motor base, with internal and external belt guards as specified. Bearings shall be grease-lubricated ball bearings type, with minimum 200,000-hour life. Grease fittings will be extended to the casing.

Fan wheel shall be electro-galvanized after fabrication. Fan shall be solid or hallow construction. Fan shafts with intermediate bearings are not acceptable. Extend drain pan to the blower section to catch any carry-over of moisture.

Fan resistances indicated on equipment schedules and drawings are for reference only. The Sub-Contractor shall check the exact resistance with calculation submitted for approval before ordering. Any required modification to the system (e.g. fan size, motor, switchgear, cables silencers, etc.) to meet the specified duty and space conditions shall be entirely at the Sub-Contractor's expense.

All fans shall be provided with variable pitch pulleys. Pulleys shall be multiple sheaves and belts selected such that full fan bhp is handled with one belt broken.

**D. FILTER BOXES:**

Design airtight filter boxes to hold filters conforming to requirements of Section 15200 "Ductwork and Accessories".

**E. FILTER DRAFT GAUGES - DIAL TYPE:**

Gauge shall be 100mm dial type, diaphragm actuated with a range of 0 to 500 Pa with 12.5 Pa division, installed with filter gauge accessory package. Provide a draft gauge at each filter bank. Filter gauge shall have a dial indicator and dry alarm contact for connection to a Building Management System (BMS).

**F. MIXING BOXES:**

Include equally sized flanged openings, sized to handle full airflow capacity. Provide automatic dampers as indicated. Arrange dampers in such a way that when one starts to close from its opened position the other starts to open from its closed position.

**G. OUTSIDE AIR INTAKE:**

The outside air intake, if ducted to the air handling shall be complete with unit volume dampers or automatic dampers, if the latter is specified.

**H. COIL SELECTIONS:**

Coils shall be removable and shall contain cooling coils in common or individual casing as manufacturer's standard. Cooling coils shall have insulated drain pans with piping connections to remove condensate. Seal coils to casing to prevent leakage of air around coils. Coils shall be seamless copper, to be mechanically bonded to aluminum plate fins by expansion of tube in fin collars. Unless otherwise specified, cooling coils shall not have more than 8 rows. Rows and fins shall be as specified in the schedule. By pass factor

of the coil shall have a range of 0.08 to 0.15. Cooling coil shall be ARI certified. Headers for coil shall have a range of up to 900mm height shall be cast iron and copper headers shall be used for more than 900mm. Ample space shall be allowed at both sides of coil to facilitate periodic cleaning. Drain shall be provided to all coils for complete draining of water and vent for manual air venting.

Coils shall be designed for 250 psi working pressure or higher and water velocity shall be between 120 fpm to 360 fpm. Air face velocity through coil shall not be greater than 500 fpm. Maximum fin space shall be 12 per inch.

### **2.03 FAN COIL UNIT:**

Fan Coil Unit shall be provided where shown, complete with all necessary components, including coils, drip pans, motors, etc. Size and type of unit shall be as scheduled on the drawings. The casing shall be lined with 25mm rigid glass fiber sound and thermal insulating board. Units shall be ceiling suspended and wall mounted unless otherwise specified. Filters shall be washable type. Coils shall be seamless copper tubing expanded into aluminum plate fins, for 1670 kPa working pressure rated tested at 2500 kPa air. Fans shall be aluminum forwardly-curved centrifugal; type, belt or direct driven. Motors shall be single phase, long life high efficiency permanent split capacitor type with built in impedance protection and permanently lubricated ball bearings with 100,000 hour life. Direct-connected motor shall be 3 speed type. Provide fusestat overload device for motor protection, disconnect switch and permanent greenfield connection to motors. The drip pan shall be constructed of galvanized steel with bituminous coating. The outside shall be insulated with 20mm polystyrene insulation or approved equivalent. Drip pan shall extend below the 2-way control valve.

#### **A. COILS**

Single refrigerant coil with aluminum fins and copper tubes. Coil duty shall satisfy both specified total cooling load and total sensible load.

#### **B. FAN:**

Fan motor shall be premium efficiency rating.

#### **C. HOUSING:**

1. Exposed unit shall be 1.3mm (minimum) steel, phosphatized, prime coated and finish with baked enamel.
2. The return air plenum shall be large enough to remove the blower section.

#### **D. DRIP TRAYS:**

Fan coil unit shall be provided with drip trays insulated with pipe connection to condensate drain.

#### **E. CONTROLS:**

Electric type as indicated. Interlock valves with fans so that the valves shall be de-energized and fluid flow stopped when fans are turned off.

1. FANS:

Manual with three-speed fan switch

2. VALVES:

Unless otherwise specified control valves for fan coil units shall be of two-way modulating type normally closed.

Two-way motor operated valves.

3. THERMOSTAT:

Valve operator shall be of the silent operation electric type that closes or open the valve to control the room temperature.

**2.04 MOTOR AND MOTOR STARTERS:**

Motors shall be totally enclosed fan cooled and drip proof. Motor starters shall be magnetic across the line for 2.0 KW and below. Motor 5.5 KW above shall be reduced voltage wye delta type.

**2.05 BELT DRIVES**

1. Fans shall be V-belt driven as specified in the schedules. Sheaves shall be of the adjustable ratio type, and of approve make. They shall be sized to give the required fan speed with the motor sheave at about the middle of its range of adjustment. There shall be at least two belts, capable of carrying the entire load with one belt broket. Furnish and install belt guards perforated metal for all sheaves and belts. Belt shall have grommeted openings at the fan and motor shafts to facilitate tachometer readings. All belt connected motors shall have adjustable bases and set screws to maintain proper belt tension.
2. The fan wheel shall be statically and dynamically balanced and over hung on a steel shaft running on heavy duty ball bearings. Bearings shall be self-aligning. To prevent leakage of oil and grease; cups or oil chambers must be provided in accessible position outside of the duct connection for easy lubrication. All bearings within the air stream shall be sleeve bearings. Brackets must be cast iron and mounted on side of the blower.
3. Fan housing shall be constructed of galvanized steel or aluminum and rigidly built and braced. The fan scroll shall be of galvanized steel. Where fam scroll is 480mm or more in width, an access door shall be provided. The door shall be of the pan tpe set in a raised frame by hand frip bolts, and shall be provided with lift handles. Fan and their motor drives shall be supported on vibration absorbing bases. Provide a 12mm drain valve in the housing for fan wheel diameter of 480mm or more.

**3.01 INSTALLATION:**

Install air distribution equipment as indicated and in accordance with the manufacturer's instructions. Provide clearance for inspection repair, replacement and service. Electrical work shall conform with NFPA 70. Provide conduits for wirings. Equip motors with un-fused safety disconnect switches mounted under or near fan housings. Provide overload protection in the operating disconnect switches and magnetic starters.

**3.02 FIELD INSPECTION AND TESTS:**

Schedule and administer the specified tests. Provide personnel, instruments, and equipment for such tests. Correct defects and repeat the respective inspection tests. Give the Engineer ample notice of the dates and times scheduled for tests and trial operations. Conduct inspection and testing in the presence of the Engineers. Submit test data certified by the equipment manufacturer's representative.

**3.03 FIELD INSPECTION:**

Prior to initial operation, inspect equipment installation for conformance with drawings and specifications.

**3.04 FIELD TESTS:**

1. Preliminary Tests:

For each air handling and distribution equipment and its components, perform an operational test for a minimum period of 24 hours.

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**SECTION 15200 DUCTWORK AND ACCESSORIES**

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**1.01 GENERAL REQUIREMENTS**

Section 15000, "General Requirements, Mechanical," with the additions and modifications specified herein, applies.

**A. SCOPE OF WORK**

The work involves the supply and installation of ductworks and its accessories including dampers, fire dampers, hangers, diffusers, registers, grilles, troffers, flexible ducts, sound attenuators, filters, louvers, access panels flow and pressure test ports.

**1.02 SMACNA DUCT CONSTRUCTION MANUALS:**

The SMACNA recommendations shall be considered as mandatory requirements. Substitute the word "shall" for the word "should" in these manuals.

**1.03 CORROSION PREVENTION**

Special protection is not required for equipment that has a zinc coating conforming to ASTM A 386 or a duplex coating of zinc and paint. Where expressly stipulated in equipment requirements paragraph below, the affected equipment item shall be protected by the manufacturer with a corrosion inhibiting coating or paint system that has been proved capable of satisfactorily withstanding the following test. Test method shall be ASTM B 117. Period of test shall be 125 hours for equipment intended for installation indoors; test period shall be 500

hours for equipment which will be installed outdoors or which will be otherwise subjected to marine atmosphere. Each specimen shall have a standard scratch as defined ASTM D 1654.

**A. CRITERIA:**

Upon completion of exposure, coating or paint shall show no indication of deterioration or loss of adhesion. Nor shall there be indication of rust or corrosion extending further than 3mm on either side of original scratch.

**B. THICKNESS OF COATING**

Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry film thickness.

**1.04 DIMENSIONS**

Duct sizes given in the drawings are clear internal dimensions and allowance shall be made for both internal and external insulation and/or acoustic linings where applicable.

**2.01 SHEET METAL MATERIALS:**

**A. GALVANIZED STEEL SHEET**

ASTM A52 designation G.90 galvanized and lock forming quality. Thickness and weight shall not be less than that specified in Chapter "DUCT CONSTRUCTION" of ASHRAE HANDBOOK.

**C. GALVANIZED STEEL HOT DIPPED AFTER FABRICATION:**

ASTM A23

Galvanized steel shall be as manufactured by Philsteel, APO/Puyat Steel

**2.02 SHEET METAL WORK:**

**A.** All sheet metal work for the air conditioning and ventilation system shall be furnished, installed, completely connected, cleaned, tested and, adjusted by the Sub-Contractor. This shall include the following major items of work.

**B. DUCTWORK FOR CONVENTONAL SYSTEMS:**

1. All sheet metal work exposed to the weather and elsewhere as indicated on the drawings, shall be built substantially as shown, of galvanized steel or aluminum steel sheet properly braced and supported and secured to the building construction and/or equipment. Wherever not otherwise specified thickness shall be as follows:

<u>Larger Dimension (US)</u>	<u>Galvanized</u>	<u>Aluminum</u>
Up to 600mm	No. 20 US Gauge	No. 24 US Gauge
600mm to 1200mm	No. 18 US Gauge	No. 20 US Gauge

1200mm and larger                      No. 16 US Gauge                      No. 18 US Gauge

2. All other ductwork for conventional system, except where otherwise specified, shall be built of best bloom galvanized iron or aluminum of the following thicknesses.

<u>Larger Dimension (US)</u>	<u>Galvanized</u>	<u>Aluminum</u>
Up to 300mm	No. 26 US Gauge	No. 24 US Gauge
325mm to 750mm	No. 24 US Gauge	No. 22 US Gauge
775mm and 1350mm	No. 22 US Gauge	No. 20 US Gauge
1375mm to 2100mm	No. 20 US Gauge	No. 18 US Gauge
Above 2100mm	No. 18 US Gauge	No. 16 US Gauge

3. All exhaust ductwork securing kitchen shall be formed from 304 stainless steel sheet ductworks shall have soldered seams and low points shall have a drain sump. Air tight access door shall be provided every bend and 4m length of minimum size 450 x 450mm. Thickness is similar to that for galvanized iron but with one commercial size larger. Accessories, e.g. damper splitter etc. shall be of stainless steel.

4. Duct shall be braced as follows:

Larger Dimension of Duct (mm)	Size of Brazing Angles (mm)	Distance Between Bracing (mm)
65 – 100	25 x 25 x 3	1.20m
Above	38 x 38 x 3	0.60m

Angle bracing shall be carried around all four sides of duct.

5. kitchen exhaust duct shall be black iron steel **US Gauge#16** with fully welded connection.

### 2.03 FLEXIBLE DUCTS

UL 181, Class 1. Use to connect between rigid ducts and outlets or terminals. There shall be no erosion, delamination, loose fibers, or odors from the ducts into the air stream. Minimum working pressure shall be 350mm water positive and 40mm negative for low velocity flexible ducts. Flexible ducts shall be maximum 2.40 meters in length. Minimum bend radius shall be twice of the duct diameter.

#### A. MATERIALS:

Interlocking spiral or helical corrugated type constructed of aluminum.

#### B. INSULATION AND VAPOR BARRIER:

ASTM C 553; 25mm nominal thickness and 32 kg/m<sup>3</sup> density. The insulation shall be sheathed with vapor barrier having a maximum permeability of 0.02 perm per ASTM E96, Procedure C. THERMOBREAK or approved equal.

#### C. JOINTS



Make airtight slip-joints sealed with pressure-sensitive vapor seal adhesive tape or duct sealer and secured with sheet metal screws. To prevent insulation compression, place 50mm wide by 25mm thick closed cell foam plastic spacers over the joints under vapor barriers. To provide a vapor tight joint, use a corrosion-resistant steel aluminum clamp over such spacers.

## **2.04 DUCTWORK INSULATION**

Use in low pressure ducting particularly on branch ducts. It can operate at 996 Pascal (4") water column static pressure and velocities of 25.4 m/sec (5000 fpm).

### **A. MATERIALS:**

Closed Cell Crosslinked Polyolefin Insulation, made of material such as Polyethelene based Crosslinked, factory applied reinforced aluminum foil and acrylic adhesive backing, 32 kg/cu.m density, maximum 0.32 w/mK at 20°C, non-hydroscopic, water vapor permeability better than 0.8gm/02/24 hours (90% RG, 38°C), -80 to 100 °C service temperature. Class 1 or better fire ratings.

### **B. VAPOR BARRIER:**

The exterior surface shall be fire resistant foil scrim kraft facing. The interior shall be coated with thermosetting acrylic polymer.

### **C. JOINTS:**

Joints are pre-molded double density slip-joint edges.

## **2.05 ACOUSTICAL DUCT LINING**

Flexible or rigid mineral fiber lining. Lining shall not be less than 25mm and where applicable shall be of sufficient thickness to be thermally equivalent to the thickness of insulation of ductwork. Duct sizes indicated shall be increased to compensate for the thickness of lining.

## **2.06 CASINGS AND PLENUMS:**

### **A. FIELD-FABRICATED COMPONENTS:**

Unless otherwise indicated, metal thickness, reinforcements, joint sealing, and fabrication and erection of equipment casings and plenums shall conform to ASHRAE STANDARD.

### **B. FACTORY-FABRICATED COMPONENTS:**

Factory-fabricated and insulated sheet metal may be used if conforming to paragraph "Field-Fabricated Components." The panels shall be of modular design pretested for structural strength, thermal control, condensation control, and acoustical control. The panel joints shall be sealed and access doors shall be gasketed to prevent air leakage. Insulate access doors. Fasteners shall be corrosion resistant.

## **2.07 DRIP PANS:**

Each cooling coil section in both field and factory assembled casings shall be provided with a stainless or galvanized steel drip pan not less than 18-gauge with drain connections. Drip pan shall collect, confine, and disposed of all condensate from cooling coils and attachments, including headers, return bends, distributors, and un-insulated pipe and fittings. Where individual eliminator blades are in section (not in one piece from top to bottom of coil bank), provide auxiliary drip through bottom of each section with drains to drip pans. Insulate drip pans with water impervious insulation of sufficient thickness to prevent condensation formation on the exterior at ambient condition to be encountered.

## **2.08 DIFFUSERS, REGISTERS, AND GRILLES**

### **A. MATERIAL AND FINISHES:**

Construct diffusers, registers and grilles of steel unless otherwise specified. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded.

Steel part shall factory zinc-phosphate treated prior to priming and painting or have a baked-on enamel finish.

## **2.09 DAMPERS AND DIFFUSERS**

### **A. CEILING DIFFUSERS**

Equipped with baffles or other devices required to provide air distribution pattern. Provide factory fabricated, single key, volume dampers. Except linear air diffusers, internal parts shall be removable through the diffuser neck for access to the duct and without the use of special tools.

### **B. CIRCULAR, SQUARE AND RECTAGULAR DIFFUSER:**

Each ceiling diffuser shall consist of four or more concentric circular elements designed to deliver air radially in a generally horizontal direction without excess smudging of the ceiling. The interior elements of the square and rectangular ceiling diffusers may be circular, square or rectangular as manufacturer's standard.

### **C. PERFORATED PLATE DIFFUSER:**

Provide adjustable one-way, two-way, three-way or four-way air patter controls as indicated. Mount perforated diffuser plates flush with finished ceiling. Diffuser face-plates shall not sag or deflect when operating under design conditions.

### **D. LINEAR AIR DFFUSERS:**

Linear diffuser shall be colored anodized aluminum and outdoor air fitting shall be stainless steel. Colors shall be selected or approved by the architect. Joints between diffuser sections shall appear as hairline cracks. Provide alignment slots for insertion of key strips or other concealed means to align exposed butt edges of diffusers. Equip with plaster frames when mounted in plaster ceiling. Do not use screws and bolts in exposed face of frames or flanges. Metal-fill and ground smooth corner-joints of steel frame and flanges exposed below ceiling. Furnish separate pivoted or hinged adjustable air volume-

damper and separate deflection blades. Volume and deflection blades shall be structurally rigid.

**E. REGISTERS:**

Supply register shall be double-deflection type. Provide volume dampers furnished by the manufacturer. Volume damper shall be of the group operated, opposed blade type and key adjustable by inserting key through face of register. Operating mechanism shall not project through any part of the register face.

**F. GRILLES:**

Construct and finish as specified above for registers, except that volume dampers shall be omitted.

**2.10 DUCT SLEEVES AND PREPARED OPENINGS**

**A. DUCT SLEEVES AND CLOSURE COLLARS:**

Fabricate from 20 gage galvanized steel. Where sleeves are installed in bearing walls or partitions use black steel pipe, standard weight, instead.

**B. PREPARED OPENINGS:**

Provide 25mm clearance between the ducts and the sleeve.

**C. ACCESS DOORS**

Door frame shall be welded in place airtight or bolted with air tight foam rubber gasket. Door shall be rigid and airtight with foam rubber gaskets and two or more galvanized steel hinges and tension fasteners. Provide doors as large as practical. Mount doors, if possible, so that air pressure holds them closed.

**2.11 DAMPERS AND LOUVERS:**

Shall be 2-gauge heavier than ducts in which installed. Dampers shall be opposed-blade type. The construction shall be aluminum or galvanized steel with interlocking edges and maximum 10 inch blade width. Conform to ASHRAE STANDARDS.

**A. BACKDRAFT DAMPER (GRAVITY DAMPERS OR SHUTTERS):**

Factory fabricated, with delicately balanced blades that open automatically when the fan starts and closed by gravity when the fan stops. Provide the edges of blades with felt or rubber strips to prevent rattling.

**B. MANUAL VOLUME DAMPERS:**

Balancing, factory-fabricated type. Equip dampers with accessible mechanism such as quadrant operators or 5mm rods brought through the side of ducts with locking set screw and airtight bushings. All air fittings shall be chrome plated with all volume control dampers in both supply and exhaust systems. Quadrants operators and rods will be marked to indicated damper position.

**C. LOUVERS:**

Fixed type. Fold or bead the edges of the louver blades to exclude driving rain. Louver frame shall be made of 16 gauge aluminum. Provide insect screen constructed of the same type metal as the louvers. Louver depth shall be as indicated.

1. Bird Screens:

With 12mm by 12mm mesh, 1.6mm diameter aluminum wire or 0.33 diameter stainless steel wire. Insect screen frames shall be grooved type with vinyl or neoprene spline insert for securing screen cloth.

2. External Louvers:

Weather-proof external louver shall be supplied and installed by the Mechanical Contractor unless otherwise specified.

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**SECTION 15300 – VARIABLE REFRIGERANT FLOW (VRF) SYSTEM**

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**1.0 GENERAL REQUIREMENTS**

Section 15000, “General Requirements, Mechanical,” with the additions and modifications specified herein, applies. The contract drawings indicate the extent and general arrangement of the air conditioning system. Equipment, ductwork, and piping arrangement shall fit into space allotted and shall allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

**A. STANDARD PRODUCTS:**

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products, similar to “**LG, Panasonic VRF**” or of equal material, design, workmanship and country of origin of the VRF Technology. The standard products shall have been in satisfactory use for at least 2 years prior to bid opening. The 2-year use shall include application of equipment and materials under similar circumstances and similar size.

**B. SCOPE OF WORK**

The work involves the supply and installation of Variable Refrigerant Flow (VRF) / Variable Refrigerant Volume (VRV) system, consists of an outdoor unit equipped with inverter and dual compressor(s), one or more indoor units integrated system controls, and

interconnecting field-provided refrigerant pipe containing various fittings including factory supplied "Branch Kits".

## **2.0 VARIABLE REFRIGERANT FLOW (VRF) SYSTEM**

### **2.01 OUTDOOR UNIT**

1. Unit shall be air cooled, VRF / VRV multi split system consisting of one, two or three outdoor units (combined as one) and multiple indoor units, each having capability to cool the area or room independently.
2. Inverter compressor shall have multi discharge port for optimized pressure control and better balancing. The compressor should have concentrated winding motor and vector control to achieve higher output and better efficiency.
3. Total piping length should be up to 1000 meters, must also have a maximum pipe equivalent of 190 meters and 70m level difference without any oil traps. The 70m level difference is based on the case where the outdoor unit is located above the indoor unit. The level difference is of a maximum of 40m when outdoor unit is located below the indoor unit. The level difference between indoor units in one refrigerant circuit shall be within 18m. Both indoor unit and outdoor unit are factory assembled and tested.
4. Outdoor coils shall be black/blue-finned coated for extra protection against harsh environment and corrosion.

#### **A. REFRIGERANT CIRCUIT**

1. The refrigerant circuit shall include an accumulator, plural electronic expansion valves, one or two oil separators, a receiver and liquid and gas shutoff valves. Filter drier and crankcase heaters are also built in.
2. The outdoor unit shall have scroll type compressor. The indoor unit shall be equipped with an electronic control valve to control refrigerant flow individually.
3. Heat exchanger coil must be three rows and it should have distributor for better heat transfer.
4. Safety Devices: The following safety devices shall be part of the outdoor unit; high pressure switch, fused crankcases heater, fusible plug, thermal protectors for compressor and fan motor, over current protection for inverters, short recycling protection timer.
5. Oil recovery system: Unit shall be equipped with an oil recovery system to ensure stable operation with long refrigerant piping.
6. Oil Equalized System: The outdoor unit with two compressors shall be equipped with an oil equalized system to avoid unbalance oil level.

#### **B. CONTROLS**

1. Outdoor unit shall have a minimum of 12 capacities steps to meet load fluctuation and indoor unit individual control in case of inverter series.
2. VTCC or Variable Temperature and Capacity control shall be used to maintain a correct room temperature.
3. Unit shall be equipped with a self-diagnosis circuit for easy maintenance and service
4. The unit shall be operated individually and each having a remote controller with an on/off switch, a fan speed selector, a timer, a thermostat setting button and LCD which indicates temperature setting, operation mode, malfunctions code and filter cleaning timing etc.
5. The remote controller shall memorize the latest malfunction code for easy maintenance.
6. Up to 16 indoor units can be controlled by a single wired remote controller. Group controller must be capable to connect and control 128 indoor units.

### **C. ACCESSORIES**

The following accessories shall be provided:

1. Branch pipe with insulation for quick work and smooth refrigerant flow
2. Wired remote control only.

### **D. CASING**

The outdoor case shall be constructed with galvanized steel finished with powder coat baked enamel paint. Each unit should have removable inspection panel with enough space clearance to allow access to service tool connection, dip switches, auto addressing and error codes. The outdoor unit frame should be completely factory assembled, piped and wired. Should there be dual and triple frame outdoor unit, the pipes should be field connected with factory designed and supplied Y-branch kits to manifold them together into a single refrigerant circuit.

### **E. REFRIGERANT SYSTEM**

The refrigeration system shall consist of a single refrigeration circuit and uses R410A or approved equal refrigerant. The outdoor unit is provided with factory installed components, including refrigerant strainer, check valves, oil separator, accumulator, reversing valve, electronic controlled expansion valve, high and low side charging ports, high pressure safety switch, service valves and interconnecting piping.

### **F. COMPRESSORS**

The outdoor unit shall be equipped with digitally controlled inverter-driven hermetically scroll compressor to modulate capacity from a variable of 15 to 150 Hz in 0.5 Hz increments.

### **G. OUTDOOR UNIT COILS**

The outdoor unit coils shall be of the nonferrous construction with louvers fins on copper tubing, and are protected with an integral metal guard. Coil fins should have factory applied corrosion resistant material with hydrophilic coating.

### **H. FANS AND MOTORS**

The outdoor unit shall include two direct drives, variable speed propeller type fans. The fan motors should have inherent protection, permanently lubricated bearings, and are variable speed with a maximum speed of up to 1,100 rpm. Raised guard should be provided to limit contact with moving parts. The outdoor unit should be vertical discharge type airflow with static pressure capability of up to 0.32" WG.

## **I. ELECTRICAL**

The outdoor unit shall be rated at 400V, 60Hz, 3-phase and should be capable of operating within voltage limits of ( $\pm 10\%$ ) rated voltage with overcurrent protection.

## **2.02 INDOOR UNIT**

The indoor units shall be factory assembled, wired, piped, and provided with an internally factory mounted electronic expansion valve, control circuit board, fan, and motor. Each should be designed to operate using 208~230V / 60Hz / 1 Ph power with voltage variation of ( $\pm 10\%$ ). The refrigeration circuit should be pressure-tested at the factory and shipped with a holding charge of dry nitrogen gas. The indoor unit shall also be equipped of non-metallic condensate drain pan with insulated flexible condensate drain hose to connect the unit drain pan nipple to a field-provided condensate drain pipe.

The unit coils should be minimum of two rows and are composed of copper tubes with mechanically bonded aluminium fins pressure tested at a minimum of 550 psig.

### **A. MICROPROCESSOR CONTROLS**

The unit shall be provided with an integrated microprocessor-based controller. The controller shall be capable of performing functions necessary to operate the system without the use of a wall mounted controller. The unit shall have temperature thermistor factory mounted in the return air stream. The field supplied communication cable between the indoor units and the outdoor unit shall be of the minimum of 18 AWG, 2-conductor, stranded, ad shielded cable, terminated via screw terminals on the control boards. The microprocessor control boards shall provide the following functions: self-diagnostics, auto restart following power restoration, test run, and will operate the indoor unit using one of five operating modes:

A single indoor unit shall be capable of being controlled by up to two local wired controllers. The microprocessor controls space temperature using the value provided by the temperature sensor sensing a space temperature that is farthest away from the temperature set-point.

If the unit is provided with an optional wall mounted local or central controller, displayed diagnostic codes shall be specific, alpha-numeric, and provide the service technician with a reason for the code displayed.

### **B. INDOOR UNIT COIL**

Indoor unit coils shall have minimum of two rows and are composed of copper tubes with mechanically bonded aluminum fins. Coils are pressure tested at a minimum of 551 psig. Units are provided with either a 45° flare or brazed refrigerant pipe connections.

Indoor coils shall be blue-finned coated for extra protection against harsh environment and corrosion.

**C. CASING**

The unit casing shall be designed to mount on a vertical surface and come complete with an installation mounting template guide and a separate hanging bracket. The unit case is manufactured with coated metal. Cold surfaces are covered with a coated polystyrene insulating material. The unit case is manufactured using ABS polymeric resin and comes with a light matte finish color. The front surface of the unit has an architectural flat panel smoked mirror finish.

**D. FAN ASSEMBLY AND CONTROL**

The unit should have a single, direct-drive, cross flow tangential Sirocco fan made of high strength polymeric resin material. The fan motor should be brushless, digitally-controlled, design with permanently lubricated and sealed ball bearings. The fan/motor assembly is mounted in vibration attenuating rubber grommets. The fan speed shall be controlled using a microprocessor-based direct digital control algorithm that provides pre-programmed fan speeds and Fan Only modes and four speeds in the Cooling mode. Fan settings are high, medium, and low. The fan speed algorithm provides a field-selectable fixed-speed or auto-speed setting that changes the fan speed based on the difference between the controller set-point and space temperature.

**A. AIR FILTER**

Return air is filtered shall have a removable, washable pre-filter equipped with a plasma filter. Filter access is from the front of the unit without the use of tools.

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**SECTION 15400 UNITARY AIR CONDITIONING SYSTEMS**

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**1.01 GENERAL REQUIREMENTS**

The contract drawings indicate the extent and general arrangement of the air conditioning system. Equipment, ductwork, and piping arrangements shall fit into the space allotted and shall allow adequate acceptable clearances for installation, replacement, entry, serving and maintenance.

**1.02 PACKAGE AIR CONDITIONING UNITS:**

**A. TYPE**

Unit shall be of indicated capacity, factory fabricated assembled, and pre-charged. Unit shall be ready for full operation after terminal point connection. Unit shall conform to the requirements of UL 484 and produce an EER as indicated when rated in accordance with ARI 440 not less than in the equipment schedule. Unit shall provide year round cooling functions. Function and temperature control shall be integral to unit.

**B. WALL SLEEVE:**

Louver shall be storm-proof type, constructed of anodized stamped aluminum. Sleeve shall be a water and airtight assembly, with weather-resistant protective coating.



**C. ROOM CABINETS:**

Cabinet shall be free of visible fasteners, sharp protuberances and edged. Enclosure sheet metal shall be a minimum of 18-gage steel with a protective coating. Face panels shall be removable and shall provide full access to unit appurtenances. Access to control shall be without removal of the face panel. Conditioned air shall discharge through adjustable louvers. Cabinet shall be thermally and acoustically insulated with material which conform to NFPA 90A.

**D. COOLING SYSTEM:**

**1. Compressor**

Compressor shall be hermetically sealed reciprocating type. Compressor shall be fitted with permanent split capacitor motor, overload protection, and vibration isolators. Compressor shall be protected against high discharge pressure, loss of charge, low voltage and short cycling.

**2. Cooling Section**

Cooling section shall include self-contained, pre-charged, slide-in or removable chassis-mounted, air cooled refrigeration system. Unit shall be suitable for rated capacity cooling operation with 95°F outdoor air temperature. Cooling section shall be equipped with a filter-drier on the section line.

**3. Condenser and Evaporator coil**

Coils shall be nonferrous tubes of 3/8-inch minimum diameter with copper or aluminum fins mechanically bond or soldered to the tubes. A condensate removal system shall be provided.

**4. Fans**

Room air fans shall be centrifugal type, dynamically and direct driven. Condenser fans shall be manufacturer's standard type. Fan motors shall be inherently protected, permanent split-capacity type.

**5. Filters**

Filter shall be of the sectional or panel cleanable type, and shall filter the entire air supply.

**6. Function Control**

Controls shall include and off-coil switch, high and low cool and high, and low heat selector switch, multiple speed fan cooling mode, room air fan switch, outside air damper control, and an adjustable thermostat.

**1.03 AIR COOLED PACKAGE SPLIT SYESTEM:**

**1. CONDENSING UNIT:**

**1. Compressor:**

The compressor shall be

a) Reciprocating rotary of semi-hermetic type.

b) Refrigerant-gas cooled.

c) complete with internal motor protection against motor overload and motor winding overheat, high pressure cut-out, low pressure cut-out, oil

failure switch, crankcase heater, discharge and suction stop valves, mufflers, automatically reversible oil pump for pressurized lubrication, time delay to prevent short-cycling, and mounted on external spring isolators.

2. Condensing Coil

The coil shall be

- a) Made of copper tubes arranged in staggered rows mechanically expanded into aluminum fins.
- b) Integrated with sub-cooling coil.
- c) Leak tested, dehydrated and refrigerant charged at factory.
- d) Matched with the capacity of the compressor.

3. Condenser Fan

The condenser fan shall be

- a) Either propeller type, aerofoil axial flow type or centrifugal type.
- b) Belt-driven or directly driven by a totally enclosed fan cooled inherently protected motor.
- c) Capable to start and stop automatically in response to the heat rejection requirements.
- d) Capable to start and stop automatically in response to the heat rejection requirements of the compressor under full/partial load condition and outside ambient temperature.

4. Casing

The casing of the condensing unit or condenser shall be:

- a) Constructed of steel sheets galvanized after fabrication.
- b) Rigidly braced to eliminate casing vibration.
- c) Painted with anti-corrosion primer and finishing coats to the architect's approval and shall be suitable for outdoor installation.
- d) The housing shall be treated with sound insulation.

**2. EVAPORATOR BLOWER:**

1. Blower

The blower of the air handling unit shall be

- a) Centrifugal type and belt-driven.
- b) Selected with an outlet velocity of not more than 9 m/s unless otherwise specified.

The impeller of the blower shall be

- a) D.I.D.W type or S.I.S.W. as required.
- b) Statically and dynamically balanced at works.
- c) Securely fixed to stainless steel shaft adequately sized and proportioned to ensure that the maximum operating speed is not more than 60% of the first critical speed.

The motor shall be

- a) Rated at least 15% above normal calculated fan horsepower.
- b) Suitable for cool/hot and humidified cooling conditions.
- c) Rated at a speed not exceeding 1750 rpm synchronous speed.

2. Evaporator Coil

The coil shall be

- a) Made of copper tubes arranged in staggered row mechanically expanded into aluminum fins for direct expansion operation.
- b) Leak tested. Dehydrated and refrigerant charged at factory.
- c) Matched with the capacity of the compressor.
- d) Equipped with a separate thermal expansion valve.

3. Casing

The casing shall be

- a) Heavy steel sheets galvanized filter frame shall be provided. Air filter shall be of the cleanable type and shall be constructed of aluminum at least 25mm thick. Air filters shall be easily removable for cleaning and replacement.
- b) Adequately factory insulated to prevent sweating.

4. Heavy steel sheets galvanized filter frame shall be provided. Air filters shall be of the cleanable type and shall be constructed of aluminum at least 25mm thick. Air filters shall be easily removable for cleaning and replacement.

5. Access door(s) shall be provided to allow for the following.

- a) Removal of air filters.
- b) Cleaning of cooling coils and drain tray.
- c) Inspection of fans and bearings.
- d) Inspection of damper mechanism and bearings

6. Temperature control and wiring shall be complete and pre-wired at the factory.

7. Refrigerant pipes shall be copper type "L" insulated with 50mm fiberglass with aluminum foil. Exposed (i.e. not in false ceiling) pipe shall be clad with galvanized sheet. Alternate insulation shall be flexible closed all rubber insulation with 32~40mm thickness.

All fittings shall be Stainless Steel, Grade 304, Schedule 40, Thread

8. insulation with 32~40mm thickness.

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**SECTION 15500      GAS PIPING**

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**1.0      GENERAL REQUIREMENTS**

Section 15000, "General Requirements, Mechanical," with the additions and modifications specified herein, applies.

**A.      SCOPE OF WORK**

- 1. Provide fuel gas piping, valves, supports, accessories, LPG container foundation and all appurtenances.

2. Supply and installation of gas meters and automatic main line shut-off valves activated during earthquake and fires.

## **B. GENERAL**

Pipe and fittings shall be as follows with sizes as indicated:

Aboveground and Within Buildings and Vaults. Pipe Black steel per ASTM A53 or seamless schedule 40, threaded ends for Sizes 50mm and smaller, otherwise, plain end bevelled for butt welding.

Butt Welding ANSI B16.9, with backing rings of Fittings compatible material NFGS-15355

## **2.0 VALVES, ABOVEGROUND**

Valves shall be as follows with sizes as indicated:

### **A. SHUT-OFF VALVE, SIZES LARGER THAN 50MM**

Cast-iron body ball valve with flanged ends per ANSI B16.36. Seals shall be PTFE rated at 300 psi.

### **B. SHUT-OFF VALVE, SIZES 50MM AND SMALLER:**

Bronze body ball valve, per ANSI B16.33, full port pattern, reinforced PTFE seals, threaded ends, PTFE seat rated at 300 psi.

### **C. PRESSURE REGULATOR**

Spring-loaded diaphragm pressure regulation, pressure operating range as required for the pressure reduction indicated, volume capacity not less than indicated, and threaded ends for sizes 2 inches and smaller, otherwise flange.

### **D. EARTHQUAKE AUTOMATIC GAS SHUT-OFF VALVE:**

ANSI Z21.70 fabricated and UL listed or AGA (American Gas Association) listed or IAPMO (International Association of Plumbing and Mechanical Officials) listed. The valve may be either pendulum or ball type with electric actuator.

#### **1.1 GAS METER:**

Pipe mounted diaphragm style cast-iron, and a resettable counter. Furnish combined register-totalizer, water escape hole housing, and means for scaling against tampering.

## **3.0 GAS EQUIPMENT CONNECTORS**

- A. Flexible Connector: ANZI Z21.45.
- B. Quick Disconnect Couplings: ANZI Z21.41.
- C. Semi-rigid Tubing and Fittings: ANZI Z21.69.

## **4.0 GAS VENTS AND GAS-VENT ROOF JACKS**

UL 441 galvanized steel (G90 Coating Class).

## 5.0 LIQUID-PETROLEUM GAS (LPG) CONTAINERS AND ACCESSORIES

NFPA, DOT Department of Transportation or ASME containers with appurtenances, system working pressure, minimum design pressure (LPG vapor at 100 Degrees F), and water capacity indicated. Provide containers with piping and fittings, fuse plugs, hose and hose connectors, strainer, and marking. Containers shall be provided by Gas Company.

## 6.0 GAS SHUT-OFF SYSTEM

**GAS LEAK DETECTOR** : This shall be installed on the wall surface within 300mm from the floor (LPG gas) and shall be installed within 4 meters from the gas cooking equipment.

**Brand:** “Hankook Gas” or “Soosan” or approved equal  
**Power Supply:** 12V DC (+/-) 10%  
**Detectable Gas:** LPG, LNG  
**Detection:** Catalytic Combustion Type  
**Detection Method:** Buzzer sound (70 dB or higher) and blinking Yellow LED (Automatic Return)  
**POWER ON:** Green Light LED  
**Initial Stabilization Time:** Normally after about 30 seconds  
**Operating Temperature:** 10°C ~ 40°C  
**Mounting Method:** Wall-hanging with bracket  
**Dimensions:** 113mm H x 76mm x 44mm D  
**Weight:** 130 g

**GAS CONTROLLER** : This device remotely controls the open and close status of the valve by manual operation. This shall be installed on a wall surface near a power source and shall be conveniently located.

**Brand:** “Hankook Gas” or “Soosan” or approved equal  
**Power Supply:** 220V AC (+/-) 10%, 60 Hz  
**Open Indication:** Green LED  
**Close Indication:** Red LED  
**Method of Alarm:** Buzzer sound (70 dB or higher) and blinking Red LED  
**Shut-off Time:** About 10 seconds after alarm  
**Operating Temperature:** 10°C ~ 40°C  
**Mounting Method:** Wall-hanging with bracket  
**Dimensions:** 145mm H x 100mm x 45mm D  
**Weight:** 450 g

**GAS SHUT-OFF VALVE (Automatic)** : This valve is used for automatic gas shut-off in case of emergency. Its open/close status can be checked on the Gas Controller. This shall be installed on the ball valve connected with the gas pipe.

**Brand:** “Hankook Gas” or “Shinwoo” or approved equal  
**Shut-off Type:** Geared motor lever type  
**Power Supply:** 120V DC (+/-) 30%, 60 Hz

**Manual Operation:** Clutch push method  
**Open/Close Speed:** Within 10 seconds  
**Mounting Method:** Wall-hanging with bracket  
**Dimensions:** 165mm H x 110mm x 75mm D  
**Weight:** 674 g

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**SECTION 15600 NOISE, VIBRATION AND SEISMIC CONTROL**

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**1.01 GENERAL REQUIREMENTS:**

The provisions of Section 15000, “General Requirements, Mechanical”, apply to this section.

**1.02 DESCRIPTION OF WORK:**

Provide and install noise, vibration and seismic control as part of supplied equipment or independently from them as specified in this section.

**1.03 MACHINERY VIBRATION CRITERIA**

Mechanical and electrical machinery and associated piping and ductwork shall be mounted on vibration isolators and seismic snubbers as indicated as indicated or specified and required to minimize transmission of vibrations and structure borne to the building structure or spaces of from the building structure to the machinery.

Minimum isolation efficiencies shall be as follow:

a)	Centrifugal fans with over 900mm wheel and unspecified equipment	95% at rotor speed
b)	Equipment installed at plantroom. Guestroom floors except fan coil units	90% at rotor speed
c)	Screw compressors in roof	98% at rotor speed
d)	Fan coil unit	90% at rotor speed
e)	Pumps at basement and centrifugal fan less 900mm wheel	90% at rotor speed

**B. VIBRATION LIMITS:**

The RMS vibration limit velocities Table 1 apply to measurements with a filter turned to the operating speed in series with the vibration measuring instrument on the machinery mounted in the vertical, horizontal, and axial directions. These measurements shall be taken at the lowest operating speeds of the components generating self-excited vibration velocities.

**C. VIBRATION ANALYZER:**

Use a portable analyzer conforming with ISO 954, and with testing equipment and calibration standard referenced to the National Bureau of Standards. The vibration pick up and connecting cable and indicator set shall be operable without damage between -18°C and 44°C temperature range at a maximum relative humidity of 95 percent. Analyzer shall be complete with battery pack or 120 volt AC, 60Hz cord, manual, scope jack, DC recorder outlets, and necessary accessories. Analyzer shall contain a tunable filter over the range of one to 10,000 Hz with a maximum 5 percent load band width at 3dB down points.

**D. VIBRATION ISOLATION APPLICATION:**

The type of isolation, base, and minimum static Deflection shall be as required for each specific equipment application, but not less than that given in the Vibration Isolation Schedule, when supported on a solid, minimum 2406 kg per cubic meter, concrete structural floor slab having a thickness of not less than 100mm. Should vibration isolators installed for the machinery prove inadequate to prevent transmission of machinery vibrations to the building structure or limit machinery vibration originated noise in the building spaces to their specific noise criteria levels and, if the specific limits of Table 1 are exceeded, the isolators shall be replaced with units having the largest deflection that can be practically installed, not less than 25mm greater than the functioning isolators up to a total unit deflection of 125 mm.

**E. VIBRATION ISOLATION SCHEDULE AND SELECTION CRITERIA:**

The minimum vibration isolation materials and equipment required for each piece of vibration isolated machinery shall be as indicated and selected for the lowest speed of the operating machinery as specified in clause 1.03.

The following correction shall be added to the selection based on massive floor on grade for the concrete slab of this building.

Operating Speed	Allowance
600	25 mm
900	12 mm
1200	11 mm
1500	8 mm
3600	5 mm

**F. VIBRATION ISOLATOR PROCUREMENT:**

For each piece of machinery to be isolated from vibration, the machinery base, vibration isolators, seismic snubbers, and other associated materials and equipment shall be supplied as coordinated package by a single manufacturer or by the machinery manufacturer. Procure isolators selected to provide a uniform loading and deflection even when the machinery weight is not evenly distributed. This requirement does not include the flexible connectors or the hangers for the associated piping and ductwork.

**1.04 SUBMITTALS: Submit the following:**

**A. MANUFACTURER'S VIBRATION ISOLATION MATERIALS AND EQUIPMENT DATA:**

1. Vibration Isolators
2. Seismic Snubber
3. Vertical Stops
4. Flexible Connectors
5. Flexible Duct Connectors
6. Silencers
7. Acoustic Wall Lining

For each type and size of spring type isolators, the spring outside diameter, deflection, operating spring height, solid spring height, the ratio of the outside diameter to the spring height, the load to deflection ratio of the springs, and weight and sizes of structural steel members.

**B. CERTIFICATE OF COMPLIANCE:**

1. Neoprene
2. Flexible Pipe and Duct Connectors

**C. ACOUSTIC TREATMENT:**

1. Submit complete catalogue information and shop drawings for sound attenuators including Octave band mid-frequency curves, dynamic insertion loss, pressure drop, materials, etc.
2. Submit noise level curves at octave band mid-frequency for Air Handling Unit, Fans, and Fan Coil Unit for approval.
3. Pressure loss thru the duct lining, acoustic silencers shall be allowed for in the estimation of fan pressure.
4. The Sub-Contractor shall submit calculation supporting selection of air side equipment such as diffuser, opposed blade damper. This calculation has to be prepared and signed by an approved acoustic specialist.
5. Galvanized perforated sheet catalogue.
6. All acoustic treatment calculation and proposal shall be prepared by an approved acoustic specialist.

**2.01 MATERIALS AND EQUIPMENT:**

Vibration isolators, flexible connectors and seismic snubbers, their components and materials shall be designed for replacement.

**A. CORROSION PROTECTION:**

Steel parts of vibration isolators and seismic snubber, except springs, shall be hot dipped galvanized in accordance with ASTM A123. Where steel parts are exposed to the weather, galvanized coating shall be at least 2 ounces of zinc per square foot of surface. Springs shall be neoprene coated.



**B. NEOPRENE:**

Neoprene material used in vibration isolators and seismic snubbers shall be oil resistant in accordance with ASTM D 471.

**C. FLOOR MOUNTED ISOLATORS:**

1. Neoprene Isolation Pads:

Provide neoprene pads at least 6mm thick with cross-ribbed or waffle design. For concentrated loads, provide steel bearing plates bonded or cold cemented to the pads. Size pads for not more than 345 kPa (50 psi) or as recommended by the pad manufacturer.

2. Neoprene Isolator

Provide molded neoprene isolators having steel base plates with mounting holes and at the top, steel mounting plates with mounting holes or threaded insert. Neoprene element shall be designed for operating on a straight line deflection curve and loaded so that deflection does not exceed 15 percent of the free height of the elements. Elements shall be type and size coded with molded letters or numbers or color coded for capacity identification. Metal parts of neoprene elements shall be completely embedded in neoprene.

**D. SPRING ISOLATORS AND PROTECTED SPRING ISOLATORS:**

Provide spring isolators or protected spring isolators that are adjustable including laterally stable free standing springs with horizontal stiffness at least 80 percent of the vertical (axial) stiffness. If included, machine attached and floor attached restraining elements shall be separated from metal-to-metal contact by neoprene cushions 3mm thick minimum. Neoprene acoustic friction pads at least 6mm thick shall be provided.

1. Springs:

Springs shall be securely fastened to base and compression plates and designed so spring ends remain parallel during and after deflection to operating height. Outside coil diameter shall be at least 0.8 of the operating height. At operating height, spring shall have additional travel to complete (solid) compression equal to at least 50 percent of the operating deflection to control (solid) compression equal to at least 50 percent of the operating deflection.

2. Mounting and Adjustments:

Provide base and compression plates with mounting holes or threaded fittings. Adjustment leveling bolts shall be rigidly bolted to match machinery or base.

**E. SUSPENSION TYPE ISOLATORS:**

Provide hangers with suspension type isolators encased in open steel brackets. Isolate hanger rods from isolator steel brackets with neoprene grommets.

1. Suspension Type Neoprene Isolators:

Provide hangers with molded neoprene elements which conform with requirements for “Neoprene Isolators” except that elements shall be double deflection type with at least 9mm deflection.

2. Suspension Type Spring Isolators:

Provide hangers with springs and molded neoprene elements in series. Spring shall conform with requirements for “Neoprene Isolators”. Provide isolators with adjustable spring preloading devices where required to maintain constant pipe elevations during installation and when pipe operational loads are transferred to the spring.

**F. VERTICAL STOPS:**

Stops shall be designed to be out of contact during machinery operation and to act as blocking devices during erection.

**G. STEEL EQUIPMENT BASES, PLATFORMS, RAILS AND SADDLES:**

Fabricate equipment bases, platforms, rails in accordance with AISC Manual of Steel Construction with AISC structural steel shapes of ASTM A36 steel. Welding shall conform to AWS D1.1. Design and sizes shall be as recommended by the machinery manufacturer and as indicated. Provide machinery bases, platform, rails and saddles of sufficient strength to resist distortion during construction and when machinery is in operation. Design calculations shall show that the maximum stress in any structural steel member will not exceed that allowed by AISC Manual of Steel Construction during machinery operation. Beams shall have a minimum depth of 1/12<sup>th</sup> of the longest dimension of the base and of the corresponding width and weight given in Table 3.

**-- END OF SPECIFICATION --**

# **PROPOSED ACADEMIC BUILDING II**

Barangay Rizal, Odiongan Romblon

## **TECHNICAL SPECIFICATIONS FOR FIRE PROTECTION WORKS**

Submitted by:

**MELITON A. NAGUE**  
Professional Mechanical Engineer

PRC REG. NO. : 0004908  
VALIDITY : JUNE 5, 2021  
TIN NO. : 912-907-486  
PTR NO. : 8535022  
DATE ISSUED: : JAN. 05, 2021  
PLACE ISSUED: : MAKATI CITY

# TECHNICAL SPECIFICATIONS

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**SECTION FPW : FIRE PROTECTION WORKS**

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**FPW 100 : GENERAL CONDITION**

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- A. The General Conditions form a part of these specifications and contract.
- B. The sub-contractor for the Fire Protection Works is designated as the Contractor in this Division.

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**FPW 200 : SCOPE OF WORKS**

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- A. Furnishing of all materials, labor, tools, equipment and accessories for the complete installation, testing and adjustment, ready for use of the proposed automatic fire sprinkler system.
- B. The works essentially shall include, but shall not necessarily be limited to the following items :
  - 1. Supply and install complete with the automatic fire sprinkler system (AFSS) consisting of 100 mmØ/100 mmØ supply fire lines, risers, feedmains, crossmains, branchlines, riser nipples, pipe droppings, fittings, valves, hangers, trims and its accessories required to complete the system.
  - 2. Supply and install complete with all floor control valves, water flow switches, pressure gauges, drain line stacks and drain valves assembly including termination/tapping of monitoring supervisory wiring and conduit up to the fire alarm or electrical junction/boxes and its accessories required to complete the system.
  - 3. Supply and install complete with all inspector test connection, drain line stacks, pressure gauges, combination type inspector test valve with nozzle and its accessories required to complete the system (on the farthest point of each system).
  - 4. Supply and install complete with the sprinkler heads including spares and cabinet for sprinkler system tools and stocks, trims and its accessories required to complete the system.
  - 5. Supply and install complete with the wet standpipe system (WSP) consisting of fire hose cabinet housing, fire hoses and pressure reducing / restricting

- angle valves including installation of handhose connection line and tapping to the Automatic Fire Sprinkler System and its accessories required to complete the system.
6. Supply and install of fire hydrants
  7. Supply and install complete with the portable fire extinguishing system consisting of mounting support, bracket, trims and its accessories required to complete the system.
  8. All openings through which fire may spread from one floor to the other, such as holes through floors made for the passage of plumbing pipes and electrical circuits shall be sealed with fire resistant / or fire stopping materials.
  9. Supply and installation of Fire pump and jockey pump including controllers, alarm check valve assembly, pressure relief valves, OS and Y valves, check valve, sound and vibrator isolator flexible connector, suction strainer, trims and its accessories required to complete the system including internal wiring of factory assembled procured equipment.
  11. Furnishing and installation of instruction and identifications boards, charts, signs and markers, to include operating methods and instructions.
  12. Priming and finish painting (red) of cladded and exposed piping and other part of sprinkler system except for sprinkler heads.
  13. Complete testing and commissioning, start-up of the entire Automatic Fire Sprinkler System and Fire Protection System in accordance with NFPA-13, to include cleaning, draining, adjusting and inspecting.
  14. Miscellaneous items and other related materials required for the satisfactory completion of the sprinkler system to include metal works, hangers, supports, anchors, bolts, bracing and its accessories.
  15. Securing and payment of permits, licenses and bonds for the construction purposes, including approval from the Fire Department having jurisdictions.
  16. Contingency to include the furnishing of written one (1) year warranty upon completion works of sprinkler system.
  17. Preparation and submission of As-Built drawings in reproducible sheets including two (2) white prints copies at no cost to the Owner(s).
  18. Securing and payments of all Contractor's taxes, VAT, etc.

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**FPW 300 : WORK NOT INCLUDED**

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- A. The following items of works will be supplied and done by others.
  1. All cutting and patching shall be made by the General Contractor, except us a specifically noted and modified herein.

2. All electric power wirings, except that is furnished as an integral part of factory assembled equipment, except us otherwise specified herein shall be by Electrical Contractor.
3. Supply and installation of fire doors shall be by General Contractor.
4. Fire alarm and fire station for the alarm system shall be by Electrical Contractor.
5. Construction of the reinforced concrete water and fire storage reservoir shall be by General Contractor.

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**FPW 400 : APPLICABLE SPECIFICATIONS CODES, ORDINANCES, PERMITS AND FEES**

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- A. The work covered in this contract is to be installed according to the specifications, codes, ordinances and requirements of the following:
  1. Fire Code of the Philippines
  2. NFPA NO. 13 - latest edition  
NFPA NO. 80 - latest edition  
NFPA NO. 75 - latest edition  
NFPA NO. 18 - latest edition (National Fire Code)  
NFPA NO. 20 - latest edition  
NFPA NO. 101 - latest edition
  3. National Plumbing Code of the Philippines
  4. Fire Department Ordinances of concerned city and municipality.
- B. All construction permit and fees required for the work shall be obtained by and at the expense of the Contractor. The Contractor's shall furnish the Architect, the Engineer and the Owner final certificates of inspection and approval from the government authorities having jurisdiction after the completion of the work.
- C. The Contractor's shall obtain all necessary allowances, pays, royalties, etc. In connection with the use of any patented device or system and shall save the Owner harmless from any claim or lawsuit arising from such use.

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**FPW 500 : SHOP DRAWINGS, SAMPLES AND OTHER SUBMITTALS**

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- A. The Contractor's shall prepare and submit for approval the following:
  1. Dimensional layout of all pumping system, fire hose cabinet connections, etc.
  2. Manufacturer's catalog, sheets, marked as necessary to indicate materials or equipment being furnished for the following items:

- a. Fire and Jockey Pumps
  - b. Controls and pump controllers
  - c. Pressure relief and reducing valves, alarm check valves, waste cone, O.S. and Y gate valve, drain valves, gate valves, water flow switches and flow measuring device.
  - d. Mechanical grooved couplings and flexible connectors.
  - e. Fire department connections (inlet and outlet), siamese roof outlet, hose valves, hose headers and hose cabinets.
  - f. Sprinkler heads, sprinkler wrench and spare cabinets
  - g. Riser supports and sleeves
3. List of miscellaneous materials proposed, including pipe, fittings, valves, etc. and manhole accessories, identifying manufacturer and type.
  4. Field test reports
  5. Such other similar information the Engineer may require.

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**FPW 600 : SUBSTITUTION AND TESTING OF MATERIALS**

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- A. Materials intended to be substituted for these originally specified shall be accepted only after a formal request for substitution, accompanied by:
  1. Reasons for substitutions;
  2. Certificate of test indicating quality, compared to those originally specified.
  3. Cost comparisons with material originally specified. Requests shall be submitted to the Architect/or Engineer subject for evaluation at least fifteen (15) working days before installation of subject material.
- B. Cost of testing of materials, whether on originally specified items or on substitutions, shall be to the account of the Contractor.
- C. Results of tests shall be submitted to the Architect /or Engineer for evaluation at least fifteen (15) days before the material is due for installation on the Jobsite.

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**FPW 700 : NOTES ON DRAWINGS:**

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- A. The Drawings show the general arrangement of all pipings. However, where local and/or actual conditions at the Jobsite necessitate a deviation or rearrangement, the Contractor's shall prepare and submit the new arrangement/shop drawings for the Architect's and/or Engineers final approval.
- B. Small scale drawings do not possibly indicate all offset, fittings and other parts of the system required. The Contractor's shall arrange such work accordingly, furnishing such valves, hangers, supports, fittings, trims and its accessories as may be required to complete the system in accordance to NFPA-13 Standard Installation of Sprinkler System.

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**FPW 800 : WORKMANSHIP AND COORDINATION OF WORK WITH OTHERS**

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- A. The Contractor shall be held fully responsible for the work of any manufacturer or sub - contractor supplying materials to or performing work for; as it is intended that the entire Fire Protection System shall be ready in every respect for satisfactory and efficient operation when finally delivered to the Owners.
- B. The Contractor shall assume full responsibility and shall provide the services of a qualified Engineer to supervise the complete installation of equipment and to conduct the final acceptance tests.
- C. The work throughout shall be executed in the most thorough and satisfactory manner in accordance with the best practices of the trade.

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**FPW 900 : SPRINKLER HEADS**

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- A. Type :  
  
Shall be 15 mm□ for Standard coverage and 20 mm□ for extended coverage orifice with 5mm□ glass bulb type spray sprinkler for all upright, pendent or sidewall sprinkler heads.  
  
Pendent heads (recessed type) shall be provided with aluminum escutcheon or approved equivalent to fit into ceiling boards or ceiling runners. Flush or concealed type pendent units shall be accepted as substitute. Heads shall be UL Inc. approved, of one brand all throughout similar to "VIKING", "TYCO" brand or approved equal and/or shall be standard product of a reputable manufacturer.
- B. Head Rating and Type :  

Public/Lobby, Common areas, Hallway with Drop Ceiling Areas	Standard, pendent concealed or/flushed type quick response sprinkler heads(k=5.6) rating @ 175 <sup>0</sup> F to 225 <sup>0</sup> F	Chrome Plated finish
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Parking, storage and other Areas	Standard / Conventional upright type sprinkler heads(k=11.2) rating @ 135 <sup>0</sup> F to 165 <sup>0</sup> F	Chrome Plated finish
Parking, AHU, Pump Room and Other Areas	Standard / Conventional upright type quick response sprinkler heads rating @ 175 <sup>0</sup> F to 212 <sup>0</sup> F	Chrome Plated finish
Kitchen Areas	Standard / Conventional upright type quick response sprinkler heads rating @ 212 <sup>0</sup> F	
Ballroom, Function Rooms, VIP rooms with drop ceiling areas	Standard pendent semi-recessed type sprinkler finish heads (k=5.6) rating @ 135 <sup>0</sup> F to 165 <sup>0</sup> F (for use in maximum ceiling temperature of 100 <sup>0</sup> F)	Chrome Plated finish
Ballroom, Function Rooms, VIP rooms with exposed slab and less than 5.0 mts covered throw area	Standard/extended coverage sidewall type quick response sprinkler heads (K=5.6) rating @ 135 <sup>0</sup> F to 165 <sup>0</sup> F (for use in max. Ceiling temp. of 100 <sup>0</sup> F)	Chrome Plated finish
Ballroom, area with exposed slab and motorized/movable ceiling panels	Standard, pendent type response flexible sprinkler heads (k=5.6) with 72" hose length and bracket system. Similar to "Aquaflex" stainless steel sprinkler fittings	Chrome Plated finish
C.	Pipe Thread and Valve Seat	- 15 mm diameter nominal (Conventional) - 20 mm diameter nominal (extended)
D.	Spare Sprinkler Heads :	

Furnished spare heads as required in the code and maintenance service part list for a period of at least one (1) year reckoned from the date after termination of warranty

(165 °F) (212 °F)

- |    |                            |   |                |
|----|----------------------------|---|----------------|
| 1. | Upright Type               | - | 24 pcs. 6 pcs. |
| 2. | Semi Recessed Pendent Type | - | 24 pcs. 6 pcs. |

- 3. Sidewall Type
  - 3.1 Standard Type - 24 pcs. 6 pcs.
  - 3.2 Extended Coverage Type - 24 pcs. 6 pcs.
- E. Sprinkler Tong - 3 pcs. required
- F. Sprinkler Wrench - 3 pcs. required

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**FPW 1000 : FIRE HOSE CABINETS**

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- A. Fire hose valve and cabinets assembly shall be UL listed and FM approved similar to “VIKING”, “CENTRAL” brand or approved equal and to match Local Fire Department requirements/or Bureau of Fire Protection.
  - Hose - 40 mm Ø X 45.00 meter single jacketed rubber-lined finish.
  - Nozzle - combination fog and solid stream, 40 mm Ø chrome plated.
  - Rack - semi-automatic, chrome plated.
 

Angle Valve type, Pressure Reducing /or restricting Valve - 40 mm Ø chrome plated polished trim provided with nipple and union patent for exceeding 100 PSI upstream working pressure and set at 70 PSI downstream working pressure. Use ordinary Angle valve for upstream working pressure below 100 PSI.
  - Hose Nipple - for components, shall be chrome plated. Provide two (2) universal spanner wrenches.
- B. Cabinet - full flush mounting door with anodized colored aluminum for all glass plate, frame and box shall be No.18 gauge steel with white interior baked enamel finishes over primer. Cabinet size shall contain the above components.

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**FPW 1100 : FIRE DEPARTMENT CONNECTION (INLET)**

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- A. Shall be UL listed flushed wall mounted (sidewalk connection) for Automatic Sprinkler/or Wet Standpipe system complete with cap/plugs and chains, plates lettered with “Automatic Sprinkler Standpipe” and “Wet Standpipe” similar to “BEST”, “CENTRAL/SPRAYSAFE”, “POWHATAN” brand or approved equal and to match Local Fire Department requirements/or Bureau of Fire Protection.
- B. Type : - Two way outlet connections (2) way 65 mmØ x 65 mmØ x 100 mmØ. For Wet Standpipe.

- Two way outlet connections (2) way x 65 mm□ x 65 mm□ x 100 mm□.
- C. Finish:
  - Cast brass body with drop clappers
  - Polished brass rectangular identification plates
  - Polished brass, double female snoots, pin lugs, and chains
- D. Shall be female snoots and NPT x pin lug hose thread swivels and provided with pin lug plugs and chains connections.

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**FPW 1200 : TESTING HOSE HEADER (OUTLET)**

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- A. Shall be flushed wall mounted (sidewalk connection provided with valves, caps and chains plates lettered with “Pump Test Connection” similar to “BEST”, “CENTRAL/SPRAYSAFE”, “POWHATAN” brand or approved equal and to match Local Fire Department requirements/or Bureau of Fire Protection.
- B. Type :
  - Two way hose outlet connection; two (2) way 65 mmØ x 65 mmØ x 100 mm□.
- C. Finish:
  - Cast brass body with back inlet
  - Brass rectangular identification plates
  - Cast brass valves with red hand-wheel
  - Polished brass cap and chain
- D. Shall be female NPT inlet x male hose thread outlet provided with caps and chains.

---

**FPW 1300 : WALL HYDRANTS (FIRE HOSE VALVES)**

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- A. Shall be UL listed straight globe female x male assembly similar to “BEST”, “CENTRAL/SPRAYSAFE”, “POWHATAN” brand provided with valves, caps and chains or approved equal and to match Local Fire Department requirements/or Bureau of Fire Protection.
- B. Type : - Single outlet connection 65 mmØ x 100 mmØ.
- C. Finish: - Cast brass valve with red hand-wheel
  - Polished brass caps and chains.
- D. Shall be female NPT inlet x male hose thread outlet provided with caps and chains.

---

**FPW 1400 : ROOF MANIFOLDS (OUTLET)**

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- A. Shall be UL listed flushed parapet wall mounted back inlet body, provided with valves, caps, chains and provided with round identification plates similar to “BEST”, “CENTRAL/SPRAYSAFE”, “POWHATAN” brand or approved equal and to match Local Fire Department requirements/or Bureau of Fire Protection.
- B. Type : - Double (twin) roof outlet manifolds; two (2) way 65 mmØ x 65 mmØ x 100 mmØ.
- C. Finish: - Cast brass body back inlet
  - Cast brass valve with red hand-wheel
  - Polished brass caps and chains.
  - Brass round identification plates
- D. Shall be female NPT inlet and male NPT twin outlets for body and to match female NPT inlet and male hose thread outlet for valves and provided with caps and chains.

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**FPW 1500 : PORTABLE FIRE EXTINGUISHERS**

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- A. Furnish and install as indicated on the drawings. Units shall be approved by the Fire Department having jurisdiction and UL listed. Similar to “Fimco” brand or approved equal and to match Local Fire Department requirements/or Bureau of Fire Protection. Mounting shall be inside fire hose cabinets and as shown on Drawings.
- B. Types and Locations
  - 1. 10 lbs FE-36 - All common areas, hallways, main lobby, pumphoom and Rentable spaces.
  - 2. 10 lbs FE-36 - fan room, parking area, EE room, telephone rooms, machine room and other energized room.
  - 3. 50 lbs FE-36 Wheel Type PFE - Parking area, transformer, genset room and machine room.
- C. Types and quantity of portable fire extinguisher shall be as per final approval and recommendations of Local Fire Department having jurisdiction.

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**FPW 1600 : PIPINGS - GENERAL**

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- A. Where American Standards are specified, other approved national or local standards may be acceptable, provided copies of these standard Specifications are forwarded to the Engineer for his written DRY CHEMICAL approval.
- B. Black iron, schedule 40 standards, conforming to ASTM A-53 for pipe sizes 150 mm dia. and above only (wet) similar to “Pacific”, “Southern Pipes”, “Supreme”, “Goodyear”.
- C. Black iron, schedule 40 pipes, standard, conforming to ASTM A-120 for inside building installations (feed mains, cross mains and branch lines) similar to “Pacific”, “Southern Pipes”, “Supreme”, “Goodyear”.
- D. All fire line piping shall be installed by means of screwed or flanged fittings. Flanged joint shall be used at all sprinkler risers and provided with 1.6 mm thick long neophrene gasket.
- E. Torch cutting shall not be permitted as means of modifying or repairing sprinkler system.  
  
All welding shall be “shop welding” only and shall be done by electric arc welding process.

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**FPW 1700 : FITTINGS - GENERAL**

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- A. Sprinkler system fitting shall be extra heavy pattern. Whenever a change in pipe size is made, one piece of reducing fitting shall be used. Provide mechanical grooved couplings at riser pipes of every floor.
- B. All fittings shall be of malleable iron fittings.
- D. Steel pipe flangers mating with steel equipment flangers shall have the same facing as mating flange.
- E. Screwed union shall not be used on pipes larger than 50 mm (2”). Coupling and unions of pipes other than screwed type shall be of types approved specifically for sprinkler used.

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**FPW 1800 : VALVES - GENERAL**

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- A. All valves shall be of the same manufacture for each class of piping and as such as possible, for the entire Project similar to “BEST”, “CENTRAL/SPRAYSAFE”, “KENEDY” brand or approved equal. Valves shall permanently bear affixed stamp or tag indicating manufacturer, catalog number, pressure and temperature ratings of isolation gate valve, OS & Y gate valves, angle valves, check valves, fire alarm check valve, pressure relief valves with all cast iron body with bronze trim.

- B. Furnish all valves and accessories material necessary for piping not shown on drawings as follows:
  - 1. Vents and drains for equipment to which piping connections are made.
  - 2. Connections to metering instruments and controls including pressure gauges, thermometer, controllers, traps and appurtenances required for proper functioning on instruments in controls.
  - 3. Temporary valves and accessories required for placing equipment into initial service.
  - 4. Piping 50 mm (2") and smaller required for proper operation of piping system and equipment, including drain valves required to drain all low points in piping.
- C. Valve seats shall be renewable except for forged steel and high pressure cast steel valves where Manufacturer's standard is integral seats.
- D. All valves shall be approved by Factory Manual and Underwriters Laboratories, Inc. (UL listed) in accordance with ANSI B 16.1, class 125.
- E. Where required and not noted, provided chain - wheel operators, extending chain for chain operated valves to which 1.2 meters of nearest floor or operating platform of valves.
- F. Provide floor stand with flanged faces for bolting to floor or platforms and other special devices where specified or noted on drawings.
- G. Provide extension stems, universal joints stem guide bearings and other accessories required to locate floor stands in convenient location with interference with other equipment, piping or building parts.
- H. Floor control valves within the building shall be approved indicating wedge gate with electrical contact and which will open when valve is partially or totally put in close position.

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**FPW 1900 : SWAY BRACES, HANGERS, SUPPORTS AND SEISMIC BRACINGS**

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- A. Sway Bracing : Steel flat bars, structural grade 7 mm minimum thickness, with corrosion protection; shape /or type as shown on plans.
  - 1. Sway Bracings Installation;
    - 1.1 Adequate sway bracing shall be provided to oppose longitudinal or transverse pipe movements.
    - 1.2 Lateral bracings shall withstand a force equal to 50% of the weight of the water contained in piping, valves and fittings. Spacing shall be 40 ft. (12m) maximum distances along main lines.

- 1.3 Longitudinal bracing shall with stand a force equal to 50% of the weight of crossmain and feedmain within the zone of water contained in piping, valves and fittings. Spacing shall be 80 ft. (24 m) maximum distances along main lines.
  - 1.4 Piping anchorages shall not be scured on two (2) dissimilar parts of the building which will move differently.
- B. Pipe Hangers: Steel flat bars, structural grade, 7 mm minimum thickness, with corrosion protection, shape as shown on plans and 13 mm diameter bars with corrosion protection as shown on plans.
1. Hangers Installation;
    - 1.1 Approved inserts may be used for the support of hangers, anchorages in concrete. Expansion shield should be used in a horizontal position on the sides of concrete beams and shall be above the bottom reinforcements.
    - 1.2 Increaser couplings shall be attached immediately adjacent to the expansion shields.
    - 1.3 When pipes 100 mm diameter and larger are supported in the vertical position, the supports shall be at a minimum spacing of 3.0 meters (10') on center. Holes in concrete for expansion shield shall be made of the proper size and depth, as specified for the type of shield used, to provide a uniform contact with the shield over its entire length and circumference.
    - 1.4 Maximum distance between hangers shall be 3.65 meters (12') for size mm (1"). Provide at least one hanger for each length of branch line, one between each two cross main branches, one hanger for each 4.75 meters (15') length of feed mains. The distance between the hanger and the center line of upright sprinkler shall be not less than 76 mm (3").
- C. Support on Risers (Four Way Bracing)
- Risers shall be adequately supported either by attachments directly to the riser or by hangers located on the horizontal connections close to the risers. Supports shall be provided at the ground level and for every second level and at the top most level of the riser.
- D. Seismic Separation Bracing
- Seismic separation assembly shall provided at every piping crosses at every construction joints of the building separation assembly shall composed of fittings,

pipe and approved victaulic coupling that permits movement in all directions and sufficient to withstand differential motion during earthquake. For nominal 4" dia. (100 mm) and above sizes of pipes the separation distances shall not exceed 8 inches (203 mm) maximum. For other separation distances and pipe sizes, length and distances should be modified proportionally.

E. Restraints

Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

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**FPW 2000 : PIPES SLEEVES**

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A. MATERIALS:

1. Through fittings - cast iron
2. Below Grade-cast iron or standard weight iron pipe
3. Above Grade - steel pipe

B. INSTALLATION:

1. Minimum clearance between the pipe & sleeve shall not be less than 25 mm (1") for pipes, 25 mm (1") to 89 mm (3-1/2") and 50 mm (2") clearance between pipes 100 mm (4") and larger. The clearance between pipes and sleeves shall be filled with non - combustible flexible materials such as asbestos rope and furnished with semi-hardening mastic flush.
2. Floor sleeves shall be extended at least 76 mm (3") above the top of the wearing surface.

Drains, fire department connections, test manifolds and other auxiliary piping connected to risers shall not be cemented into walls or floors.

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**FPW 2100 : FIRESTOPPING MATERIALS**

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1. MATERIALS :

1. Firestop compounds and damming materials shall be UL listed and shall conform to the requirements of qualified designers or Manufacturers approved modifications, as supported by Engineering reports. Similar to "Hilti", "Metacaulk" brand or approved equal.
2. The penetration seal materials must be unaffected by moisture and must maintain the integrity of the wall or floor assembly for its rated time period when tested in accordance with ASTM E814 (UL 1479). The system shall be UL listed classified for up to and including three (3) hours.



3. Fire stopping materials shall be asbestos and lead free and shall not incorporate oil not require the use of hazardous solvents.
4. All fire stopping materials shall be manufactured by one manufacturer thru out the completion of the project.
5. Do not proceed with installation of fire stop materials when temperatures exceeded the Manufacturer recommendation limitations for installations.

2. PREPARATIONS

1. Clean substrate of dirt, dust, grease, oil, loose materials, rust or other matter that may affect proper fittings or adhesion of the firestopping materials.
2. Clean metal and glass surfaces with a non-alcohol solvent.

3. INSTALLATION

1. Installation of firestops shall be performed by an applicator / installer qualified and trained by the manufacturer. Installation be performed in strict accordance with manufacturer's detail installation procedure.
2. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installation and Manufacturer's recommendations.
3. Unless specified and approved all insulation used in conjunction with through penetrations shall remain intact and undamaged and may not be removed.
4. Seal holes and penetrations to ensure an effective smoke seal.
5. In areas of high traffic, protect firestopping materials from damaged. If the opening is large, install firestopping materials capable of supporting the weight of a human load.
6. Insulation types specified in other sections shall not be installed in lieu of firestopping materials specified herein.
7. All combustible penetrants (e.g. non-metallic or insulated metallic pipes) shall have firestopping using products and system tested in a configuration representative of the field condition.
8. When required to properly contain firestopping materials within opening, damming or packing materials may utilized. Combustible damming material must be move after appropriate curing. Non-combustible damming materials may be left as permanent components of the firestop system.

4. CLEANING

1. Remove spilled and excess materials adjacent to firestopping without damaging adjacent surface.
2. Leave finished work in neat, clean condition with on evidence of spillovers or damage to adjacent surfaces.

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**FPW 2200 : PIPE PAINTING**

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- A. Sprinkler heads, valve stems and the like shall not be painted.
- B. After installation and test and before the installation of ceiling fixtures or boards, all pipings shall be prime painted and coated with two coats of gloss red quick drying enamel.

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**FPW 2300 : ALARM CHECK VALVES ASSEMBLY (WET TYPE)**

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- A. The alarm check valve assemblies and its components shall be UL listed so constructed and installed similar to “VIKING”, “CENTRAL” brand or approved equal and to match Integrated Metropolitan Fire Department requirements/or Bureau of Fire Protection. That any flow of water from the sprinkler system equal to or greater than from a single automatic sprinkler head, will result in an audible and visual alarm bells whether water or electrically actuated shall be capable of being actuated both automatically and manually.
- B. The water-actuated alarm check valve assembly shall be complete with all the necessary attachments required to give an alarm and ease in maintenance.

The gong shall be installed as indicated in the plans. The alarm check valve shall consist of but not limited to the following:

- 1. Retard chamber
- 2. Water motor
- 3. Weatherproof gong, 300 mmØ
- 4. Strainer
- 5. Pressure gauges
- 6. Drain and attachments
- 7. Electrically supervised control valves
- 8. Pressure switches

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**FPW 2400 : SUPERVISORY FLOOR CONTROL VALVES ASSEMBLY**

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- A. Water Flow Switches
  - 1. Flow alarm valves shall be UL listed similar to “SYSTEM SENSOR” brand or approved equal and to match Integrated Metropolitan Fire Department requirements/or Bureau of Fire Protection. Sizes indicated on the plans shall be provided with two (2) numbers electrical contacts that will close instantaneously with steady flow of water in the pipe and shall be complete with tamperproof terminal chamber with minimum of ½” diameter conduit. False alarm shall be prevented by an adjustable pneumatic device to retard the flow of shall be actuated only by an indirectional flow of water. Electrical

connections from these valves shall be done by the Electrical /or Fire Alarm Contractors.

2. The alarm apparatus shall be substantially supported, located and installed so that all parts shall be readily accessible for inspection, removal and repair.
3. An actual waterflow, through the use of the test connection, shall be employed to test the operation of the sprinkler alarm units in each floor or as a whole.

B. O.S. and Y Gate / Control Valve

Floor Control Valve- shall be UL listed and FM approved similar to “KENEDY”, “MUELLER” “STOCKHAM” brand or approved equal. Control valve shall be rising stem O.S. and Y resilient seat valves with accordance with ANSI B 16.1, class 125. Provide with tamper alarm switch for supervisory signal indicating unauthorized closing and tampering of the isolation valves.

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**FPW 2500 : ALARM AND SUPERVISORY SYSTEM**

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The supervisory and alarm system shall be integrated with the building Fire Alarm System. The Fire Alarm System annunciator shall indicate the flow valves, and the valve supervisory switches.

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**FPW 2600 : MARKERS, INSTRUCTIONS AND IDENTIFICATION SIGNBOARD**

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These signboards shall be made of gauge No. 14 black iron sheet with baked enamel finish and letter instruction as shown on the plans. Additional signboards shall be mounted on the unobstructed area for easy identification reading. Paints shall be basically gloss fire red and white.

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**FPW 2700 : ACCEPTANCE TESTS**

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- A. The Contractor shall conduct tests in the presence of inspector or authority having jurisdiction.
- B. Isolated leak tests or partial tests of areas may be performed prior to installation of ceiling materials in the area to preclude any damage and during the total system final tests.
- C. To remove foreign materials which may have entered the piping during installation of same, flushing or underground connection is required before sprinkler piping is connected.
- D. Hydrostatic Tests:
  1. Minimum tests pressure shall not be less than to 200PSI on the system pressure. Exceeding System pressure requirements to the minimum test pressure shall be tested applying additional test pressure of 50PSIG on the system for at least twenty four (24) hours minimum.

2. No visible leakage for inside sprinkler piping will be allowed. For underground mains and laid - ins, exceeding the permissible leakage or joints necessary repair shall be made.
  3. All control valve water pressure to insure proper operating tests. Use clean, non - corrosive water.
  4. Fire connection shall be tested.
- E. The Contractor shall furnish the Owner a written statement to the effect that the work covered by the Contract has been completed and tested, before requesting for final approval of the installation from the Fire Department Authority.
- F. Testing of drainage facilities shall be made by opening the main drain valve while the control valve is wide open.
- G. Test certificate shall be filled out and signed by the Owner's and Contractor's representative.
- H. System operations and maintenance chart shall be submitted to the Owners upon completion of the Contract. This shall include, among others, the locations of the control valves and care of the new equipment.

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**FPW 2800 : MINOR MODIFICATIONS AND TIME COMPLETION**

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- A. The plans as drawn should show conditions as accurately as it is possible to indicate them in scale. The plans are diagrammatically and do not necessarily show all fittings, etc. necessary to fit the building conditions. The locations of valves, fittings and the fixture shown on the plans are approximately. The Contractor shall be responsible for the proper location in order to make them for with Architectural details and instructions.
- B. The Contractor shall complete the work herein described in accordance with the specific schedules set by the Owners in accordance with General Contractor's Schedule of Work.

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**FPW 2900 : GUARANTEE**

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The Contractor shall guarantee that the installed sprinkler system complies with the requirements of the authorities and free from all defective workmanship and materials and will remain so, for a period of one (1) year from the date to final inspection and acceptance of the work. Any defect appearing within one year shall be corrected by the Contractor at no additional cost to the Owner.

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**FPS 3000 : CONTRACTOR'S RESPONSIBILITY**

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- A. The Contractor's shall provide temporary fire protection system during the construction period. This shall be of sufficient capacity to put any fire that may break

out due to construction operations. This is in addition to temporary fire extinguisher required.

- B. The Contractor's shall identify and save the Owner, the Architect and the Consulting Engineer Harmless from and against all liabilities for damage to property occasioned by any or omission of this Contractor's on any of this Sub-contractors including any and all expenses, legal or otherwise which may be insured by the Owner, the Architect or the Consulting Engineer, in the defense of any claims, action or suits.
- C. The General Contractor shall be responsible for the coordination among the different trades on the Jobsite in order to finish the Works in the least possible time, in strict compliance and in accordance with the Plans and Specifications.
- D. Throughout the construction period open ends of all installed AFSS fire lines, crossmains, branch lines, riser nipples, drop nipples and other related piping shall be kept closed by temporary plugs.
- E. All installed AFSS, wet and dry standpipe system risers, FCV and ITC drain line stacks and other related piping shall not be used to conduct dirty construction wash water especially those with cement mixes to avoid possible clogging.
- F. A temporary potable water supply shall be made available to construction workers as construction progresses.
- E. A temporary human excreta disposal system shall be provided by the Contractor to serve the Workers during the construction period.

**--END OF SPECIFICATION--**

# CONSULTING SERVICES FOR THE ARCHITECTURAL AND DETAILED ENGINEERING DESIGN FOR THE CONSTRUCTION OF MULTI-PURPOSE GYMNASIUM AND CONSTRUCTION OF ACADEMIC BUILDING II

PHILIPPINE SCIENCE HIGH SCHOOL – MIMAROPA REGION CAMPUS  
Barangay Rizal, Odiongan, Romblon

## *TECHNICAL SPECIFICATIONS COMMUNICATION SYSTEMS*

### CONTRACT DOCUMENTS



PREPARED BY:



IN JOINT  
VENTURE  
WITH



**EFREN T. PINEDA**  
PROFESSIONAL ELECTRONICS AND COMMUNICATION ENGINEER

PRC No. : 494  
PTR No. : 703592  
DATE : January 04, 2021  
PLACE : Quezon City

**TECHNICAL SPECIFICATIONS  
ON  
DIVISION 27 – COMMUNICATIONS  
FOR  
MULTI-PURPOSE GYMNASIUM  
and  
ACADEMIC BUILDING II  
Of  
Philippine Science High School (PSHS)  
MIMAROPA Region Campus  
Located at  
Barangay Rizal, Odiongan, Romblon**

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## DIVISION 27 – COMMUNICATIONS

### A. SCOPE

This division of technical specifications covers the COMMUNICATIONS requirement of Philippine Science High School (PSHS) proposed Multi-Purpose Gymnasium and Academic Building II to be located MIMAROPA Regional Campus at Barangay Rizal, Odiongan, Romblon.

This division covers the following sections:

<u>Section</u>	<u>Description</u>
<a href="#">27 05 00</a>	<a href="#">Common Work Results for Communications</a>
<a href="#">27 10 00</a>	<a href="#">Structured Cabling</a>
<a href="#">27 20 00</a>	<a href="#">Data Communications</a>
<a href="#">27 30 00</a>	<a href="#">Voice Communications</a>
<a href="#">27 40 00</a>	<a href="#">Audio/Video Communications</a>

The intent of this document is to provide a standard specification that will be used for all PSHS (MIMAROPA) building facilities requiring electronic communication systems. This document provides a list of approved components and systems comprising a complete structured cabling system that shall accommodate PSHS (MIMAROPA) requirements in excess of ten years. Buildings are dynamic. Over the life of a building, or facility, both the telecommunications equipment and the cabling will change dramatically. The telecommunications infrastructure must be capable of handling these changes. The information transport system (ITS) is more than just voice and data. It also encompasses many building systems including environmental controls, security, audio, television, sensing, alarms and paging. The ITS includes all low voltage signal systems that convey information within or between buildings.

In order to have a building, or facility, successfully designed, constructed, and provisioned for telecommunications, it is imperative that the ITS design be incorporated during the preliminary architectural design phase. To accomplish this, the architect/engineer must work closely with the designated IT staff via the Project Manager of PSHS - MIMAROPA Project.

Use of, and compliance with these guidelines is mandatory for PSHS (MIMAROPA) personnel, and for architects, engineers, and installation contractors working on PSHS (MIMAROPA) projects such as this one.

If PSHS (MIMAROPA) architects/engineers find this document complete, this can be made as a pattern specification for other facilities of PSHS (MIMAROPA) buildings and/or facility/offices requiring communication systems.



## B. REFERENCES

A	Ampere
AC	Alternating Current
AE	Architect and Engineer
AFF	Above Finished Floor
AHJ	Authority Having Jurisdiction
ANSI	American National Standards Institute
AWG	American Wire Gauge (refer to STP and UTP)
BCT	Bonding Conductor for Telecommunications (also Telecommunications Bonding Conductor (TBC))
BDA	Bi-Directional Amplifier
BICSI	Building Industry Consulting Service International
BOM	Bill of Materials
BTU	British Thermal Units
CAD	AutoCAD
CBC	Coupled Bonding Conductor
CCS	Cross Connection System (refer to VCCS and HCCS)
CCTV	Closed Circuit TV
CFE	Contractor Furnished Equipment
cm	Centimeters
CO	Central Office
COR	Contracting Officer Representative
CPU	Central Processing Unit
CPE	Customer Premises Equipment
CSU	Customer Service Unit
dB	Decibel
dBm	Decibel reference to 1 milliwatt
dBmV	Decibel reference to 1 millivolt
DC	Direct Current
DSU	Data Service Unit
EBC	Equipment Bonding Conductor
EDM	Electrical Design Manual
EMI	Electromagnetic Interference (refer to RFI)
EMT	Electrical Metallic Tubing or thin wall conduit
ENTR	Utilities Entrance Location (refer to DEMARC, POTS, LEC)

EPBX	Electronic Digital Private Branch Exchange
FA	Fire Alarm
GRC	Galvanized Rigid Metal Conduit
HCCS	Horizontal Cross Connection System (refer to CCS & VCCS)
HDPE	High Density Polyethylene Conduit
HEC	Head End Cabinets (refer to HEIC, PA)
HEIC	Head End Interface Cabinets (refer to HEC, PA)
Hz	Hertz
IBT	Intersystem Bonding Termination (NEC 250.94)
IC	Intercom
IDC	Insulation Displacement Contact
IDF	Intermediate Distribution Frame
IMC	Intermediate Steel Conduit
ISDN	Integrated Services Digital Network
LAN	Local Area Network
LEC	Local Exchange Carrier (refer to DEMARC, PBX & POTS)
LED	Light Emitting Diode
m	Meter
MCR	Main Computer Room
MDF	Main Distribution Frame
MH	Manholes or Maintenance Holes
MHz	Megahertz (10 <sup>6</sup> Hz)
mm	Millimeter
µm	Micrometer
MOU	Memorandum of Understanding
NEC	National Electric Code
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
OTDR	Optical Time-Domain Reflect meter
PA	Public Address System (refer to HE, HEIC, RPEC)
PBX	Private Branch Exchange (refer to DEMARC, LEC, POTS)
PE	Professional Engineer
PEC	Philippine Electrical Code
PEC V1	Philippine Electronics Code (Volume 1) - SAFETY
PEC B1	Philippine Electronics Code (Book 1) – Telecommunications Facilities Distribution System

PEC B2	Philippine Electronics Code (Book 2) – Fire Detection and Alarm System
PEC B3	Philippine Electronics Code (Book 3) – Cable Television System
PEC B4	Philippine Electronics Code (Book 4) – Distributed Antenna System
PM	Project Manager
PoE	Power over Ethernet
POTS	Plain Old Telephone Service (refer to DEMARC, LEC, PBX)
PSTN	Public Switched Telephone Network
PVC	Poly-Vinyl Chloride
PWR	Power (in Watts)
RBB	Rack Bonding Bus-bar
RE	Resident Engineer or Senior Resident Engineer
RF	Radio Frequency (refer to FR)
RFI	Radio Frequency Interference (refer to EMI)
RFID	RF Identification (Equipment, System or Personnel)
RMC	Rigid Metal Conduit
RMU	Rack Mounting Unit
SME	Subject Matter Experts (refer to AHJ)
SMS	Security Management System
STP	Shielded Balanced Twisted Pair (refer to UTP)
TCO	Telecommunications Outlet
TER	Telephone Equipment Room
TGB	Telecommunications Grounding Busbar (also Secondary Bonding Busbar (SBB))
TMGB	Telecommunications Main Grounding Bus-bar (also Primary Bonding Bus-bar (PBB))
TMS	Traffic Management System
TOR	Telephone Operators Room
TP	Balanced Twisted Pair (refer to STP and UTP)
TR	Telecommunications Room (refer to STR)
TWP	Twisted Pair
UHF	Ultra High Frequency (Radio)
UMTS	Universal Mobile Telecommunications System
UPS	Uninterruptible Power Supply
UTP	Unshielded Balanced Twisted Pair (refer to TP and STP)
V	Volts
VCCS	Vertical Cross Connection System (refer to CCS and HCCS)

VSWR	Voltage Standing Wave Ratio
W	Watts
WEB	World Electronic Broadcast
WI-FI	Wireless Fidelity

### C. DEFINITIONS

1. Access Floor: Pathway system of removable floor panels supported on adjustable pedestals to allow cable placement in area below.
2. BNC Connector (BNC): United States Military Standard MIL-C-39012/21 bayonet-type coaxial connector with quick twist mating/unmating, and two lugs preventing accidental disconnection from pulling forces on cable.
3. Bond: Permanent joining of metallic parts to form an electrically conductive path to ensure electrical continuity and capacity to safely conduct any currents likely to be imposed to earth ground.
4. Bundled Microducts: All forms of jacketed microducts.
5. Conduit: Includes all raceway types specified.
6. Conveniently Accessible: Capable of being reached without use of ladders, or without climbing or crawling under or over obstacles such as, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
7. DEMARC, Extended DMARC or ENTR: Service provider's main point of demarcation owned by LEC or service provider and establishes a physical point where service provider's responsibilities for service and maintenance end. This point is called NID, in data networks.
8. Effectively Grounded: Intentionally bonded to earth through connections of low impedance having current carrying capacity to prevent buildup of currents and voltages resulting in hazard to equipment or persons.
9. Electrical Supervision: Analyzing a system's function and components (i.e. cable breaks / shorts, inoperative stations, lights, LEDs and states of change, from primary to backup) on a 24/7/365 basis; provide aural and visual emergency notification signals to minimum two remote designated or accepted monitoring stations.
10. Electrostatic Interference (ESI) or Electrostatic Discharge Interference: Refer to EMI and RFI.
11. Grounding Electrode Conductor: (GEC) Conductor connected to earth grounding electrode.
12. Grounding Electrode System: Electrodes, through which an effective connection to earth is established, including supplementary, communications system grounding electrodes and GEC.
13. Grounding Equalizer or Backbone Bonding Conductor (BBC): Conductor that interconnects elements of telecommunications grounding infrastructure.
14. Head End (HE): Equipment, hardware and software, or a master facility at originating point in a communications system designed for centralized communications control, signal processing, and distribution that acts as a common point of connection between equipment and devices connected to a network of interconnected equipment, possessing greatest authority for allowing information to be exchanged, with whom other equipment is subordinate.
15. Microducts: All forms of air blown fiber pathways.

16. Ohm: A unit of resistive measurement.
17. Received Signal Strength Indication (RSSI): A measurement of power present in a received RF signal.
18. Service Provider Demarcation Point (SPDP): Not owned by LEC or service provider, but designated by Government as point within facility considered the DEMARC.
19. Sound (SND): Changing air pressure to audible signals over given time span.
20. System: Specific hardware, firmware, and software, functioning together as a unit, perform task for which it was designed.
21. Telecommunications Bonding Backbone (TBB): Conductors of appropriate size (minimum 53.49 mm<sup>2</sup> [1/0 AWG]) stranded copper wire, that connect to Grounding Electrode System and route to telecommunications main grounding bus bar (TMGB) and circulate to interconnect various TGBs and other locations shown on drawings.
22. Voice over Internet Protocol (VoIP): A telephone system in which voice signals are converted to packets and transmitted over LAN network using Transmission Control Protocol (TCP)/Internet Protocol (IP). VA'S VoIP is not listed or coded for life and public safety, critical, emergency or other protection functions. When VoIP system or equipment is provided instead of PBX system or equipment, each TR (STR) and DEMARC requires increased AC power provided to compensate for loss of PBX's telephone instrument line power; and, to compensate for absence of PBX's UPS capability.
23. Wide Area Network (WAN): A digital network that transcends localized LANs within a given geographic location.

#### **D. DESIGN GUIDELINES**

This PSHS (MIMAROPA) Telecommunications Infrastructure Standards are based upon the code requirements and telecommunications industry standards contained in the following documents. These guidelines will not duplicate the information contained in those references, except where necessary to provide guidance, clarification or direction. It is imperative that PSHS (MIMAROPA) project-in-charge, architects, engineers, and installation contractors working on PSHS (MIMAROPA) projects becomes familiar with these guidelines and the industry telecommunications standards referenced.

In instances where several technical alternatives may be available to provide a design solution, these guidelines will identify the preferred solution to meet PSHS (MIMAROPA) needs particularly the proposed PSHS (MIMAROPA) building. However, each facility and project is unique. Design for new construction will differ from design for retrofit of existing facilities. These guidelines will differentiate certain design approaches and solutions to be applied to new construction versus existing facilities, and different types of PSHS (MIMAROPA) facilities. However, designers and installers shall always use sound engineering judgment in order to comply with the requirements of the codes and standards identified in this section. Design or installation questions shall be referred to designated PSHS (MIMAROPA) project-in-charge for resolution.

#### **E. APPLICABLE CODES AND STANDARDS**

Adherence to, and compliance with, the codes and standards referenced, and the PSHS (MIMAROPA) unique requirements and design solutions identified in the manual, is mandatory. Requests to deviate from the industry standards and design solutions prescribed in these guidelines may be submitted, on a case-by-case basis, in

accordance with the instructions in the Policy and Procedures section of these guidelines. No deviation from the requirements of the National Electrical Code and/or Philippine Electrical Code and/or applicable Philippine Electronics Code will be allowed.

Architects, Consultant Engineers and Contractors shall always reference the most recent standards available.

The cabling system described in this specification is derived in part from the recommendations made in the current editions of these industry standard documents. The list of documents below is incorporated by reference:

### Reference Standards (International and National)

1. British Standards Institution (BSI):

BS EN 50109-2	Hand Crimping Tools – Tools for The Crimp Termination of Electric Cables and Wires for Low Frequency and Radio Frequency Applications – All Parts & Sections. October 1997
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2. Building Industry Consulting Service International (BICSI):

ANSI/BICSI 002-2011	Data Center Design and Implementation Best Practices
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ANSI/BICSI 004-2012	Information Technology Systems Design and Implementation Best Practices for Healthcare Institutions and Facilities
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ANSI/NECA/BICSI 568-2006	Standard for Installing Commercial Building Telecommunications Cabling
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NECA/BICSI 607-2011	Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
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ANSI/BICSI 005-2013	Electronic Safety and Security (ESS) System Design and Implementation Best Practices
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3. Insulated Cable Engineers Association (ICEA):

ANSI/ICEA S-80-576-2002	Category 1 & 2 Individually Unshielded Twisted-Pair Indoor Cables for Use in Communications Wiring Systems
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ANSI/ICEA S-84-608-2010	Telecommunications Cable, Filled Polyolefin Insulated Copper Conductor, S-87-640(2011) Optical Fiber Outside Plant Communications Cable
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ANSI/ICEA S-90-661-2012	Category 3, 5, & 5e Individually Unshielded Twisted-Pair Indoor Cable for Use in General Purpose and LAN Communication Wiring Systems
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S-98-688 (2012)	Broadband Twisted Pair Cable Aircore, Polyolefin Insulated, Copper Conductors
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S-99-689 (2012)	Broadband Twisted Pair Cable Filled, Polyolefin Insulated, Copper Conductors
ICEA S-102-700 (2004)	Category 6 Individually Unshielded Twisted Pair Indoor Cables (With or Without an Overall Shield) for use in Communications Wiring Systems Technical Requirements

4. Institute of Electrical and Electronics Engineers (IEEE):

ISSN 0739-5175	March-April 2008 Engineering in Medicine and Biology Magazine, IEEE (Volume: 27, Issue:2) Medical Grade-Mission Critical-Wireless Networks
IEEE C2-2012	National Electrical Safety Code (NESC)
C62.41.2-2002/Cor 1-2012 IEEE	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits 4)
C62.45-2002	IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits
81-2012 IEEE	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System
100-1992	IEEE the New IEEE Standards Dictionary of Electrical and Electronics Terms
1100-2005	IEEE Recommended Practice for Powering and Grounding Electronic Equipment

5. Institute of Electronics Engineers of the Philippines (IECEP):

PEC Volume 1	General Safety (including Grounding and Lightning Protection of a Communication System)
PEC Book 1	Telecommunications Facilities Distribution System (update the PEC Volume 2 – Telephone Standards)
PEC Book 2	Fire Detection and Alarm System
PEC Book 3	Cable Television System
PEC Book 4	Distributed Antenna System

6. National Building Code of the Philippines (NBCP)

7. National Electrical Manufacturers Association (NEMA):

NEMA 250 (2008)	Enclosures for Electrical Equipment (1,000V Maximum)
ANSI C62.61 (1993)	American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits
ANSI/NEMA FB 1 (2012)	Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing EMT) and Cable
ANSI/NEMA OS 1 (2009)	Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA SB 19 (R2007)	NEMA Installation Guide for Nurse Call Systems
TC 3 (2004)	Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
NEMA VE 2 (2006)	Cable Tray Installation Guidelines

8. National Fire Protection Association (NFPA):

70E-2015	Standard for Electrical Safety in the Workplace
70-2014	National Electrical Code (NEC)
72-2013	National Fire Alarm Code
75-2013	Standard for the Fire Protection of Information Technological Equipment
76-2012	Recommended Practice for the Fire Protection of Telecommunications Facilities
77-2014	Recommended Practice on Static Electricity
90A-2015	Standard for the Installation of Air Conditioning and Ventilating Systems
101-2015	Life Safety Code
241	Safeguarding construction, alternation and Demolition Operations
255-2006	Standard Method of Test of Surface Burning Characteristics of Building Materials
262 - 2011	Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
780-2014	Standard for the Installation of Lightning Protection Systems
1221-2013	Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
5000-2015	Building Construction and Safety Code

9. Philippine Electrical Code (PEC) – latest edition

10. Society for Protective Coatings (SSPC):

SSPC SP 6 / NACE No.3 (2007)	Commercial Blast Cleaning
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11. Telecommunications Industry Association (TIA):

TIA TSB-140	Additional Guidelines for Field-Testing Length, Loss and Polarity of Optical Fiber Cabling Systems (2004)
TIA-155	Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T (2010)
TIA TSB-162-A	Telecommunications Cabling Guidelines for Wireless Access Points (2013)



TIA/EIA-423-B	Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits (2012)
TIA-455-C	General Requirements for Standard Test Procedures for Optical Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components (August 2014)
TIA-455-53-A	FOTP-53 Attenuation by Substitution Measurements for Multimode Graded-Index Optical Fibers in Fiber Assemblies (Long Length) (September 2001)
TIA-455-61-A	FOTP-61 Measurement of Fiber of Cable Attenuation Using an OTDR (July 2003)
TIA-472D000-B	Fiber Optic Communications Cable for Outside Plant Use (July 2007)
ANSI/TIA-492-B	62.5- $\mu$ m Core Diameter / 125- $\mu$ m Cladding Diameter Class IA Graded-Index Multimode Optical Fibers (November 2009)
TIA-492CAAA	Detail Specification for Class IVA Dispersion-Unshifted Single-Mode Optical Fibers (September 2002)
TIA-492E000	Sectional Specification for Class IVD Nonzero-Dispersion Single-Mode Optical Fibers for the 1550nm Window (September 2002)
TIA-526-7-B	Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant – OFSTP-7 (December 2008)
TIA-526.14-A	Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant – SFSTP-14 (August 1998)
TIA-568	Revision/Edition C Commercial Building Telecommunications Cabling Standard Set: TIA-568-C.0-2 Generic Telecommunications Cabling for Customer Premises (2012), TIA-568-C.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements (2012), TIA-568-C.2 Commercial Building Telecommunications Cabling Standard – Part 2: Balanced Twisted Pair Cabling Components (2009), TIA-568-C.3-1 Optical Fiber Cabling Components Standard, (2011) TIA-568-C.4 Broadband Coaxial Cabling and Components Standard (2011) with addendums And errata
TIA-569	Revision/Edition C

	Telecommunications Pathways and Spaces (March 2013)
TIA-574	Position Non-Synchronous Interface between Data Terminal equipment and Data Circuit Terminating Equipment Employing Serial Binary Interchange (May 2003)
TIA/EIA-590-A	Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant (July 2001)
TIA-598-D	Optical Fiber Cable Color Coding (January 2005)
TIA-604-10-B	Fiber Optic Connector Intermateability Standard (August 2008)
ANSI/TIA-606-B	Administration Standard for Telecommunications Infrastructure (2012)
TIA-607-B	Generic Telecommunications Bonding and Grounding (Earthing) For Customer Premises (January 2013)
TIA-613	High Speed Serial Interface for Data Terminal Equipment and Data Circuit Terminal Equipment (September 2005)
ANSI/TIA-758-B	Customer-owned Outside Plant Telecommunications Infrastructure Standard (April 2012)
ANSI/TIA-854	A Full Duplex Ethernet Specification for 1000 Mb/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling (2001)
ANSI/TIA-862-A	Building Automation Systems Cabling Standard (April 2011)
TIA-942-A	Telecommunications Infrastructure Standard for Data Centers (March 2014)
TIA-1152	Requirements for Field Testing Instruments and Measurements for Balanced Twisted Pair Cabling (September 2009)

12. Underwriters Laboratory (UL):

1-2005	Flexible Metal Conduit
5-2011	Surface Metal Raceway and Fittings
6-2007	Rigid Metal Conduit
44-010	Thermoset-Insulated Wires and Cables
50-1995	Enclosures for Electrical Equipment
65-2010	Wired Cabinets
83-2008	Thermoplastic-Insulated Wires and Cables
96-2005	Lightning Protection Components
96A-2007	Installation Requirements for Lightning Protection Systems
360-2013	Liquid-Tight Flexible Steel Conduit

444-2008	Communications Cables
467-2013	Grounding and Bonding Equipment
486A-486B-2013	Wire Connectors
486C-2013	Splicing Wire Connectors
486D-2005	Sealed Wire Connector Systems
486E-2009	Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-2007	Thermoplastic-Insulated Underground Feeder and Branch Circuit Cable
497/497A/497B/497C/497D/497E	Protectors for Paired Conductors / Communications Circuits / Data Communications and Fire Alarm Circuits / coaxial circuits / voltage protections / Antenna Lead In
510-2005	Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
514A-2013	Metallic Outlet Boxes
514B-2012	Fittings for Cable and Conduit
514C-1996	Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-2011	Schedule 40 and 80 Rigid PVC Conduit
651A-2011	Type EB and A Rigid PVC Conduit and HDPE Conduit
797-2007	Electrical Metallic Tubing
884-2011	Underfloor Raceways and Fittings
1242-2006	Intermediate Metal Conduit
1449-2006	Standard for Transient Voltage Surge Suppressors
1479-2003	Fire Tests of Through-Penetration Fire Stops
1480-2003	Speaker Standards for Fire Alarm, Emergency, Commercial and Professional use
1666-2007	Standard for Wire/Cable Vertical (Riser) Tray Flame Tests
1685-2007	Vertical Tray Fire Protection and Smoke Release Test for Electrical and Fiber Optic Cables
1861-2012	Communication Circuit Accessories
1863-2013	Standard for Safety, Communications Circuits Accessories
1865-2007	Standard for Safety for Vertical-Tray Fire Protection and Smoke-Release Test for Electrical and Optical-Fiber Cables
2024-2011	Standard for Optical Fiber Raceways

2024-2014	Standard for Cable Routing Assemblies and Communications Raceways
2196-2001	Standard for Test of Fire Resistive Cable
60950-1 ed. 2-2014	Information Technology Equipment Safeties

13. Determine and adhere to the most recent edition of these specifications when developing responses.
14. Specifications as provided by PSHS (MIMAROPA) IT department and any other special codes that may apply.
15. If this document and any of the documents listed above are in conflict, then the more stringent requirement shall apply. All documents listed are believed to be the most current releases of the documents; the contractor is responsible to determine and adhere to the most recent release when developing the proposal for installation.

## **F. APPROVAL FOR ALTERNATIVE DESIGN SOLUTIONS**

This guideline identifies specific design solutions that are intended to meet the technical requirements of PSHS (MIMAROPA) telecommunications and information technology systems. Requests to deviate from industry standards or PSHS (MIMAROPA) design solutions will be considered on a case-by-case basis. Any request to deviate from the requirements of the National Electrical Code and/or Philippine Electrical Code and/or Philippine Electronics Code will not be accepted.

Requests to apply alternative design solutions shall be submitted to the PSHS (MIMAROPA) Project Manager in collaboration with PSHS (MIMAROPA) IT Department for consideration.

Approval will only be granted in writing.

The request must include:

A complete description of the proposed alternative design solution identifying:

1. The type of facility;
2. The conditions at the facility;
3. The approved design solution contained in these guidelines and the relevant standards identified herein;
4. The proposed alternative design;
5. Identify all standards referenced in these guidelines which the alternative design will not be in compliance with, and the effect of non-compliance, both short and long term; and
6. The reason for wishing to use the alternative design.

## **G. SUBMITTALS**

1. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

2. Provide parts list including quantity of spare parts.
3. Provide manufacturer product information. Government reserves the right to require a list of installations where products have been in operation.
4. Provide Source Quality Control Submittal:

Submit written certification from OEM indicating that proposed supervisor of installation and proposed provider of warranty maintenance are authorized representatives of OEM. Include individual's legal name, contact information and OEM credentials in certification.

Submit written certification from OEM that wiring and connection diagrams meet appropriate Life Safety Guidelines, NFPA, NEC, these specifications, and other PSHS (MIMAROPA) requirements and instructions, requirements, recommendations, and guidance set forth by OEM for the proper performance of system.

Pre-acceptance Certification: Certification in accordance with procedure outlined in Section 01 00 00, GENERAL REQUIREMENTS and specific Division 27 qualification documentation.

5. Installer Qualifications: Submit three installations of similar size and complexity furnished and installed by installer; include:

Installation location and name.

Owner's name and contact information including, address, telephone and email.

Date of project start and date of final acceptance.

System project number.

Three-paragraph description of each system related to this project: include function, operation, and installation.

6. Provide delegated design submittals (e.g. seismic support design).
7. Submittals are required for all equipment anchors and supports. Include weights, dimensions, center of gravity, standard connections, manufacturer's recommendations and behavior problems (e.g., vibration, thermal expansion,) associated with equipment or conduit. Anchors and supports to resist seismic load based on available standards regarding this matter.
8. Test Equipment List:

Supply test equipment of accuracy better than parameters to be tested.

Submit test equipment list including make and model number:

- i. ANSI/TIA-1152 Level IV twisted pair cabling test instrument
- ii. Fiber optic insertion loss power meter with light source
- iii. Optical Time Domain Reflectometer (OTDR)
- iv. Volt-Ohm meter (VOM)
- v. Digital camera (digicam)
- vi. Bit Error Test Set (BERT)

- vii. Signal level meter
- viii. Time Domain Reflectometer (TDR) with strip chart recorder (Data and Optical Measuring)
- ix. Spectrum analyzer
- x. Color video monitor with audio capability
- xi. Video Waveform Monitor
- xii. Video Vectorscope
- xiii. 100 MHz Oscilloscope with Video Adapters

Supply only test equipment with a calibration tag from government accepted calibration service dated not more than 12 months prior to test.

Provide sample test and evaluation reports.

#### 9. Submittal Drawings:

Telecommunications Space Plans/Elevations: Provide enlarged floor plans of telecommunication spaces indicating layout of equipment and devices, including receptacles and grounding provisions. Submit detailed plan views and elevations of telecommunication spaces showing racks, termination blocks, and cable paths. Include following rooms:

- xiv. Telecommunications rooms/closets (TR/TC) – location of Intermediate Distribution Frame (IDF)
- xv. Building Entrance Facility/Demarcation rooms – location of Main Distribution Frame (MDF)
- xvi. Telephone/Data – location of each Data/Telephone
- xvii. Server rooms/Data Center – also known as MIS/Data rooms
- xviii. Equipment rooms (ER)

Logical Drawings:

- xix. Provide logical riser or schematic drawings for all systems.
- xx. Provide riser diagrams systems and interconnection drawings for equipment assemblies; show termination points and identify wiring connections/number of connections.

Access Panel Schedule on Submittal Drawings: Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment.

10. Provide sustainable design submittals.

11. Furnish electronic certified test reports to COR prior to final inspection and not more than 90 days after completion of tests.

#### CLOSEOUT SUBMITTALS

1. Provide following closeout submittals prior to project closeout date:

Warranty certificate.

Evidence of compliance with requirements such as low voltage certificate of inspection.

Project record documents.

Instruction manuals and software that are a part of system.

2. Maintenance and Operation Manuals:

Submit in accordance with Section 01 00 00, GENERAL REQUIREMENTS.

Prepare a manual for each system and equipment specified.

Furnish on portable storage drive in PDF format or equivalent accepted by COR.

Furnish complete manual as specified in specification section, fifteen days prior to performance of systems or equipment test.

Furnish remaining manuals prior to final completion.

Identify storage drive "MAINTENANCE AND OPERATION MANUAL" and system name.

Include name, contact information and emergency service numbers of each subcontractor installing system or equipment and local representatives for system or equipment.

Provide a Table of Contents and assemble files to conform to Table of Contents.

Operation and Maintenance Data includes:

- xxi. Approved shop drawing for each item of equipment.
- xxii. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of equipment.
- xxiii. A control sequence describing start-up, operation, and shutdown.
- xxiv. Description of function of each principal item of equipment.
- xxv. Installation and maintenance instructions.
- xxvi. Safety precautions.
- xxvii. Diagrams and illustrations.
- xxviii. Test Results and testing methods.
- xxix. Performance data.
- xxx. Pictorial "exploded" parts list with part numbers. Emphasis to be placed on use of special tools and instruments. Indicate sources of supply, recommended spare parts, and name of servicing organization.
- xxxi. Warranty documentation indicating end date and equipment protected under warranty.

- xxxii. Appendix; list qualified permanent servicing organizations for support of equipment, including addresses and certified personnel qualifications.

### 3. Record Wiring Diagrams:

Red Line Drawings: Keep one E size 91.44 cm x 121.92 cm (36 inches x 48 inches) set of floor plans, on site during work hours, showing installation progress marked and backbone cable labels noted. Make these drawings available for examination during construction meetings or field inspections.

#### General Drawing Specifications:

- xxxiii. Detail and elevation drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches).
- xxxiv. ER, TR and other enlarged detail floor plan drawings to be D size 61 cm x 91.44 cm (24" x 36") with a minimum scale of 0.635 cm = 30.48 cm (1/4 inch = 12 inches).
- xxxv. Building composite floor plan drawings to be D size 61 cm x 91.44 cm (24 inches x 36 inches) with a minimum scale of 3.175 mm = 30.48 cm (1/8 inch = 12 inches).

Building Composite Floor Plans: Provide building floor plans showing work area outlet locations and configuration, types of jacks, distance for each cable, and cable routing locations.

#### Floor plans to include:

- xxxvi. Final room numbers and actual backbone cabling and pathway locations and labeling.
- xxxvii. Inputs and outputs of equipment identified according to labels installed on cables and equipment
- xxxviii. Device locations with labels.
- xxxix. Conduit.
  - xl. Head-end equipment.
  - xli. Wiring diagram.
  - xlii. Labeling and administration documentation.

Submit Record Wiring Diagrams within five business days after final cable testing.

Deliver Record Wiring Diagrams as CAD files in .dwg formats as determined by COR.

Deliver four complete sets of electronic record wiring diagrams to COR on portable storage drive.

- 4. Service Qualifications: Submit name and contact information of service organizations providing service to this installation within four hours of receipt of notification service is needed.



## MAINTENANCE MATERIAL SUBMITTALS

1. After approval and prior to installation, furnish COR with the following:

A 300 mm (12 inch) length of each type and size of wire and cable along with tag from coils of reels from which samples were taken.

One coupling, bushing and termination fitting for each type of conduit.

Samples of each hanger, clamp, and supports for conduit and pathways.

Duct sealing compound.

## H. PROCUREMENT AND INSTALLATION POLICY

In larger construction projects, the telecommunications infrastructure installation will be part of the general construction contract. A competitive acquisition should still be pursued with the contractors listed by PSHS (MIMAROPA) IT Department / designated Consultant as approved contractors.

The procurement and installation of the telecommunications infrastructure in this project and future IT projects will be a combined effort between the PSHS (MIMAROPA) IT and Facilities staff.

## I. SYSTEM WARRANTY AND CERTIFICATION

PSHS (MIMAROPA) requires a warranty on the installation of all systems covered in this division of at least one year from building acceptance. In addition, PSHS (MIMAROPA) requires that 100% of the cables and termination equipment installed be tested and certified at the designed and intended performance level.

## **27 05 00 – COMMON WORK RESULTS FOR COMMUNICATIONS**

### **27 05 11 CAMERAS FOR AUDIO-VISUAL SYSTEMS**

This section includes common requirements to communications installations and applies to all sections of Division 27 and Division 28.

### **27 05 13 COMMUNICATIONS SERVICES**

The PSHS (MIMAROPA) IT department is tasked with designing, specifying, deploying and maintaining all devices related to networking and telephony on the whole PSHS (MIMAROPA) building. This includes but is not limited to all fiber optic and copper cabling, connectors and terminating hardware, network devices such as switches, routers, and wireless access points. PSHS (MIMAROPA) IT is also the resource for information on deploying VoIP and traditional telephone handsets as well as emergency phones. All other communications systems such as fire alarms, card access, A/V systems, and building automation systems are designed, specified, deployed and maintained by the system provider.

### **27 05 14 COMMUNICATIONS CABLES INSIDE BUILDINGS**

1. The maximum length of LAN copper horizontal distribution cable is 90 meters (295 feet) from the workstation outlet to the TC patch panel, no exceptions. Where this length would be exceeded the designer will add additional TCs as required.
2. Telecommunications cabling is always installed in a home-run fashion with individual cables running from the work area all the way to the TC. Splices in horizontal distribution cable are not allowed.
3. Factory-manufactured sweeps, which meet ANSI/TIA/EIA 569-A, bend radius requirements shall be used for all telecommunications conduit. The bend radius of the sweeps must be a minimum of 10-times the internal conduit diameter. Bending conduit in the field using manual or mechanical methods is not acceptable. Standard electrical elbows shall not be used. This sweep radius is necessary to insure that the conduits can accept future fiber optic cables. The conduit installation contractor will test all horizontal conduits with a mandrel to prove compliance with the sweep radius requirements throughout the conduit run.
4. Each telecommunications outlet box shall have an individual conduit routing to the telecommunications closet, or to the pull box or pulling point, connecting to a major cable pathway routing to the telecommunications closet. Box shall be located in serviceable space. Looping, or “daisy-chaining,” of conduits between outlet boxes is not allowed.
5. All conduit ends shall have plastic bushings installed before the cable is pulled into the conduit.

6. Conduits will not be run next to hot water lines, steam pipes, or other utilities that may present a safety hazard or cause a degradation of system performance.
7. Conduits entering the Telecommunications Closet should be designed and located allowing for the most flexibility in the routing and racking of cables.
8. Conduits or conduit sleeves entering through the floor of the Telecommunications Closet shall terminate four (4) inches above the finished floor.
9. All metallic telecommunications conduits entering the Telecommunications Closet, Equipment Room, or Entrance Facility shall be bonded together, and bonded to the Telecommunications Main Grounding Busbar (TMGB) with a #6 AWG ground cable.
10. All in-use and spare conduits entering the Telecommunications Closet, Equipment Room, or Entrance Facility shall be sealed to prevent the intrusion of water, gasses, and rodents throughout the construction project. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.
11. All conduits and cables that penetrate fire rated walls or floors must be fire stopped.
12. All outside plant (OSP) conduits and inner duct, used and spare, shall be plugged with watertight plugs at both ends to prevent the intrusion of water, gasses, and rodents throughout the construction project. All OSP conduits shall have pull lines rated at a minimum of 90 kg (200 lbs.) pulling tension installed. The pull lines must be re-pulled each time an additional cable is installed. Prior to releasing the conduit for the installation of cables, all OSP conduits must be cleaned with a brush pulled through the conduit at least two times in the same direction and swabbed with clean rags until the rag comes out of the conduit clean and dry. All OSP conduits must be tested with a mandrel to prove compliance with the sweep radius requirements throughout the conduit run. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.

## **27 05 26 GROUNDING AND BONDING**

A #6 AWG insulated stranded copper cable shall be provided from the ER to the building main electrical service ground electrode. A Telecommunications Main Grounding Busbar (TMGB) shall be installed in the ER. All metallic conduits entering the ER, all equipment racks in the ER, and all exposed non-current carrying metal parts of telecommunications and information technology equipment in the ER must be bonded to the TMGB.

## **27 05 28 PATHWAYS FOR COMMUNICATION SYSTEM**

### **DESIGN CRITERIA FOR INSIDE PLANT CONDUIT**

Telecommunications conduit must be properly designed and installed. The design and installation practices for telecommunications conduit have some unique requirements beyond those normally seen in standard electrical conduit. The following items are required to be included in the design and installation of interior telecommunications conduit:

Conduits must be designed and installed in the most direct route possible from the telecommunications closet to the work area.

## **27 05 28.29 HANGERS AND SUPPORTS**

Hangers and cable support mechanisms must be designed to easily accommodate current and future high-performance cabling upgrades, eliminating the need to replace infrastructures when more cable is added.

Products such as Caddy Cat Links or equivalent are designed for aerial cable support system. They provide a wide bend radius that reduces cables friction and offers less vertical cable compaction. These cable supports come in several sizes.

## **27 05 28.33 CONDUITS AND BACKBOXES**

Pull boxes used with telecommunications conduits in interior locations shall be rated NEMA-1. Pull boxes used in damp or wet locations such as plumbing chases or out of doors shall be rated NEMA-3R. Pull boxes shall be installed in conduits at an interval no greater than every 100 feet. A pull box shall be installed in conduit runs whenever there are two 90° sweeps, or a total of 180° of sweeps, in a conduit run. Any deviations from these criteria must have prior approval from PSHS (MIMAROPA) IT department.

## **27 05 28.36 CABLE TRAYS**

1. The Inside Plant (ISP) telecommunications substructure are the cable pathways and support structures necessary for routing telecommunications cabling between telecommunications closets, and from the telecommunications closet to the work area. There are numerous different products and methods that can be employed to build the substructure. Some of these methods include: Enclosed conduit system, Open or enclosed cable trays, Routing above a false ceiling using cable supports, and in-slab floor ducts.

Cooper B-Line's FLEXTRAY® Cable Management provides value through jobsite flexibility and labor savings. The systems combine strength, lightweight construction, depth, and unmatched adaptability to support cables in a fast and economical way.

FLEXTRAY® is a flexible, field-adaptable way to manage cables throughout the project. The tray itself can be cut and bent to the needs of the installer on the jobsite, allowing cable runs to be adjusted as needed. The wide range of sizes offered by Cooper B-Line makes Flextray a great choice for everything from a small cable drop to a large trunk of cables, 12- to 24-inches wide by 2-inches high is the preferred size for PSHS (MIMAROPA) building. The tray has the market-preferred "T" weld safety edge, protecting both the cable and the installer during cable installation. Flextray is also UL Classified as an equipment-grounding conductor.

2. The conduit system shall be routed inside ceilings, floors, and walls to the greatest extent possible. Surface mounted conduit shall be used only when there is no other route to provide service to the desired location.
3. For the main floor (slab on grade constructed buildings) in conduit will route in walls and ceilings not in or under the slab. If this design is not possible, an alternate must be presented and approved following Section F – Approval for Alternate Design Solutions.

If an under-slab route solution is approved, the conduit must be installed with at least 1” of concrete encasement around all sides of the conduit. Exceptions occur in cases of modular furniture installation. In which in-slab conduit routing is sometimes necessary; design should work in conjunction with modular furniture.

4. Telecommunications outlets shall be located to minimize the length of patch cord required to connect the computer or telephone to the outlet.
5. All outlets shall have a minimum one (1) inch conduit. Increase the conduit size as necessary for the quantity of cables to be installed. Cable fill shall not exceed 40%.
6. All wall outlets shall be mounted in a minimum 4 x 4 x 2.5 inches deep double gang outlet box.
7. An electrical outlet shall always be located within 3 feet of a telecommunications outlet.
8. Telecommunications cable and conduit shall maintain the minimum separation distance from power as listed below.

For power systems operating at 480V or greater, including electrical distribution panels, step down devices or transformers, maintain a minimum separation distance of 6 meters (20 feet) from all telecommunications cross-connects.

For power systems operating at 480V or greater, maintain a minimum separation distance of 3 meters (10 feet) from all telecommunications cabling. Pathways should cross perpendicular to electrical power cables or conduits.

For large electrical motors or transformers, maintain a minimum separation distance of 1.2 meters (4 feet) from all telecommunications cabling.

For lightning protection system conductors (NEC 800-13), maintain a minimum separation distance of 1.8 meters (6 feet) from all telecommunications cabling.

For power systems operating at less than 480V, including all conduit and cables used for electrical power distribution, maintain a minimum separation distance of 0.6 meter (2 feet) from all telecommunications cabling. Pathways should cross perpendicular to electrical power cables or conduits.

For fluorescent lighting, maintain a minimum separation distance of 12 cm (5 in) from all telecommunications cabling. Pathways should cross perpendicular to fluorescent lighting.

For branch circuits (secondary) power (120/240V, 20A) where electric light or power circuits coexist with telecommunications cabling, maintain a minimum separation distance of 0.50 m (2 in).

## **27 05 43 UNDERGROUND DUCTS AND RACEWAYS**

This section is applicable for the main entrance of required communication services but not limited to voice and data but for other low voltage systems that requires connection to other buildings and/or facilities of PSHS (MIMAROPA). Proper coordination to PSHS (MIMAROPA) IT Department and/or Facilities and/or Maintenance Department is a must.

### **A. TELECOMMUNICATIONS SUBSTRUCTURE—OUTSIDE PLANT (OSP)**

The Outside Plant (OSP) Substructure is the physical pathway used to distribute backbone cabling between buildings, and to bring the entrance cable from the nearest facility backbone access point across PSHS (MIMAROPA) property to the Entrance Facility. Underground conduit is the standard method of distribution between buildings on facility. Input from PSHS (MIMAROPA) IT and Building Facilities staff must be incorporated in developing the initial and on-going construction schedules. This input is especially important when an early or phased turn-up of buildings is required. Timing on the construction of the main telecommunications room and building, and the backbone cable plant connecting it to key buildings, would be a vital consideration in bringing key buildings online at required dates. In new construction, the OSP substructure must be sized to accommodate all low voltage services planned for initial installation, plus a minimum of 25% growth capacity.

### **B. UNDERGROUND DISTRIBUTION**

Underground distribution of low voltage services on PSHS (MIMAROPA) property will consist of appropriately sized conduits and telecommunications manholes or hand-holes. Telecommunications services (voice and data) and other low voltage services such as fire alarm, security systems, and CATV distribution shall not share the same underground distribution conduits and manholes as electrical power distribution.

### **C. UNDERGROUND CONDUIT**

Direct burial of telecommunications cable is not desired, and will only be approved under unique circumstances on a case-by-case basis. A requests to direct bury cable is needed and must follow Section F – Approval for Alternative Design Solutions” process.

The major cost in placing underground utilities is the labor for digging the trench. Therefore, underground telecommunications distribution to permanent facilities shall always be placed in conduit to facilitate the easy installation of additional future cables.

Key requirements for underground conduit installation include:

1. OSP conduit quantity and size shall be determined based on the requirements for the initial installation of cable and a realistic prediction of future expansion in the area. <sup>[1]</sup><sub>SEP</sub> Always provide a minimum of 25% spare capacity above the initial installation requirements and known growth.



2. OSP conduit quantities shall be based on a maximum of 40% cable fill per conduit. <sup>[17]</sup><sub>SEP</sub>All OSP telecommunications conduit installations shall have a minimum of two spare conduits.
3. Building Facilities will specify the products to be used for OSP telecommunications conduits. Typically these will consist of Schedule 40 or Schedule 80 Rigid Nonmetallic conduit, Polyvinyl Chloride (PVC), and must meet the requirements of NEMA TC 6. All conduit sections shall be glued with PVC pipe glue to form a watertight joint. All schedule 40 pipes to be embedded in sand. Spacers are required to maintain proper separation between multiple conduits in a run.
4. All OSP conduits shall be installed with a slight drain slope (0.125 inches-per-foot) away from buildings to prevent the accumulation of water in the conduit or ingress to the buildings.
5. Factory-manufactured sweeps, which meet ANSI/TIA/EIA 569-A, bend radius requirements shall be used for all telecommunications conduit. The bend radius of the sweeps must be a minimum of 10-times the internal conduit diameter. Bending conduit in the field using manual or mechanical methods is not acceptable. Standard electrical elbows shall not be used.
6. All facility distribution conduits must be buried a minimum of 24 inches below grade, with preferred depth of 36 inches.
7. All cable shall be installed in the lowest available conduit in a duct bank, working up as additional cables are installed.
8. All OSP conduits and inner duct, used and spare, shall be plugged with watertight plugs at both ends to prevent the intrusion of water, gasses, and rodents throughout the construction project. All OSP conduits shall have quarter (1/4)-inch polypropylene pull ropes installed. The pull ropes must be re-pulled each time an additional cable is installed. All OSP conduits must be tested with a mandrel to prove compliance with the bend radius requirements throughout the conduit run. Within five days of releasing the conduit for the installation of cable, the conduit installation contractor shall prove all conduits to be clean and dry.
9. In new construction and new conduit, fiber optic backbone cables shall always be installed in fiber optic inner duct. Normally, three to four inner duct can be placed in a four (4)-inch conduit. Where fiber optic cable is installed into existing conduits, the use of fiber optic inner duct is preferred if space is available. Inner duct is used to separate and segregate cables, and to prevent the tangling of cables in a conduit. Types of textile maxcell inner duct may be used.
10. Splices in backbone fiber optic cable are not allowed, design OSP conduit accordingly.

#### **D. TELECOMMUNICATIONS MANHOLES**

Telecommunications manholes shall be placed in outside plant conduit runs at an

interval no greater than every 500 feet. Conduits routing between two telecommunications manholes, or between a manhole and a building, shall contain no more than two 90° sweeps or a total of 180° of sweeps. If additional conduit sweeps are required, place additional manholes as needed. Telecommunications manholes are typically constructed in pre-fabricated cast concrete, and contain a floor section, wall section, and top section. Manholes are sized based on the ultimate duct structure and equipment that will be located in the manhole. Minimum size of any manhole shall be 6 x 8 x 7 feet.

Key requirements for telecommunications manhole installation include:

1. Telecommunications manhole sections must be installed with a watertight joint sealer between the sections of the manhole.
2. Telecommunications manholes must be equipped with a pre-cast concrete floor section. Bare earth for the floor of a manhole is not allowed. The floor section must contain a sump to facilitate the use of a submersible pump for de-watering the manhole.
3. Telecommunications manholes must be equipped with steel pulling eyes pre-cast in the walls opposite to each duct bank to facilitate cable-pulling apparatus.
4. Telecommunications manholes must contain 18-hole or 37-hole cable racks for dressing and securing cables that route through the manhole. Must contain at least two sets per manhole wall.
5. Telecommunications manholes over five (5) feet deep must have permanently installed ladders. All telecommunications manholes shall have a minimum of one grounding rod.

All metal hardware in the manhole or handhole (racks and ladders) must be grounded to the bonding tabs pre-cast in the manhole, with the bonding tabs bonded to the ground rod.

The cover of all telecommunications manholes must be a minimum of one (1) inch above the finished grade after all landscaping is completed. If manholes are located in paved areas, the pavement must be tapered up to the manhole cover.

## **E. TELECOMMUNICATIONS HANDHOLE**

A handhole is similar to a miniature manhole that is used solely as a pulling point to expedite the installation of cable in conduit runs over 500 feet or with more than two 90° sweeps. Maximum size of handhole is 4 x 4 x 4 feet.

The following rules apply to the use of handholes:

1. A handhole shall not be used if the ultimate or total requirements exceed the capacity of two four (4)-inch conduits, in and out.
2. Where more than two four (4)-inch conduits are used in a duct bank, telecommunications manholes must be used in lieu of handholes.
3. A handhole shall not be utilized for splicing cables together. [S&EP]



4. Conduit entering the handhole shall be aligned on opposite walls of the handhole at the same elevation.

## **27 05 44 SLEEVES AND SLEEVE SEALS FOR COMMUNICATION PATHWAYS AND CABLING**

Refer to Division 28

## **27 05 53 IDENTIFICATIONS**

To be consistent with ANSI/TIA/EIA standards and industry practices, it is important that both labeling and color coding be applied to all telecommunications infrastructure components. Labeling with the unique identifier will identify a particular component. Proper color coding will quickly identify how that component is used in the overall telecommunications infrastructure of the facility.

Administration of the telecommunications infrastructure includes documentation of cables, termination hardware, patching and cross-connection facilities, conduits, other cable pathways, telecommunications closets, and other telecommunications spaces.

In order to create a consistent environment, the PSHS (MIMAROPA) IT Department maintains a facility wide numbering scheme for voice and data outlets and patch panels.

Voice and data outlets shall use the following labeling sequence: A1W1A1

A = Building Code such as A for Building A, B for Building B and C for Building C

1 = Floor number

W = facility orientation of telecom room (North, South, East or West)

1 = rack number (numeric)

A= patch panel (A-Z)

1= port number (1-24/48), depending on the number of port on the switch

A label must be affixed to both the top and bottom label holder in the faceplate.

Example: Building A Ground Floor 4 port single gang faceplate labels Top label – A1W1 A1 A2<sup>[L]</sup><sub>[SEP]</sub> and Bottom label – A1W1 A3 A4

When more than one patch panel is needed per rack, the numbering scheme shall start over at with panel B, port one and so on.

Outlet numbers shall be labeled on each cable at the outlet and at the TC.

Labels are generally of either the adhesive or insert type. All labels must be legible, resistant to defacement, and maintain adhesion to the application surface.

Outside plant labels shall be totally waterproof, even when submerged. All labels shall be machine printed.

Labels applied directly to a cable shall have a clear vinyl wrapping applied over the label and around the cable to permanently affix the label.

Other types of labels, such as tie-on labels, may be used. However, the label must be appropriate for the environment in which it is used, and must be used in the manner

intended by the manufacturer.

### 1. **Color Coding – Cable Termination Fields**

Industry standard (ANSI/TIA/EIA 606) color coding shall be applied to all cable termination fields in Telecommunications Closets, Equipment Rooms, and Entrance Facilities. Color coding may also be used to identify specific cables in a pathway, or the function of specific equipment racks or equipment. The same color is always applied to both ends of any given cable. Cross-connections are generally made between termination fields of different colors. The color may be applied to the plywood backboard behind the termination block, may be the color of a plastic cover on a termination block, or may be the actual color of the insert label on a termination block or patch panel. The following color code shall be used in all PSHS (MIMAROPA) facilities:

1. Orange – Reserved for identification of the telecommunication service demarcation point (demarc). Orange may only be used by the telephone company.
2. Green – Used to identify the termination of network connections on the customer (PSHS (MIMAROPA)) side of the demarc.
3. Purple – Used to identify cables originating from common equipment, such as the telephone PBX, LAN hubs/switches/routers, or multiplexer.
4. White – Used to identify the first-level backbone telecommunications media termination in the building containing the main cross-connect. The main cross-connect is usually in the Equipment Room. In buildings that do not contain the main cross-connect, white may be used to identify the second-level backbone terminations.
5. Gray – Used to identify the second-level backbone telecommunications media termination in the building containing the main cross-connect.
6. Blue – Used to identify the termination of horizontal distribution cables routing from the Telecommunications Closet or Equipment Room to the Work-Area. A blue color coding is only required at the TC or ER end, not at the work-area end of the cable.
7. Brown – Used to identify inter-building backbone cable terminations.
8. Yellow – Used to identify termination of auxiliary circuits, alarms, maintenance, security, and other miscellaneous circuits.

## **F. DRAWINGS**

Drawings are used to illustrate different stages of telecommunications infrastructure planning, installation, and administration.

### **Installation or Construction Drawings**

Installation or construction drawings are the plans that show the installer/contractor how the infrastructure is to be installed. The quality of the installation can be directly impacted by the level of detail in the installation drawings and written specifications. Installation drawings for PSHS (MIMAROPA) projects shall, at a minimum, show

pathway locations and cable routing. Drawings shall indicate which telecom room cables should terminate in and the cable count in each telecom room. PSHS (MIMAROPA) IT will provide drawings showing the configuration of telecommunications spaces including backboard and equipment rack configurations.

### **As-built Drawings**

The as-built drawings graphically document the installed telecommunications infrastructure through floor plan, elevation, and detail drawings. In many cases, these drawings will differ from the installation drawings because of changes made during construction and specific site conditions. In the as-built drawings, the identifiers for major infrastructure components must be recorded. The pathways, spaces, and wiring portions of the infrastructure each may have separate drawings if warranted by the complexity of the installation, or the scale of the drawings. As-built drawings are a vital component of the telecommunications administration system, and must be kept current as adds, moves, and changes take place. The PSHS (MIMAROPA) IT Department requires the installer/ contractor to provide a complete and accurate set of as-built drawings.

## **27 06 00 SCHEDULES FOR COMMUNICATIONS**

### **A. CRITICAL DELIVERABLES EXPECTED FROM TELECOMMUNICATIONS CONTRACTOR**

During construction, the cabling contractor must contact the PSHS (MIMAROPA) IT department to inspect the work at the following milestones:

- 1. Prior to anchoring the telecom equipment racks to the floor to ensure they are positioned in the proper location.**
2. While pulling horizontal cable from TR to wall outlet locations, when pathways are open and exposed, representatives from PSHS (MIMAROPA) IT department must witness some portion of cabling installation.
3. During termination of the horizontal cabling in the TR on the patch panels, PSHS (MIMAROPA) IT representative must witness 10% of terminations. The TR and patch panels will be inspected again for proper labeling and workmanship at the end of the project.
4. During wall outlet terminations, PSHS (MIMAROPA) IT representative must witness 10% of cable termination during the project.
5. During testing and labeling faceplates, PSHS (MIMAROPA) IT representative must witness 10% of testing. Wall outlets must be tested with the faceplate installed in the outlet.

Typically a 2-3 day notice sent via email to PSHS (MIMAROPA) IT department will be sufficient to schedule the inspections. If the cabling portion of the project is small in nature, some or all of the inspections may be performed at the same time.

It is essential for PSHS (MIMAROPA) IT to receive all test results and as-built drawings prior to job acceptance. The test results must adhere to the following specifications, formats and delivery conditions:

### **B. SPECIFICATIONS**

A complete end-to-end test result for all copper UTP and fiber optic lines installed is required.

All fiber optic cable must be visually inspected upon delivery to the installation site.

During construction the cabling contractor must contact PSHS (MIMAROPA) IT to inspect the work at the following milestones:

1. Prior to mounting the fiber termination panel to ensure it is located in the proper location.
2. While pulling fiber optic cable when pathways are open and exposed. PSHS (MIMAROPA) IT representative must witness some portion of fiber installation.
3. During termination in the TR of the OSP fiber, PSHS (MIMAROPA) IT representative must witness 10% of terminations during the project. TR and fiber

termination panel will be inspected again for proper labeling and workmanship at the end of the project.

4. During testing and labeling fiber, PSHS (MIMAROPA) IT representative must witness 10% of testing.

Typically a 2-3 day notice sent via email to PSHS (MIMAROPA) IT department will be sufficient to schedule the inspections. If the cabling portion of the project is small in nature, some or all of the inspections maybe performed at the same time.

End-to-end test measurements shall be provided for single-mode and multimode fibers (2 wavelengths per test is required). Test results must be submitted for review as part of the installation inspection requirements. Test results shall be in paper form and electronic form, and must contain the names and signatures of the technicians performing the tests.

Testing shall be performed on 100% of the fibers in the completed end-to-end system.

1. TIA-526-7 (OFSTP-7)-2002+A1:2008, Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant. This standard specifies single-mode optical loss measurement methods between two passively-connected points using an optical source and power meter.
2. TIA-526-14-B-2010 (OFSTP-14), Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant; IEC 61280-4-1 Edition 2, Fibre-Optic Communications Subsystem Test Procedure- Part 4-1: Installed Cable Plant-Multimode Attenuation Measurement. This standard is used to measure the optical loss between any two passively connected points, including end terminations, of a multimode optical fiber cable plant. – The optical fiber cable plant, as the term is used here, may consist of optical fiber cables, connectors, mounting panels, jumper cables, and other passive components, but it may not include active components. This standard includes an encircled flux launch condition metric for measuring cable plant. Additionally, this standard includes the description of using an optical time domain reflectometer (OTDR) for total attenuation measurement and measurements of individual component loss. Additionally, all fiber optic cable links must pass all installation and performance tests both recommended and mandated by the cable manufacturer.

100% of all pairs in backbone copper cables shall be tested for continuity and wire-map on the finished installation.

The transmission performance of a cabling system depends upon the characteristics of the horizontal cable, connecting hardware, patch cords, equipment cords, work area cords, cross-connect wiring, the total number of connections, and the care with which they are installed and maintained. The development of high-speed applications requires that cabling systems be characterized by transmission parameters such as insertion loss, PSNEXT loss, return loss, and PSELFEXT. System designers use these performance criteria to develop applications that utilize all four pairs in a cabling system for simultaneous bi-directional transmission. This Standard provides minimum cabling component performance criteria as well as procedures for component and cabling performance validation. Wall outlet terminations on the horizontal cabling must be

complete and the faceplate attached to the wall prior to final testing.

### **C. FORMAT**

Test Results must be submitted in 2 formats. First, must be original file(s) down loaded from tester. Secondly as a .pdf file.

As Built drawings must be submitted with .dwg file extensions.

### **D. DELIVERY**

Test Results may be electronically submitted to PSHS (MIMAROPA) IT Department. Contact information will be provided after contract is awarded and before project completion.

## **27 08 00 COMMISSIONING OF COMMUNICATIONS**

### **SYSTEMS FUNCTIONAL PERFORMANCE TESTING**

1. This test is intended to test systems functional performance under normal operating conditions.
2. Upon completion of the network equipment installation, PSHS (MIMAROPA) IT network service technicians and engineers will perform systems' tests on the entire infrastructure not limited to structured cabling system to test system performance.
3. Any evidence or cause for concern that the structured cabling system is not performing as designed will be brought to the installation contractors' attention and a resolution determined before the system is accepted.
4. The Contractor shall provide the required labor, materials, and test equipment identified in the testing process to confirm that the structured cabling system is functioning properly.
5. The Contractor shall provide machine generated cable test reports on 100% of installed cabling, both copper and fiber.

## **27 10 00 STRUCTURED CABLING**

### **27 11 00 COMMUNICATIONS EQUIPMENT ROOM FITTINGS**

#### **A. MAIN TELECOMMUNICATIONS EQUIPMENT ROOM (ER)**

The Main Telecommunications Equipment Room (ER) is the central location in a building where the major telecommunications equipment is located.

1. The ER typically contains the telephone demarc, Distribution Layer data equipment and LAN switching equipment, closed circuit TV (CCTV) and security systems, card access controllers and additional low voltage systems.
2. To minimize both conduit and cable lengths, the ER shall be located as close as practical to the center of the building.
3. ER shall be a minimum of 10' by 10'.

In this PSHS (MIMAROPA) Project, the Main ER (Server Room) is located beside elevator lobby of Upper Ground Floor.

4. In new construction, the ER shall be sized and provisioned to contain all major voice, data, and video equipment required to support the building, and all other computer based and networked low voltage systems.
5. During renovation or remodeling of existing facilities, every reasonable effort shall be made to co-locate these systems in a common equipment room.

#### **B. ER PLANNING, LAYOUT, AND SIZING**

The first step in determining the size required for the ER is to identify the systems that will be installed into the ER. In this process, first identify the size of the area that will be served from the ER. Next, identify the quantity, size and variety of systems to be installed to support the area, and the space required for each of the systems. Once the size and quantity of systems are identified, they shall be laid out in a functionally efficient arrangement. Some equipment, such as voice cross-connects, LAN switches and patch panels will require regular access and shall be located where they are easily accessible. PSHS (MIMAROPA) IT staff must be involved in the design phase and must approve the final space requirements and design layout for all equipment and racks as well as conduit paths in ER.

When laying out the arrangement of the ER, the following requirements and issues shall be addressed:

1. Groups of like equipment types shall be located together; i.e., voice, data for both LAN and video.
2. Wall space and equipment rack space must be designated for particular uses by particular people.
3. Set aside specific backboard space and equipment rack space for the service providers demarc, and any associated equipment.



4. Designate specific adjacent areas for each of the various service providers. Keeping all of the service providers on a common wall and row of equipment racks will limit their access to other areas of the equipment room.
5. Separate wall and equipment rack space is designated for the termination and cross connection of facility distribution cables, both copper and fiber optic.

These areas shall be located adjacent to the equipment providing the services, such as the PBX, routers, and switches.

Careful design planning must be performed to ensure that all telecommunications cabling has the minimum setback distanced from all potential sources of electromagnetic interference (EMI) or radio frequency interference (RFI), such as electric motors, power transformers, etc. Incorrect planning can result in expensive changes at a later date.

Equipment racks and rack-mounted equipment must have a minimum of three (3) feet of unrestricted clearance in front and back for technician access. In smaller installations, wall mounted swing-out equipment racks can be used to save space, but must have three (3) feet clearances to the front of the rack. Note that some LAN equipment may be large, or may require clearance at both the front and back, and wall mounted swing-out racks may not be appropriate.

Once an acceptable equipment layout is developed, the size of the equipment room can be calculated. Always provide a minimum of 25% spare space for future growth. With the size determined, the location of the equipment room can be selected.

### **C. EQUIPMENT ROOM CHARACTERISTICS**

The characteristics of the ER have a significant impact on all other aspects of telecommunications design. Next to insuring adequate size, selecting a suitable location is the most critical step in planning the ER.

The major factors that must be considered when planning and locating the ER are:

1. Access for delivery and installation of large equipment into the ER.
2. Access by PSHS (MIMAROPA) IT and service provider maintenance personnel.
3. Restrictions on unauthorized access.
4. Close proximity to electrical service.
5. The ER must be dedicated to the telecommunications and information technology function. Shared use of boiler rooms, washrooms, janitor closets, electrical closets, or storage rooms is not allowed.
6. The floor, walls, and ceiling shall be sealed to reduce dust. Finishes shall be light in color to enhance room lighting. Flooring materials having antistatic properties shall be selected. Raised flooring maybe considered with a minimum of 20mm above finished floor line.
7. The room must be free of plumbing and electrical utilities not directly required to support the telecommunications functions.



8. Close proximity to service entrances for telecommunications and power.
9. Close proximity and centralized to the facility telecommunications distribution pathways (conduits and/or aerial distribution) to minimize the backbone cable lengths.
10. No pass thru to other rooms otherwise required by U IT department for easy access to adjoining IT rooms.

#### **D. EQUIPMENT ROOM LOCATIONS**

Unacceptable Room Locations: Any areas subject to water or steam infiltration, particularly basements. A floor drain is required if there is any risk of water entering the ER. Any areas exposed to excessive heat or direct sunlight. Any areas exposed to corrosive atmospheric or environmental conditions.

Near or adjacent to any potential sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power transformers, arc welding equipment, or high power radio transmitting antennas. This is a critical consideration, as EMI and RFI can render IT networks totally inoperable. No point within the ER shall be closer than 6 meters (20 feet) to power panels or equipment rated at greater than or equal to 480V that may cause Electrical Interference or equipment which may cause RFI or EMI.

#### **E. ENVIRONMENTAL PROVISIONING**

The following environmental provisions are required in the Main ER:

1. Heating, ventilation, and air conditioning (HVAC) shall be provided on a 24 hours per day, 365 days per year basis. If the building system cannot assure continuous operation, a stand-alone unit shall be provided for the ER.
2. The temperature and humidity shall be controlled to provide a continuous operating range of 64°F to 75°F, with 30% to 55% relative humidity (RH).
3. Lighting shall be a minimum of 50-foot candles, measured three (3) feet above the finished floor in the middle of all aisles between equipment racks and cabinets.
4. Minimum clear height in the ER shall be eight (8) feet without obstructions.
5. Dry chemical fire suppression systems are preferred in the ER. [L] [SEP]

#### **F. ELECTRICAL PROVISIONING**

The following electrical provisions are required for the Main Telecommunications Equipment Room (ER):

1. A separate supply circuit serving the room shall be provided and terminated in its own electrical panel located in the ER. This power panel shall be designated as “ER Technical Power.” The ER Technical Power panel shall be used exclusively for supplying power to electronics equipment in the equipment room.
2. If emergency generator power is available to the facility, the ER Technical Power panel must be linked to the emergency generator power supply. Sizing of

electrical power is dependent upon the equipment types and equipment load, and must be calculated on a case-by-case basis, including sufficient spare capacity for future growth.

3. Each equipment rack and all major freestanding equipment shall be provided with two dedicated 20A 220VAC electrical circuits from the ER Technical Power panel, each terminated in a quad (4-plex) outlet. Technical power shall be identified with orange colored electrical outlets. These outlets shall be used exclusively for electronics equipment. Do not use Technical Power outlets for general-purpose or utility devices such as electric drills, vacuum cleaners, or coffee pots.
4. Some IT equipment, such as large LAN switches and routers, are ordered with dual power supplies. The placement of equipment with dual power supplies shall be identified and the appropriate racks must have three, separate, dedicated 20A 220VAC electrical circuits from the ER Technical Power panel, each terminated in separate quad (4-plex) outlets, and be appropriately marked to identify the separate circuit breakers.
5. Some major pieces of telecommunications equipment, such as PBX remote equipment, may require 208 or 220 VAC power. These systems must be identified, and power requirements determined, well in advance of the ER architectural and electrical design.
6. The ER shall have 20A 220VAC general-purpose convenience electrical outlets placed at 6-foot intervals round the room. The general-purpose circuits must not originate from the ER Technical Power panel. The general-purpose circuits shall be used for general purpose, utility devices such as power tools or vacuum cleaners. Do not use general-purpose outlets for ER electronics equipment.  
  
White, gray, or beige colored outlets to match all other general-purpose outlets in the building shall identify the general-purpose outlets (color coded).
7. The ER shall be equipped with a power disconnect switch. This switch shall be located near the main door of the ER. The switch shall disconnect power to all electronic equipment in the ER, and is to be used in the event of electrocution or fire in the ER. There shall also be a similar means to disconnect the power to all dedicated HVAC systems serving the ER and cause all required fire/smoke dampers to close.

Refer to the National Electrical Code, NFPA 70, Article 645-10.

## **G. TELECOMMUNICATIONS BACKBOARDS**

All walls of the ER shall be covered with three-quarter inch A-C grade fire retardant plywood, painted with two coats of light colored, non-conductive fire retardant paint. The plywood shall extend from the floor to eight (8) feet above the finished floor, and shall be mounted with the “A” side exposed. Cutouts shall be provided around existing power and telecommunications outlets. In new construction, power and telecommunications outlets, and light switches in the ER shall be surface mounted on the plywood backboard.

## **H. TELECOMMUNICATIONS CLOSETS (TC) OR ROOMS (TR)**

The Telecommunications Closet(s) or Room(s) (TCs/TRs) is located in each building, or each floor of a building, where backbone cables transition to horizontal distribution cables. These cables will be both fiber optic and copper, and will support voice, data, video, and other low voltage systems. The TC/TR may also contain certain items of network electronics equipment such as routers or switching equipment. A large building, with large floors, may have multiple TCs/TRs on a floor. To minimize both conduit and cable lengths, the TC/TR shall be located as close as practical to the center of the building where it is housed on each floor of the area to be served. TCs/TRs should be “stacked” one above the other for multiple floors. Close attention must be given to the maximum length (90m) on LAN copper horizontal distribution cable.

## **I. PLANNING, LAYOUT, AND SIZING**

1. ANSI/TIA/EIA 569-A provides sizing formula for a TC/TR in normal office buildings. The sizing is based on the “usable floor space,” which is the space on a floor that can actually be used for office activities. TC/TR shall be a minimum of 60 square feet. Spaces such as mechanical rooms, janitorial closets, and rest rooms cannot be used for office activities, and are not counted as usable floor space. The sizing formula assumes an average of 100 square feet of floor space for each person, or “work –area.” Many PSHS (MIMAROPA) buildings are not traditional commercial or office buildings, and the sizing guidelines of ANSI/TIA/EIA 569-A must be adjusted to accommodate these buildings.
2. There shall be a minimum of one TC/TR per building (may be an ER). Additional TCs/TRs shall be added when the area to be served exceeds 10,000 square feet, or the cable length from the TC/TR patch panel to the farthest work area outlet exceeds 90 meters (295 feet). Cable length is not calculated on a straight-line distance. The distance must include the rises, drops, and bends that the cable will follow from the TC/TR to the work area.

## **J. LOCATION**

1. The TC/TR in each building is the transition point between backbone cabling and horizontal distribution cabling.
2. The TC/TR must be able to contain telecommunications equipment, cable terminations, and associated cable interconnection apparatus.
3. The TC/TR shall be dedicated to the telecommunications function.

4. The TC/TR shall not be shared with electrical installations other than those necessary for telecommunications.
5. The TC/TR shall be located as close as practical to the center of the area to be served, preferably in the core area of the building, to minimize the cable length. The maximum length of copper horizontal distribution cable is 90 meters (295 feet) from the workstation outlet to the TC/TR patch panel, no exceptions. Where this length would be exceeded the designer will add additional TCs/TRs as required.
6. Multiple TCs/TRs on a floor shall be interconnected by a minimum of three spare conduits. Additional conduits shall be installed as necessary based on the quantity of services supported.
7. All fiber optic backbone cables shall home run from each individual TC/TR to the main telecommunications ER, which should be the location of the data switching equipment.
8. TCs/TRs shall not be located in or adjacent to areas containing sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power transformers, arc-welding equipment, radio transmitting antennas, etc. This is a critical consideration, as EMI and RFI can render IT LAN networks totally inoperable. No point within the TC/TR shall be closer than 6 meters (20 feet) to power panels or equipment rated at greater than or equal to 480V, that may cause electrical interference or equipment which may cause RFI or EMI.

#### **K. SIZING AND LOCATION IN EXISTING FACILITIES**

Existing facilities present a unique challenge for sizing and locating the TC/TR. Many buildings were designed and constructed only to support telephones. When planning the size and location of TCs in existing buildings, every reasonable effort shall be made to meet the requirements for telecommunications closets identified above. In certain instances, the only viable alternative will be the use of one or several telecommunications cabinets in lieu of closets.

#### **L. FOR SMALL BUILDINGS WITH LIMITED SERVICES**

Certain small buildings may not justify a separate room as the TC/TR. In existing buildings, sufficient space may not be available for a TC/TR. In such cases, PSHS (MIMAROPA) IT will determine the best possible solution for serving the building and allowing room for future growth. These telecommunications spaces must provide:

1. Physical security to protect the contents and prevent unauthorized access. The space shall be accessible, but also provide physical security.
2. All power and telecommunications cables for equipment should be routed in a manner so that no cables are exposed.
3. All power and telecommunications cables routed to or from the space must be contained in conduit, surface mounted raceway, or routed within the adjacent wall.

4. The space must contain a plywood backboard for mounting telecommunications hardware.
5. The space must provide a means of mounting electronics equipment, including a LAN switch. Acceptable means are rails for rack mounting, or adequate space on the plywood backboard for electronics equipment wall mounting brackets.
6. The space must have a minimum of one 20A 220VAC quad (4-plex) electrical outlet on a dedicated circuit breaker from the electrical panel. An available general-purpose power panel may be used to support the telecommunications cabinet power outlet. The power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc-welding, or industrial equipment. The power panel must be located in close proximity to the cabinet.
7. There shall be at least one 20A 220VAC general-purpose convenience outlet located within 6 feet of the space. The general-purpose outlet shall not be used to power electronics equipment.
8. The backboard must have a telecommunications grounding busbar installed in accordance with the requirements listed in these guidelines.
9. The space shall not be located in or adjacent to areas containing sources of electromagnetic interference (EMI) or radio frequency interference (RFI) such as large electric motors, power transformers, arc-welding equipment, radio transmitting antennas, etc. This is a critical consideration, as EMI and RFI can render IT WAN and LAN networks totally inoperable.
10. Standard EIA 19-inch open frame equipment racks as approved for use in the Main Telecommunications Equipment Room may be used in the TC/TR. Floor standing racks must be securely bolted to the floor, and must be braced to the wall with cable ladder racking. Multiple racks in the same TC/TR shall be interconnected with vertical cable managers.
11. Some IT equipment, such as large LAN switch, requires an equipment rack with both front and rear mounting rails. Where space or equipment is limited, an open frame wall mounted equipment rack or enclosed equipment cabinet may be used. Wall mounted racks and cabinets must have two “swing-gates”: one for the front access panel and a second for rear access. Provide 36” (3 feet) clear work space front, rear, and at one end of each equipment rack / cabinet line up for floor mounted racks / cabinets leaving sufficient front and rear rack / cabinet footprints for any equipment planned for installation. All cabinets must have a minimum of 20” from the front rail to the wall; racks must have a minimum of 20” from the front rail to the rear isle workspace. All racks must be equipped with an appropriate number and type of horizontal and vertical wire management modules both front and rear with strain relief brackets to insure proper bend radius and that strain relief is maintained for all cables.

## **M. ENVIRONMENTAL PROVISIONING**

1. Walls and ceiling shall be treated and sealed to eliminate dust. Finishes shall be light in color to enhance room lighting. The floors in all low voltage equipment

rooms will be; light colored, fire retardant, slip resistant, and provide protection from electrostatic discharge (ESD).

2. In TCs/TRs that contain active electronics equipment (routers, switches, etc.), an HVAC system shall be provided on a 24 hours per day, 365 days per year basis.
3. See [Section 27 11 00.G, ENVIRONMENTAL PROVISIONING](#).

## **N. ELECTRICAL PROVISIONING**

1. Each TC/TR shall be equipped with a minimum of two 20A, 220VAC quad (4-plex) electrical outlets, each on its own dedicated circuit breaker. The outlets shall be colored orange, and identified as Technical Power. These outlets shall be used exclusively for electronics equipment. Do not use Technical Power outlets for general-purpose or utility devices such as electric drills, vacuum cleaners, or coffeepots.
2. The Technical Power circuits should originate from a dedicated power panel serving the TC/TR. However, in small buildings where this may not be cost effective, an available general-purpose power panel may be used. The power panel shall not be used to supply power to sources of electromagnetic interference such as large electric motors, arc-welding, or industrial equipment. The power panel must be located in the TC/TR, or in close proximity to the TC/TR.
3. Some IT equipment, such as large LAN switches and routers, are ordered with dual power supplies. The placement of equipment with dual power supplies shall be identified and the appropriate racks must have three, separate, dedicated 20A 220VAC electrical circuits from the ER Technical Power panel, each terminated in separate quad (4-plex) outlets, and be appropriately marked to identify the separate circuit breakers.
4. The TC/TR shall have 20A 220VAC convenience outlets placed at 6-foot intervals around the room.
5. See [Section 27 11 00.H, ELECTRICAL PROVISIONING](#).

White, gray, or beige colored outlets to match all other general-purpose outlets in the building shall identify general-purpose outlets. These outlets shall not be used to power electronics equipment.

## **O. TELECOMMUNICATIONS BACKBOARDS**

See [Section 27 11 00.I, TELECOMMUNICATION BACKBOARDS](#).

## **P. CABLE SERVICE LOOPS**

Horizontal distribution cables shall be installed with a service loop at one or both ends. The service loop shall have at least 10 feet of slack cable. Care must be exercised so that the service loop does not add excessive length to a cable run beyond the 295-foot distance limitation for horizontal distribution cable, or exceed the bending radius of the cable. The service loop shall be located in the most efficient location for future service depending on the type of cable raceway used.



The necessary slack provided by a service loop can be achieved in several aesthetically pleasing methods, including but not limited to:

1. Routing cables the long way around a backboard or equipment rack. [L] [SEP]
2. Placing a service loop in the pull box of a closed conduit system. [L] [SEP]
3. Placing the service loop above the false ceiling before dropping down to the outlet location.

## **27 11 13 ENTRANCE PROTECTION**

## **27 11 16 EQUIPMENT RACKS AND CABINETS**

Planning of the ER layout must make allowances for proprietary equipment and racks, and allow expansion room for future equipment.

1. PSHS (MIMAROPA) IT has standardized on a general purpose open frame 19-inch wide EIA standard equipment rack with channels measuring 16.25”.
2. Floor standing equipment racks must always be securely bolted to the floor.
3. Some IT equipment, such as large LAN switches, may require an equipment rack with both front and rear mounting rails.
4. Provide 36” (3 feet) clear work space front, rear, and at one end of each equipment rack for floor mounted racks leaving sufficient front and rear rack footprints for any equipment planned for installation.
5. All racks must have a minimum of 20” from the front rail to the rear isle workspace.
6. In cases of multiple rack installations all fiber optic terminations must be housed in left rack and all UTP terminations housed in right rack.
7. Collaborations between architects, consultants, contractors and PSHS (MIMAROPA) IT representative(s) is necessary in planning and placement of all ER/TC/TR equipment and components.

Where space or equipment is limited, an open frame wall mounted equipment rack or enclosed equipment cabinet may be used.

1. Wall mounted racks and cabinets must have two “swing-gates”: one for the front access panel and a second for rear access.
2. Provide 36” (3 feet) clear work space front, rear, and at one end of each equipment rack / cabinet line up for floor mounted racks / cabinets leaving sufficient front and rear rack / cabinet footprints for any equipment planned for installation.
3. All cabinets must have a minimum of 20” from the front rail to the wall; racks must have a minimum of 20” from front rail to the rear isle workspace.

## **27 13 00 COMMUNICATIONS BACKBONE CABLING**

### **27 13 13 COMMUNICATIONS COPPER BACKBONE CABLING**

1. The OSP inter-building backbone for Voice (telephone) will be provided by the telephone company.
2. All intra-building voice backbone cable will consist of 24AWG 25, 50 or 100-pair UTP, UL/NEC CMR rated with a gray PVC jacket or CMP if required.
3. Cable shall be third party verified to comply with TIA Category 3 requirements.
4. A coupled bonding conductor will be installed within the riser bundle and bonded and grounded at each end.
5. Voice backbone cabling must provide cabling to extend each single or business line circuit to any communications wall outlet.
6. A system using Belden/CDT BIX 25-pair multiplying connectors mounted in wall-mount frames will be used at the building demarc in the entrance facility to deliver voice circuits to each TR. A BIX frame with multiplying connectors will use Individual cross-connect jumpers to cross-connect voice circuits from the backbone cabling to the voice cabling cross-connect in each TR.
7. A 25–pair Cat 3 cable will extend the voice circuits from the BIX connectors to RJ45 patch panels mounted in the racks.
8. Standard patch cords will then be used to connect the voice circuit to the appropriate horizontal patch panel connector.

### **27 13 13.13 COMMUNICATIONS COPPER CABLE SPLICING AND TERMINATIONS**

No splices are allowed on any communications cables.

### **27 13 23 COMMUNICATIONS FIBER BACKBONE CABLING**

All intra-building data backbone cabling will consist of one or more of the following types of cable:

1. 12-strand single-mode fiber or
2. 12-strand multimode fiber or
3. Category 6A UTP as specified by PSHS (MIMAROPA) IT Department.

The department's goal is to prepare facilities for migration of networks to Gigabit and higher backbone speeds. Fiber optic cable will be required to support most Gigabit and higher applications in the longer distances encountered in PSHS (MIMAROPA) networks. Note that cable distances listed in this section refer to the terminated cable length from the patch panel in each TC/TR to the patch panel in the main ER.

Specific requirements for fiber optic backbones are:

1. All newly installed fiber optic cable and components for network equipment use must be rated and installed to comply with the IEEE 802.3z 1000Base-X Ethernet Gigabit Standard.
2. All fiber optic backbone cables shall home-run either through conduit, utilize an



interlocking armor outer jacket or induct, from each individual TC/TR to the Main Telecommunications Equipment Room (ER), which houses the data switching equipment.

3. The standard inter-building fiber optic backbone shall be to install single-mode fiber optic cable to all buildings.
4. All OSP fiber optic cable with loose tube construction installed underground shall be gel filled or be constructed of appropriate waterproofing compounds.
5. The standard cable size for inter-building fiber optic backbones is 24-strands of single-mode fiber optic cable. Strand count may be increased for specific buildings as required. PSHS (MIMAROPA) IT will determine the strand count during the design phase. All fiber optic backbones shall have a minimum of 20% spare capacity for all systems planned for use on the backbone.
6. All newly installed fiber optic cable shall be placed inside fiber optic inner-duct. Where space is limited in existing conduit systems inner-duct may be omitted. Inner-duct shall be used to segregate and identify fiber optic cables in all telecommunications manholes and at all locations where fiber optic cable is exposed.
7. Fiber optic cables shall always have a minimum 20-foot service loop at the terminating ends and all approved splice points.
8. All strands of a fiber optic cable must be terminated with connectors and tested per previously sited standards.
9. PSHS (MIMAROPA) IT department or its representative (designer/consultant) must design the interfaces on the network equipment based on the actual lengths of the backbone cable runs between the TCs/TRs. PSHS (MIMAROPA) IT or the same personnel must be given the estimated cable length between the fiber patch panels of each TC/TR and the main ER fiber patch panel in the design phase, and the actual cable length as soon as possible in the construction and installation phase.
10. There shall be no splices in fiber optic cable unless specifically allowed in the PSHS (MIMAROPA) IT project design and specifications. All splices approved by PSHS (MIMAROPA) IT must be fusion splices, and there shall never be more than one splice per cable run between the ER and TC/TR.

### **27 13 23.13 Communications Optical Fiber Splicing and Terminations**

1. Coordinate with PSHS (MIMAROPA) IT department the preferred and considered fiber optic cabling solution including the cables, connectors and hardware. Any other fiber optic cable or component not on their preferences must be approved first by PSHS (MIMAROPA) IT department before use.
2. All works related to fiber optic cables including splicing and terminations must be performed by trained technicians using approved parts and procedures as described by preferred fiber optic cabling system of PSHS (MIMAROPA) IT Department.

3. PSHS (MIMAROPA) IT requires all single-mode fiber be terminated using LC type connectors.
4. Legacy multimode cables may be terminated on SC or ST type connectors based on the system or equipment being used.

### **27 13 43 COMMUNICATIONS SERVICES CABLING**

Other backbone cable installations, consideration shall be given to migrating other low voltage systems such as CCTV, fire alarm systems, EMS, emergency call boxes and facility control and monitoring systems to the common structured cabling system.

Necessary contacts for other required communication services will be arranged via PSHS (MIMAROPA) IT Department.

### **27 15 00 COMMUNICATIONS HORIZONTAL CABLING**

In all cases, PSHS (MIMAROPA) requires cable installed in the horizontal distribution cabling (HDC) environment to support low voltage systems including voice and data, and shall be rated to match the environment it is being installed, either plenum or PVC. Horizontal distribution cable is the cable that routes from the TC/TR to the work area.

1. The standard configuration of PSHS (MIMAROPA) IT is to route a minimum of two (2) - 4 pair Category 6A UTP cables to each work area outlet. In all new installations, Category 6A UTP cable shall be used for both voice and data.
2. Where additions are made to existing buildings, Category 6 UTP cable may be used for voice and data. Splitting cable pairs from one cable to two or more outlets to avoid adding an additional four (4)-pair cable is not allowed—no exceptions.
3. The addition of spare Information Outlet jacks at any given work area, or the addition of spare Information Outlet locations on several walls of a room, is encouraged within the limitations of the project budget.
4. All horizontal distribution copper cable and components for LAN use must be rated and installed to support the IEEE 802.3an Augmented Category 6 (Cat 6A) standard.
5. All horizontal cabling will consist of AMP Net Connect cable, patch panels and connectors.

### **27 15 43 COMMUNICATIONS FACEPLATE AND CONNECTORS**

Standard faceplates are TE Connectivity SL Series faceplates and inserts or 110Connect single and double gang faceplates – either type is acceptable – standard color is almond.

1. Communications outlets are typically within 3 feet of an electrical outlet and installed at the same height, unless otherwise specified.
2. Communications outlets should be placed so that the work area or workstation cable does not exceed 5 meters (16 feet) in length. This length is figured into the

total horizontal cabling length and must not be exceeded.

3. All modular jacks shall be unkeyed, unshielded, 4-pair, RJ-45, and shall fit in a 0.790" x 0.582" opening.
4. Modular jacks shall terminate using 110-style PC board connectors, color-coded for both T568A and T568B wiring. Each modular jack shall be wired to T568B.
5. The 110-style insulation displacement connectors shall be capable of terminating 22-24 AWG solid or 24 AWG stranded conductors.
6. The insulation displacement contacts shall be paired with additional space between pairs to improve crosstalk performance. Modular jacks shall utilize a secondary PC board separate from the signal path for crosstalk compensation. Each modular jack shall meet the Category 6A performance standards and the requirements. The jack color will be orange unless otherwise specified.
7. Modular jacks shall be compatible with the TE CONNECTIVITY SL Series Modular Jack Termination Tool part number 1725150-1.
8. Each modular jack shall be provided with a bend-limiting strain relief. The strain relief shall provide cylindrical support to limit the bend radius at the point of termination.
9. Modular jacks shall be UL Listed under file number E81956.
10. Coordinate with PSHS (MIMAROPA) IT the preference materials in this project and other PSHS (MIMAROPA) IT projects.

## **27 16 00 CONNECTING CORDS, DEVICES, AND ADAPTERS**

### **27 16 19 PATCH CORDS, STATION CORDS AND CROSS CONNECT WIRE**

1. Cross-connects in the TC/TR will be done by using patch cords to connect a jack on the horizontal cabling system Category 6A patch panel to the appropriate service connector or electronics.
2. The PSHS (MIMAROPA) IT Department will install all data equipment cables and patch cords used in the TC/TR for data connectivity and install them as well as the network equipment.
3. The cost for the patch cables will be included in the total cost for all IT equipment specified by PSHS (MIMAROPA) IT Department.
4. Voice cross-connects for dial tone will be made here using standard cross connect wire.
5. All voice system cross-connects will be done by PSHS (MIMAROPA) telecommunications technicians.
6. Any other system cross-connects must be clearly labeled, identified and provided by that system provider.
7. Because UTP cable is protected from crosstalk and immunity from EMI through the cables pair twist and lay configuration, care must be taken to maintain the minimum bend radius (4 times the cable diameter) of the copper patch cords.

8. All patch cords must be certified by the manufacturer to match the cable type used in the horizontal distribution.
9. Field terminated patch cords are not acceptable. Previously, it has been common practice to assemble patch cords in the field using leftover solid-conductor cable. Field assembled patch cables will not perform to Category 6A standards, frequently do not perform to Category 5 standards, and cannot be tested for proper performance using currently available field testing equipment. Patch cables shall always be made from stranded copper wire to withstand the flexing associated with patch cords. Any existing field assembled patch cords shall be replaced with factory assembled Category 6A patch cords. Do not attempt to use Category 5 patch cords for Category 6A connections.

## **27 20 00 DATA COMMUNICATIONS**

The PSHS (MIMAROPA) IT Department will specify and install all network equipment necessary for data communications. Budgetary estimate for network equipment and hardware will be determined during the design phase. If this equipment is to be ordered through the contract it must be pre-approved by the PSHS (MIMAROPA) IT Department.

## **27 30 00 VOICE COMMUNICATIONS**

The contractor will work with the building owner to specify and install all telephone equipment necessary for voice communications. Budgetary estimate for telephone equipment and hardware will be determined during the design phase. If this equipment is to be ordered through the contract it must be pre-approved by PSHS (MIMAROPA) IT Department.

## **27 40 00 AUDIO-VISUAL COMMUNICATIONS**

The contractor will work with the building owner to specify and install all audio-visual equipment necessary for audio-visual communications. Budgetary estimate for A/V equipment and hardware will be determined during the design phase. If this equipment is to be ordered through the contract it must be pre-approved by PSHS (MIMAROPA) Facility and Maintenance Department.

=== END OF DIVISION 27 ===

**TECHNICAL SPECIFICATIONS  
ON  
DIVISION 28 – ELECTRONICS SAFETY AND  
SECURITY  
for  
MULTI-PURPOSE GYMNASIUM  
and  
ACADEMIC BUILDING II  
of  
Philippine Science High School (PSHS)  
MIMAROPA Region Campus  
located at  
Barangay Rizal, Odiongan, Romblon**

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## **DIVISION 28 – ELECTRONICS SAFETY AND SECURITY**

### **A. SCOPE**

This division of technical specifications cover the ELECTRONICS SAFETY AND SECURITY requirement of the proposed PSHS (MIMAROPA) OFFICE BUILDING.

This division covers the following sections:

<u>Section</u>	<u>Description</u>
<a href="#">28 05 00</a>	<a href="#">Common Work Results for Electronics Safety and Security</a>
<a href="#">28 10 00</a>	<a href="#">Access Control</a>
<a href="#">28 23 00</a>	<a href="#">Video Surveillance (Closed-Circuit Television/CCTV)</a>
<a href="#">28 30 00</a>	<a href="#">Security Detection, Alarm and Monitoring</a>
<a href="#">28 46 00</a>	<a href="#">Fire Detection and Alarm System (FDAS)</a>

## **28 05 00 - COMMON WORK RESULTS FOR ELECTRONIC SECURITY**

### **PART 1. GENERAL**

#### **A. SCOPE OF WORK FOR DESIGNER AND/OR CONSULTANTS**

1. The designer or consultant shall provide construction documents complete enough for contractors to bid the project. The level of completeness of the design documents shall, at a minimum, include the following information:
  - a. Floor plan drawings indicating all security devices, including card reader, locking devices, alarms, sensors, detectors, keypads, panels, power supplies, cameras, racks, etc. The designer or consultant shall establish a security plan based on his/her expertise and with input from the facility's users to determine where is the recommended location in the floor plans for all security devices.
  - b. Rough-in details for security devices indicating all sizes of junction box mounting heights, conduit, power and raceways requirements.
  - c. Security panel elevations indication all power supplies, access control panels, alarm panels with quantities, manufacturer information and part numbers of electronic boards within those panels.
  - d. Schematic drawings indicating connections to all security components and interconnection to other buildings, if applicable.
  - e. For retrofit projects, the designer or consultant shall send all design documents to PSHS (MIMAROPA)'s in-charge of the ESS projects for review. Approval from this department shall be granted before commencement of any work.
2. Special conditions particular to the project, whether or not indicated in this specification section, shall be indicated in the design documents as to allow the contractor bidding the project to account for all issues affecting price and

schedules within a reasonable (industry standard) level of accuracy.

3. The designer or consultant shall pick all applicable door elevations and mounting details, from all available details in this guideline, and include them into their design documents. This is especially important with storefront or glass wall installations, where supplied door typical do not reflect the exact set up of the doorway. The designer or Consultant shall be prepared to explain during reviews, the particular situations in the project that caused the deviation from the standard.
4. The designer or consultant shall coordinate with the project's electrical designer/engineer all power requirements for the security system. The electrical design for the project shall include all power outlets, power junction boxes, and all raceways required for access control and alarm panels, power supplies, cameras and any other devices part of the security system.
5. The designer or consultant shall coordinate with the project's architect or door hardware consultant on all locking and sensing devices mounted in doorframes or doors. The end result shall ensure the building users a system compliant with all applicable building codes and the level of safety and security in accordance with the requirements given to the designer or consultant by the users during the design process.

## **B. SCOPE OF WORK FOR CONTRACTORS**

1. Contractors shall factor in their proposals or GMP (Guarantee Maximum Price) for the projects the following tasks:
  - a. Supply and installation labor of all devices, raceways and wiring part of the security systems.
  - b. Supply of all spare parts for the security systems, as indicated in the project's design documents.
  - c. Production and delivery of all submittals for all security systems part of the project, as indicated in the design documents.
  - d. Production and delivery of all as-built information for all security systems part of the project as indicated in the design document.
  - e. All cost (materials, labor and transportation) associated with warranties for the security systems as indicated in the design documents.
2. The contractors shall also factor into their proposals all the requirements in the front-end specifications or general requirements (Division 1) part of the project.
3. The contractor shall provide all information as required in this specification section for the owner to program the access control system when the system is tied to the main access control system in the PSHS (MIMAROPA) Building.
4. The contractor shall provide all software licenses for administration or programming of security equipment.
5. The contractor shall not base their quote or GMP in equipment substitutes or



alternate methods unless the contractor has previously received an approved variance form from PSHS (MIMAROPA)'s in-charge of ESS projects for such substitute equipment or alternate methods.

### **C. CONTRACTOR QUALIFICATIONS**

1. Contractors shall submit proof of expertise and/or specializations in the field of Electronic Safety and/or Security (ESS).
2. Contractors shall have a minimum of 5 years' experience engaging in ESS projects. They shall submit the list of companies, contact persons, and other contact details for the verification of their expertise and/or specialization.
3. Contractors' engineers shall be licensed and registered professionals by PSHS (MIMAROPA) such as Professional Electronics Engineers (PECE), and/or Licensed Electronics Engineers (ECE).
4. Contractors' technicians shall be licensed and registered professionals by PSHS (MIMAROPA) such as Licensed Electronics Technicians (ECT), or Registered Master Electrician (RME).
5. Each contractor's engineers and technicians shall have a minimum of 3 years work experience in the field of ESS projects.

### **D. SUBSTITUTIONS**

1. All substitutions shall comply with not only on description but also on the detailed specifications of materials or devices.
2. All proposals for substitutions must be done in form of writing addressed to PSHS (MIMAROPA) or its representative's in-charge of the ESS projects.
3. No substitutions shall be allowed unless approved by PSHS (MIMAROPA)'s in-charge of ESS projects. The approval must be in form of writing as a reply from the proposal mentioned in Section E.1 of this Section.

### **E. SUBMITTALS**

Follow all submittal requirements applicable for ESS in Division 27 COMMUNICATIONS.

## **PART 2. PRODUCTS**

### **A. CONDUIT AND RACEWAYS**

See product requirements for electrical work in Division 26 ELECTRICAL, and Section 27 10 00 STRUCTURED CABLING.

### **B. CABLE TRAYS**

See product requirements for cable tray systems in Division 27 COMMUNICATIONS.

### **C. SLEEVE SEALS**

Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.



1. Manufacturers: Subject to compliance with requirements.
2. Sealing Elements: interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

#### **D. GROUT**

Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

### **PART 3. EXECUTION**

#### **A. COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION**

1. The only two approved methods for running security system wiring are:
  - a. Complete conduit run from security devices to security panels.
  - b. Complete conduit run from security devices to cable tray system and complete conduit from cable tray system to security panels.
2. J-Hooks for cabling part of the security systems are not allowed.
3. Uses of hollow molding, storefront frame or doorjamb as a raceway are not permitted.
4. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
5. Headroom Maintenance: If mounting heights or other location criteria is not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
6. ADA requirement: Any boxes for wall mounted security cameras, in circulation paths (corridors, hallways, lobbies, etc.) shall always be installed at a height that ensures that the lowest portion of the camera is at least at 6'-8" from finished floor.
7. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

#### **B. COORDINATION**

1. Coordinate arrangement, mounting, and support of electronic security equipment:
  - a. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - b. To provide for ease of disconnecting the equipment with minimum

interference to other installations.

- c. So connecting raceways, cables, wire ways, cable trays, and bus ways will be clear of obstructions and of the working and access space of other equipment.
2. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

### **C. SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS**

1. Electronic safety and security penetrations occurs when raceways, pathways, cables, wire ways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire- rated floor and wall assemblies.
2. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
3. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
4. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with fire stop system used are fabricated during construction of floor or wall.
5. Cut sleeves to length for mounting flush with both surfaces of walls.
6. Extend sleeves installed in floors 2 inches above finished floor level.
7. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
8. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
  - a. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
9. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with all fire stop requirements of PSHS (MIMAROPA) Design and Construction Standard.
10. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with fire stop materials. Comply with all fire stop requirements of the PSHS (MIMAROPA) Design and Construction Standard.
11. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

12. Above ground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe 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.
13. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

#### **D. SLEEVE-SEAL INSTALLATION**

1. Install to seal exterior wall penetrations.
2. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **28 00 00 – ACCESS CONTROL**

#### **PART 1. GENERAL**

##### **A. SCOPE OF WORK**

1. In design development, determine which if any locations will require access control. If any interior doors have been identified to receive electrified access; the primary building entrance shall also receive electrified access and video surveillance.
2. Preparations for electrified access shall be considered at all primary entrance exterior door locations.
3. Controller equipment may only be located in wiring closets.
  - a. Alternate locations shall be discussed with Facilities and Services.
  - b. For wiring closet information reference Division 27.
4. All new construction and major remodels shall include preparations at interior room doors for electrified access even if the card access system is not included in the project.
  - a. Doors shall be cross bored
  - b. Junction boxes, back boxes and conduit shall be provided
  - c. Conduit, chase or raceway must be included between floors and through masonry or fire rated walls
5. Do not specify magnetic locks for primary door security.

#### **PART 2. PRODUCTS**

##### **A. MANUFACTURERS**

1. Access Control System components shall be of the same manufacturer providing other electronic components and equipment.

## **B. CENTRAL CONTROLLER**

1. The central controller shall be a microprocessor with solid-state memory functions with no loss of memory, including time and date, upon loss of the AC power.
2. The central controller shall accommodate the following functions as a minimum:
  - 2.1. 64 card-reading sensors via external card-reader modules; user-assigned names up to 12 characters each.
  - 2.2. 255 monitored and supervised contacts via external contact monitoring modules; user-assigned names up to 12 characters each.
  - 2.3. 4,400 individually identified employees by five-digit number.
  - 2.4. 50 user-defined access codes (combinations of doors/times/days).
  - 2.5. 50 user-defined holidays
  - 2.6. 25 user-defined combinations of activity reporting and contact operation.
  - 2.7. Eight output contacts, fused, latched.
  - 2.8. One output contact, fused, non-latched.
  - 2.9. One output port for local terminal
  - 2.10. One output port for remote terminal RS 232C, either direct connected or dialup, with 100-message buffer and adjustable baud rate.
  - 2.11. As required connection ports for external card reading with two adjustable baud rates.

## **C. MODULES (CARD READER AND INPUT)**

1. The contact-monitoring module provides for determining the status of external contacts. It shall connect in the coaxial cable between the reader/terminal and the card-reader sensor and receive all its power over that coaxial cable.
2. Each module shall provide for connecting a maximum of four dry (isolated) contacts to a maximum distance of at least 200 feet. Each contact shall be supervised against open or shorted conditions between the contact and the contact monitor.

## **D. DISPLAY TERMINALS**

1. The display terminals shall be CRT, integral keyboard, and a separate printer using fan-fold paper. It shall be capable of operating at 120 characters per

- second. The terminals shall provide the operator interface to the system, both for viewing the output messages or reports and for the input of commands or data.
2. They shall be standard industry available units with 80 characters per line, standard ASCII characters set, and RS 232C interface port. The operating speed of the terminals shall match the expected system usage.

#### **E. POWER MODULE**

1. The power modules shall provide for converting the available commercial power to the power required by the central processor and proximity card readers, as well as power on/off switching, fault protection, and power-on indication.
2. The wiring between the power module and the powered device shall be integral and require only a plug-in connection.
3. The power module shall be of the uninterruptible type with sealed battery to maintain system operation during 2-hour power outage.

#### **F. STATUS SWITCHES (DOOR CONTACTS)**

1. The status switch shall be a reed switch with magnet, UL listed for central station direct-wire circuits. Switch shall be suitable for indoor and outdoor use.
2. Switch shall be rated at 130V, 50m A, and 100,000 operations.
3. Switch shall be suitable for use with metal or wood doors and frames. Switch shall change status when 3/8 3/4 inch is exceeded.
4. Switch and magnet shall be made for recessed mounting.

#### **G. CARD READING SENSOR**

1. The card-reading sensors shall be proximity reading type. It shall read the I.D. credential when it is held within 2 to 4 inches of its surface and transmit this unique I.D to the reader/terminal.
2. The sensor design shall be such that it may be operated behind nonmetallic surfaces. It may be surface mounted on virtually any surface (including glass) without requiring or mounting bolts.
3. The sensors shall be designed to operate properly within the temperature range of minus 40 to 82 degrees C and within a relative humidity range of zero percent to 100percent, condensing. No special housing or treatment shall be required for outdoor use.
4. Damage to the card-reading sensor shall not affect system monitoring and alarm. The transmission of signals into the sensor shall not compromise the system.

## **H. ACCESS CARD**

1. The access card shall credit-size component with the cooling technique contained inside, i.e., not visible from the outside. PSHS (MIMAROPA)'s IT department shall be warranted for at least 5 years under normal use conditions.
2. Each card shall contain a number not shared with any other card in that system. In addition, it shall have a unique facility code which identifies the end user's installation.
3. The Construction Manager will furnish to the Contractor identification and logo information to be custom printed on one side of command cards.

## **PART 3. EXECUTION**

### **A. GENERAL**

Equipment and wiring shall be installed in accordance with the manufacturer's diagrams and recommendations.

### **B. INSTALLATION**

1. Connections to all external wiring between the central controller and the card reader modules shall be made on terminal strips installed in accessible locked terminal cabinets. Connections may be made either with terminal spade lugs set on the conductors with a special setting tool or with approved pressure-type terminal blocks. A terminal cabinet shall be installed at each point where a station circuit riser originates or at any point along a circuit where a tap is made and as shown on the Drawings.
2. All station circuit shall be color coded. Wiring for other circuits shall be color codes unless of sufficiently different size to identify them and their purpose.
3. All conductors and raceways shall be sized by the fire alarm system supplier who shall coordinate all site work for routing and interfacing cables and raceway outside and inside buildings. The fire alarm system supplier shall be responsible for furnishing and installing the conductors and raceway for a complete and operational system.
4. Access control conductors shall not be installed in the same outlet box, junction box, or conduit with conductors of lighting or power systems.
5. Mount card reader sensors as shown on Drawings above finished floor (or grade, if outside).
6. All reader/terminals, contact modules, and terminal cabinets shall be located per the Drawings.
7. Coordinate the mounting of status switches operation shall be installed.

### **C. SYSTEM REQUIREMENTS**

1. Card access system must be interconnected with all door operators to ensure that:
  - a. During occupied hours both interior and exterior operator buttons will open doors of the building.
  - b. During unoccupied hours' exterior operator button will only open the door if an approved card has been presented to the card reader and interior button will allow egress at all times.
  - c. If problems arise during unoccupied hours with the interior controller button trying to open the door but door hardware not releasing. Occupants have had to push controller button and activate exit device. This is not acceptable.
2. All materials, supplies and hardware must be compatible with building backboard system.
3. Wireless systems are available. Generally wireless hardware is not preferred on high-frequency use doors and exterior applications. Wireless options should be discussed with Facilities and Services during design development.
4. When hardwired electronic access is required, the following shall be specified.
  - a. Contractor will provide 1 data drop to each master controller location.
  - b. Specify fail-secure locksets.
  - c. Discuss the need for battery back-up on access system.
  - d. Control equipment and reader shall be provided by owner, installed by contractor.
  - e. Low voltage wiring will be installed and labeled by the contractor.
  - f. Lockset, latch, hinge shall be provided by contractor.
  - g. Must maintain 7 pin small format interchangeable core capability.
  - h. Must be specified to closely match non-electrified hardware in style, color and appearance.
  - i. The power supply is integral to the Backboard Equipment. 220V power receptacles shall be specified as necessary in room where card access will be mounted. Specify the contractor shall supply and install power chords for the blackboard equipment.
  - j. Owner will make Low Voltage terminations at control equipment.
  - k. Contractor will make Low Voltage terminations at door hardware.



- I. Contractor is responsible for excise and use tax for the value of owner supplied equipment.

## **28 23 00 – VIDEO SURVEILLANCE (CLOSED-CIRCUIT TELEVISION or CCTV)**

### **PART 1. GENERAL**

#### **1. SCOPE OF WORK**

Refer to Section 28 05 00

#### **2. RELATED DOCUMENTS**

1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
2. The following sections in this Division 28 - ELECTRONIC SAFETY AND SECURITY relevant to this Section:
  - a. [Section 28 05 00](#), Common Work Results for Electronic Safety and Security
  - b. [Section 28 10 00](#), Access Control
3. Design and operation of the security systems shall conform to the applicable codes and/or standards as referred in Division 27 – COMMUNICATIONS.

#### **3. CONTRACTOR QUALIFICATIONS**

1. Refer to [Section 28 05 00](#), Common Work Results for Electronic Safety and Security.
2. The contractor shall agree, in writing, as part of their proposal, to provide both warranty and non-warranty service within 4 hours of notification of a problem. The contractor shall be able to perform any and all repairs to the systems they install within 24 hours.

#### **A. SUBSTITUTIONS AND ALTERNATE METHODS.**

1. Refer to [Section 28 05 00](#), Common Work Results for Electronic Safety and Security.
2. Substitute equipment must be a standard part of that systems current product line and should meet or exceed the capabilities of the equipment specified herein. Beta, Specials, or “One Time” products will not be acceptable. If proposed substitutions do not meet or exceed the performance levels specified herein, the limitations of this equipment must be highlighted and brought to the attention of the designer and/or consultant. Failure to notify the designer/consultant of these limitations, whether intentionally or by oversight, may result in rejection of those components at any time. Should this occur, the contractor will be required to replace the rejected equipment with pre-approved components that meet or exceed the requirements as specified herein. This will



be done at no additional cost to the client.

3. Alternate methods: When the contractor proposes alternate methods to PSHS (MIMAROPA)-TWG and/or PSHS (MIMAROPA) Project Manager.
4. P's standards indicated in this specification, the contractor shall follow the same process as for equipment substitutions. The contractor shall submit a variance form and get approval from the owner before applying any alternate methods.

## **B. SUBMITTALS**

1. Within 20 business days of receiving contract approval and notice to proceed, the contractor shall submit to the designer or consultant the project submittals. The submittal document includes, at a minimum, the following information:
  - a. Product numbers, specifications, and data sheets for all equipment and software.
  - b. All security wire product data sheets. The contractor shall indicate the intended use for all wiring submitted.
  - c. Point-to-point or end-to-end wiring diagrams for all devices that are part of the video system. This includes any power supplies, video encoders, power injectors and range extenders.
  - d. Single-line drawings representing the entire system.
  - e. Termination details.
  - f. Course outlines for each of the end user training programs. The course outlines shall include the course duration, pre-requisites, and a brief description of the subject matter.
  - g. Proposed method of wire marking, panel labeling, zone identification, and terminal strip numbering.
  - h. Project milestone schedule.
  - i. Template for weekly progress report.

## **C. ABBREVIATIONS**

The following abbreviations are used in this document:

ANSI	American National Standards Institute
ASCII	American Standard Code for Information Interchange
AWG	American Wire Gauge
Bps	Bits per second
CIF	Common Intermediate Format (352 X 240)
2CIF	Common Intermediate Format (704 X 240)
4CIF	Common Intermediate Format (704 X 480)

CCTV	Closed Circuit Television
CPU	Central Processing Unit
FPS	Frames Per Second
GUI	Graphical User Interface
IPS	Images Per Second
ODBC	Open Database Connectivity
PTZ	Pan/Tilt/Zoom
RAID	Redundant Array of Independent Disks
SDRAM	Synchronized Dynamic Random Access Memory
STP	Shielded Twisted Pair
UL	Underwriters Laboratories, Inc.
UPS	Uninterrupted Power Supply
USB	Universal Serial Bus
UTP	Unshielded Twisted Pair

## **PART 2. PRODUCTS**

### **A. SURVEILLANCE VIDEO RECORDING SYSTEM**

1. The surveillance video recording system shall be of type digital video recording system (DVRs) or network video recording system (NVRs). It shall be able to integrate seamlessly with the access control system (ACS) as well as the building management system (BMS) installed in the building.
2. The security contractor is to provide and install the latest and/or updated NVR software on the PSHS (MIMAROPA) provided server. The DVRs/NVRs server is to be purchased using an existing PSHS (MIMAROPA) contract with computer hardware manufactures to allow for PSHS (MIMAROPA) pricing and a 5-year warranty contract. Contact PSHS (MIMAROPA) IT department for current server configuration (i.e. system processor/s, system memory, RAID configuration and hard drive storage size).
3. The DVRs/NVRs shall be capable of recording all cameras in the system for a period of 30 days.
4. The DVRs/NVRs shall have an IP and/or analog connection to be accessible through the PSHS (MIMAROPA) security network.
5. **NOTES TO DESIGNERS OR CONSULTANTS:** The project designer or consultant shall work with the users to determine the location, type and number of cameras the DVRs is to record. Clear direction shall be given to the contractor

regarding the final camera count, recording frame rate and resolution so the size of storage and hardware specifications for a complete solution can be implemented.

**B. INTEGRATED FIX COLOR DOME IP CAMERA**

1. The integrated fix color dome IP camera shall have the following specifications:

Imager	1/3" or 1/4" Color Progressive Scan RGB CMOS
Minimum illumination	Color: Minimum of 1 lux
Video output	Simultaneous Motion JPEG and MPEG-4
Resolutions	Minimum of 640x480
Frame rates	Motion JPEG: 30 fps @ 640x480
Supported protocols	IPv4/6, HTTP, HTTPS, SSL/TLS, TCP, QoS, SNMPv1/v2c/v3, RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, ICMP, DHCP, UPnP, Bonjour, ARP, DNS, DynDNS, SOCKS, NTP and IEEE802.1X.
Security	Password protection for user access, IP address filtering, HTTPS encryption and IEEE 802.1X network access control
Video connector	RJ45 10Base-T/100Base-T
Lens	Varifocal, autoiris
Dome housing	Polycarbonate base
Dome	Polycarbonate dome, Rugged housing
Input voltage	PoE (IEEE 802.3af) Class 2
Pan/Tilt adjustment	Manual
Pan range	360° adjustment
Tilt range	up to tilt 170°
Rotation	340°

2. NOTE TO DESIGNERS OR CONSULTANTS: Designers or consultants shall estimate the actual range of the varifocal lens for the each camera given the range of coverage required by the security design.
3. Acceptable manufacturers: Panasonic, Sony, Axis, Bosch, DVTel, Zavio. Design selection shall be based on PSHS (MIMAROPA) requirements and approval.

**C. INTEGRATED PTZ COLOR DOME IP CAMERA**

1. A. The integrated PTZ color dome IP camera shall have the following specification:

Imager	1/3" or 1/4" Color CCD
Minimum illumination	Color: Minimum of 0.5 lux B-W (day/night mode only): 0.008 lux
Video output	Simultaneous Motion JPEG and MPEG-4
Resolutions	minimum of 704X480
Frame rates	minimum of 30 fps @ 704X480
Supported protocols	IPv4/6, HTTP, HTTPS, SSL/TLS, TCP, QoS, SNMPv1/v2c/v3, RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, ICMP, DHCP, UPnP, Bonjour, ARP, DNS, DynDNS, SOCKS, NTP and IEEE802.1X.
Security	Password protection for user access, IP address filtering, HTTPS encryption and IEEE 802.1X network access control.
Video connector	RJ45 10Base-T/100Base-T
Lens	Motorized zoom 35X optical, electronic zoom 12X, autofocus, autoiris with manual override
Dome	Polycarbonate clear
Input voltage	High Power over Ethernet (High PoE) IEEE 802.3at, max. 60 W
Synchronization	IAC line lock Motorized
Pan/Tilt adjustment	Motorized
Pan range	360°, at a maximum of 450°/second. Variable speed
Tilt range	220° at a maximum of 450°/second. Variable speed.
Required features	Programmable presets, programmable zones with labels, programmable patterns, programmable limit stops, auto-flip programmable window blank.

2. NOTE TO DESIGNERS OR CONSULTANTS: Designers or consultants shall

specify all mounting accessories for PTZ cameras, like dome housings, wall brackets, pole mount adapters, etc., given the location where each camera is going to be installed.

3. Acceptable manufacturers: Panasonic, Sony, Axis, Bosch, DVTel, Zavio. Design selection shall be based on PSHS (MIMAROPA) requirements and approval.

**D. INTEGRATED PTZ INFRARED DOME ANALOG CAMERA**

1. A. The integrated infrared dome analog camera shall have the following specifications:

Imager	1/3" or 1/4" progressive scan, CMOS
Minimum illumination	0.01lux/F1.8 0lux with IR on
Video output	TV, CVI, AHD (1080p); CVBS Selectable (960H)
Resolutions	1920 x 1080
Frame rates	30fps @ 1920x1080
Supported protocols	Coaxtron, Pelco-D, Pelco-P
Security	True Day/Night, 150ft Infrared Rating, Automatic White Balance
Video connector	UTC (coax), RS-485
Lens	10x Optimal Zoom f=5.1 (wide) ~ 51(Tele) millimeters
Dome	IP66 Weatherproof Housing
Input voltage	DC12V AC24V
Synchronization	Internal Synchronization
Pan/Tilt adjustment	Motorized
Pan range	360° endless rotation Manual speed of 0.02°/sec ~ 200°/sec
Tilt range	0° ~93° Manual speed of 0.02°/sec ~ 120°/sec
Required features	IR control under 15 grade (selectable), maximum of 220 /sec preset, auto-flip,

	automatic temperature control, AB Scan, Works on 0%~95% humidity, 3 group tour (max. 16 preset),
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2. NOTE TO DESIGNERS OR CONSULTANTS: Designers or consultants shall specify all mounting accessories for PTZ cameras, like dome housings, wall brackets, pole mount adapters, etc., given the location where each camera is going to be installed.
3. Acceptable manufacturers: Panasonic, Sony, Axis, Bosch, DVTel, Zavio. Design selection shall be based on PSHS (MIMAROPA) requirements and approval.

**E. INTEGRATED FIXED INFRARED DOME ANALOG CAMERA**

1. A. The integrated PTZ color dome analog camera shall have the following specification:

Imager	1/2.9" or 1/3" progressive CMOS
Minimum illumination	0.01lux / 0lux with IR on
Video output	AHD, CV, TV (1080p); CVBS (960)H
Resolutions	NTSC: 30fps @ 1920x1080 PAL: 25fps @ 1920x1080
Frame rates	1920x1080
Supported protocols	Coaxtron, Pelco-D, Pelco-P
Security	On-Screen-Display Supported, 50ft IR LED Range, Automatic White Balance
Video connector	RG59 Coaxiable Cable
Lens	Fixed 3.6mm
Dome	Metal body structure, IP66 weatherproof rating
Input voltage	DC12V ±10%, 350mA
Synchronization	Internal Synchronization
Pan/Tilt adjustment	None
Pan range	None
Tilt range	None
Required features	Tri-axis mounting bracket, IR Cut Filter, Auto gain control, S/N Ratio @ ≥80dB, Wide range view, Automatic color adjustment

	during nighttime
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2. **NOTE TO DESIGNERS OR CONSULTANTS:** Designers or consultants shall specify all mounting accessories for fixed cameras, like dome housings, wall brackets, pole mount adapters, etc., given the location where each camera is going to be installed.
  
3. **Acceptable manufacturers:** Panasonic, Sony, Axis, Bosch, DVTel, Zavio. Design selection shall be based on PSHS (MIMAROPA) requirements and approval.

**F. CCTV CAMERA POWER SUPPLY**

1. The camera power supply shall be a wall mounted or rack mounted type device capable of powering up to 16 devices. Each power supply output shall be PTC protected and the power supply shall be capable of delivering up to 10A of current at 24VAC, or in the case of a PoE mid-span type, shall be capable of delivering up to 30W and should be IEEE 802.3af and IEEE 802.3at compliant (PoE Plus). The power supply shall be UL listed.
2. The camera power supply shall be an Altronix ALTV2416300ULCB or NetWay16.

**G. SURGE PROTECTION**

1. All CCTV components mounted outside the building shall be provided with surge and lightning protection. Provide UL listed multi-stage protection on all low voltage and signal transmission lines.
2. All 220VAC surge suppression devices shall be EDCO HSP121BT-1RU or an approved equal.
3. For low voltage connections provide FAS-1 surge suppressors manufactured by EDCO or an approved equal.

**H. CABLES FOR CCTV SYSTEMS**

1. Cables for camera power supply shall have the following specifications:

Minimum cable gauge	AWG 18
Number of conductors	2, stranded conductors
Conductor type	Bare copper
Cable insulation	PVC
Conductor insulation colors	Black and red
Voltage rating	300V

Cable shield	No cable shields
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2. Cable gauge: All cable gauges shall be estimated as to allow a maximum of 5% voltage drop from the source to the load. Sizes given previously are only minimum gauges accepted. The contractor shall always estimate proper values.
3. Cable jackets: All cable jackets shall be suitable for the environment on which the cables will be installed. Use plenum rated cables when cables are installed in plenum spaces. Use riser rated cables when cables are installed through floor sleeves. Use cable jackets with water-blocking material when installed in underground conduits.
4. Acceptable manufacturers: Belden, Alpha Wire Company, General Cable and West Penn Wire.
5. UTP Category cables and fiber optic cables: for specifications on all UTP paired category cables and fiber optic cables the contractor shall follow the specifications on Division 27, COMMUNICATIONS.

### **PART 3. EXECUTION**

#### **A. INSTALLATION PRACTICES**

1. For all building exterior applications, CCTV imagers shall be day/night type of cameras.
2. All camera power supplies for cameras that cannot be powered over Ethernet need to be installed next to the access control equipment in the same room. UPS devices shall be provided to power up all CCTV equipment like DVRs, fiber optic transceivers, servers, power supplies, etc. Battery backup for UPS system shall be able to support all CCTV equipment for at least 1 hour.
3. NDVRs or any type of recording server shall be installed inside server rooms. The PSHS (MIMAROPA) IT Department and Security Department must approve the location of any video recording equipment in their respective areas. A variance form must be submitted to PSHS (MIMAROPA)'s in-charge of the project in collaboration with PSHS (MIMAROPA)'s IT and Security group if the proposed location for the video recording equipment is not a server room.

#### **B. WIRING METHODS**

1. All proposed wire and cable shall meet or exceed the recommendations established by the equipment manufacturers, and shall comply with all applicable codes local or international.
2. Visually inspect all wire and cable for faulty insulation prior to installation. Protect cable ends at all times with acceptable end caps.
3. Provide grommets and strain relief materials where necessary to avoid abrasion and excess tension on wire and cable.
4. All penetrations through fire rated barriers shall be provided with appropriate fire



stopping materials in accordance with NFPA requirements and local fire authority having jurisdiction.

5. Cables of similar signal level shall be bundled together and kept physically separate from power cords, plug strips or other circuits with different potential. Exposed wire bundles or individual cables shall be neatly secured with self-clinching nylon "TY Raps" (Thomas & Betts or equal). Lacing of cables shall not be permitted.

### **C. IDENTIFICATION AND TAGGING**

1. All cables, wires, wiring forms, terminal blocks, and terminals shall be clearly identified by pre-printed labels or tags. Direct ink markings on the cable shall not be acceptable. The permanent markings shall clearly indicate the function, source, and destination of all cabling, wire, and terminals. Schematic legends shall be placed inside all terminal cabinets to assist with identification.
2. All CCTV power supplies shall include a worksheet indicating what camera is being fed from each power supply port. This worksheet shall be enclosed in a plastic cover and taped to the inside of the camera power supply housing. A second copy of this worksheet shall be delivered to the owner as part of the as-built information.

### **D. ADDITIONAL CONTRACTOR RESPONSIBILITIES**

1. Upon project commencement, the Contractor shall provide qualified technical personnel on-site. Personnel shall be present on each consecutive working day until the system is fully functional and ready to begin the testing phase of this project.
2. During the installation process the contractor shall maintain an up-to-date set of as-built shop drawings, which shall always be available for review by the client and/or consultants. This set of documents should be clearly annotated with as-built data as the work is performed.

### **E. PROGRAMMING AND SYSTEM CONFIGURATION**

1. The contractor shall provide PSHS (MIMAROPA) IT department with programming sheets for all associations between cameras and door alarms.
2. The contractor shall develop the graphical maps for the alarm monitoring screens. The A&E team shall provide project floor plan drawings in the form of AutoCAD DWG or DXF file to be used for map creation. Development of maps shall include the creation of icons for all cameras.
3. Contractor shall maintain hard copy worksheets, which fully document the system installation, programming, and configuration. Contractor shall keep worksheets up to date on a daily basis until final acceptance.

### **F. WARRANTY**

During the first year of service the contractor shall ensure that manufacturer-certified repair and maintenance personnel are available for Emergency Service calls twenty-four (24) hours a day, three hundred sixty five (365) days a year.

The maximum on-site response time for emergency services shall not exceed four (4) hours for warranty or non-warranty issues. The contractor shall be able to perform any and all repairs to the system within 24 hours.

#### **G. SPARE PARTS**

1. Prior to completion of this project the contractor shall submit a list of recommended spare parts for this system. These recommendations shall be based upon the contractors and manufacturers experience with this equipment's performance history and critical impact the device has in overall system operations.
2. All cost estimates submitted for additional equipment shall remain at the same rate provided in the original contract documents.

#### **H. CONTRACTOR TESTING**

1. The contractor shall prove to the owner that all cameras are providing good video quality and the field of view of the cameras is as expected in the design documents. The contractor shall adjust all manual lenses for focus and zoom to the complete satisfaction of the users.
2. After installation and prior to termination, all wiring and cabling shall be checked and tested to ensure there are no grounds, opens, or shorts on any conductors or shields. A volt ohm meter shall be utilized for this test. Resistance check of greater than 20 Mega-Ohms shall be required to successfully complete the test.
3. All testing of UTP Category cable shall be provided in conformance with the requirements established under Section 27 10 00, STRUCTURED CABLING SYSTEM.
4. The contractor shall develop a report that indicates a complete listing of all equipment and cameras in this facility. This list shall be used as a guide during testing to ensure that all components are inspected. The personnel conducting these tests shall indicate the following information on this form:
  - a. Name of person conducting test
  - b. Date of test
  - c. Time of test
  - d. Results of test

#### **I. PREPARATION FOR FINAL ACCEPTANCE TESTING**

1. All components shall be inspected to ensure they have been properly installed, securely attached, and remain clean and unmarred.
2. All equipment shall be properly adjusted, clearly labeled, and fully operational.
3. All broken, damaged, or modified items such as walls, doorframes, ceiling tiles, etc., shall be replaced or properly repaired to the satisfaction of the client.
4. All extra or spare materials shall be delivered and stored on the premises as directed.

5. Test report of all system components shall be completed and available for inspection as indicated herein.
6. Four (4) sets of Individual factory issued Equipment Manuals containing all technical information on each piece of equipment. Advertising brochures or information instructions shall not be used in lieu of technical manuals and information. Documents to be provided in digital format CD or DVD or USB Flash drive.
7. Four (4) sets of Individual factory issued Operation Manuals containing all technical information on the system. Advertising brochures or information instructions shall not be used in lieu of technical manuals and information. Documents to be provided in digital format CD or DVD or USB Flash drive.
8. Four (4) complete sets of As-Built drawings. Documents to be provided in digital format CD or DVD or USB Flash drive.
9. Statement of Guarantee including date of termination, and the name/telephone number of person to be called in the event of equipment failure.

#### **J. TRAINING AND INSTRUCTION**

1. Before the system is turned over to the owner the contractor shall training on the new system. Provide 2 minimum hours of technical training in system setup, maintenance, troubleshooting, and service of this system.
2. Training shall be conducted during normal business hours of the client, at a date and time of mutual convenience to the client and contractor.

#### **K. AS-BUILT DOCUMENTS**

As-built documents shall be provided as part of this contract. As-built drawings shall be a complete set of AutoCAD (drawn in latest release) floor plans drawings, riser diagrams, and wiring details indicating the layout and interconnection of the system. The original project floor plan disk shall be obtained from the consulting engineer. All cable routings and elevation of each outlet, tie, and riser cable terminations shall be required. All addendum information or project revision resulting in drawing changes that occur during the construction period shall be documented and included in the as-built material. All required as-built documentation is mandatory and shall be required prior to project closeout. A complete set of prints with all changes shall be submitted to the Engineer's for review. Upon completion of the Engineer's review, the Contractor shall provide an updated CD-ROM disk containing the electronic drawing files and four (4) reproducible set of drawings. This information must include final As-Built conditions and the Engineer's review comments if any.

#### **L. FINAL ACCEPTANCE TESTING**

1. After testing reports, as-built drawings, and required manuals have been submitted for review, the Contractor shall coordinate a date for Final Acceptance Testing.
2. Testing and acceptance of this system will take place in the presence of the

Designer or Consultant and the Owner.

3. Acceptance of the system shall require a demonstration of all system components to evaluate their performance and reliability. Prior to this test the system must have been online for a period of sixty (60) days, with an uptime of no less than 99%. Should a major equipment failure occur, the Contractor shall replace the defective component and continue the period of testing. Any items discovered during final inspection which require the contractor's attention, shall be promptly addressed. These items will then be re-inspected by the Designer or consultant for approval.
4. Upon the completion of acceptable Final Acceptance Testing, the Contractor shall submit all finalized project documentation and associated electronic media. Upon approval from the Owner and the Designer or Consultant, the Owner will issue a Letter of Completion to the Contractor indicating the date of such completion. This notice will serve as Client acceptance of this system.

## **28 46 00 FIRE DETECTION AND ALARM SYSTEMS/FDAS**

### **PART 1 GENERAL**

#### **A. SCOPE OF WORK**

The scope of work under this head shall include design, supply, and installation of additional Fire Alarm System devices to the whole building complex. The work under this system shall consist of supply, installation, testing, training & handing over of all materials, equipment's and appliances and labor necessary to commission the said system, complete with Addressable fire alarm system for all common areas. The system shall comprise of Smoke Detectors, Heat Detectors, Alarm Notification Devices, Manual Pull Stations, Modules, and Relays for interfacing with other systems. It shall also include laying of cabling, necessary for installation of the system as indicated in the specification and Bill of Quantities. Any openings/chasing in the wall/ceiling required to be made for the installation shall be made good in appropriate manner.

#### **B. DESCRIPTION**

1. Provide fire detection and alarm system in accordance with the Contract Documents.
2. The fire detection and alarm system shall be a stand-alone system operating independently of other control systems. It shall have an automatic dial-up feature to the BFP Fire Station.
3. Related work specified in other divisions of these specifications:
  - 3.1. Sprinkler water flow and tamper switches.
  - 3.2. Magnetic door holders and electric door locking hardware.
  - 3.3. Public Address Emergency Announcement
  - 3.4. Life Safety Equipment Interfaces

#### **C. RELATED DOCUMENTS**

1. All work specified in this specification is subject to the provisions of Electronics General Provisions.
2. Refer to the following specification of related work in connection with the Fire Detection and Alarm System:
  - 2.1. Background Music (BGM) and Public Address (PA) System

## **D. QUALITY ASSURANCE**

1. Fire Department approval of fire detection and alarm system.
2. Manufacturer and equipment supplier shall have a minimum of ten (10) years' experience as contractor of fire detection and alarm system and shall have at least five (5) completed or on-going FDAS installation in the Philippines.
3. Equipment supplier shall have twenty-four (24) hour parts and labor service available with a maximum four (4) hour response time.
4. Prior to making required submittals, system supplier shall meet with the Fire
5. Department and make an informal presentation of the fire alarm and detection system. Meeting minutes shall be issued and comments incorporated into the required submittals.
6. Engineer In-Charge supervising the work shall be a duly registered Electronics Engineer supervised by a Professional Electronics Engineer as required by RA 9292 and the revised IRR of The National Building Code of the Philippines.

## **E. STANDARDS**

1. Fire Department Requirements
2. National Building Code of the Philippines
3. National Fire Protection Association (NFPA 72, 101, 5000)
4. RA 9514 Revised Fire Code of the Philippines of 2008 and its IRR

## **F. ABBREVIATIONS**

1. FACP - Fire Alarm Control Panel
2. FTS - Firefighter's Telephone System
3. FCC - Fire Command Center

## **G. SUBMITTALS**

1. Minutes of system supplier's meeting with the Fire Department.
2. Manufacturer's product data sheets for equipment including Fire Marshal listing numbers.
3. Floor plans showing device locations and interconnecting conduit and wire. Floor plan of the FCC indicating fire management system equipment, equipment furnished by others, tables, plan racks, and required clearances. Elevations of each wall of the FCC.

4. Riser diagram showing devices, equipment, and interconnecting conduit and wire. Indicate points of connection to other equipment such as fire pump controllers, dry pipe sprinkler systems, elevator machine rooms and shafts and kitchen hood fire protection systems.
5. Scaled detail drawings of FACP
6. Wiring diagram for each device.
7. Wiring diagrams for smoke control sequence.
8. Voltage drop calculations.
9. Interface installation shop drawing for magnetic door holders, and electric door locking hardware.
10. List of all devices with address identification.
11. Lay-out of Fire Alarm panels.
12. Seismic restraint calculations.

## **H. FIELD TESTING**

1. Wiring shall be inspected and tested for continuity and short circuits. The minimum allowable resistance between any two conductors or between conductors and ground is ten mega ohms measured with a 500-volt megger.
2. Field Test Reports:
  - 2.1. Certification that equipment has been properly installed and is in satisfactory operating condition.
  - 2.2. Sensitivity settings for smoke detectors.
  - 2.3. Detailed operational test report in matrix form indicating each initiating device, each signaling device, each communication device, and each control and indicating light on each piece of equipment. Report shall certify the following:
    - a. Successful operation of each alarm and supervisory initiating device.
    - b. Successful operation of each signaling device.
    - c. Successful operation of automatic smoke control sequences.
    - d. Successful operation of FACP
    - e. Successful operation of Fireman's Telephone Systems
    - f. Successful operation of line supervision devices.
    - g. Successful operation of offsite alarm monitoring system connection (optional).
    - h. Successful operation of unlocking electronically locked

doors.

## **I. IDENTIFICATION**

1. Provide an identification nameplate for each equipment cabinet.

## **J. SEQUENCE OF OPERATION**

1. A computerized intelligent addressable, non-coded, two stage evacuation system complete with integrated emergency voice two-way communication system will be provided. The system will be designed using National Building Code and Fire Code of the Philippines and other related standards such as NFPA as reference.
2. The main design principle of the proposed system is to provide localized microprocessor based intelligent Fire Alarm Control Panel, FACP with Emergency Voice Evacuation System, Detectors and system are able to identify maintenance points, malfunctioning and line discontinuity.
3. The primary means of detection/suppression will be a system of smoke detectors integrated with the automatic sprinkler system. Smoke detectors will be provided in all areas of the building to comply with local codes, and will be supplemented by the following types of early warning detection.
4. All detectors and zone control and monitor modules will be connected on an addressable loop and will each possess a unique address to allow specific identification in the case of alarm or malfunction and environmental adjustment.
5. Upon activation of any alarm, initiating devices the system will send signal to:
  - 5.1. Transmit an evacuation broadcast to the fire floor and floor above.
  - 5.2. Transmit an alert broadcast, IF:
    - i. Fire alarm within the floor is not acknowledged within 5 minutes.
    - ii. Manual pull station is activated within the fire alarm floor.
    - iii. Sprinkler flow switch/ supervisory switch is activated.
    - iv. Another detector is triggered/ activated within the floor.
  - 5.3. Automatically stop all building floors recirculating air handling systems (fans).
  - 5.4. Automatically start all smoke removal and pressurization fan systems as well as open/close appropriate dampers.
  - 5.5. Activate all fire shutters to stage position.
  - 5.6. Release all secured door magnetic locks.
  - 5.7. Annunciate all functions at the Fire Alarm Control Panel at the Ground Floor.



- 5.8. Should the initial alarm not be acknowledging within five minutes, an evacuation broadcast will be transmitted to the entire building complex.
  - 5.9. Transmit signal to the local fire department.
  - 5.10. A hard copy printout to be initiated at the printer.
- 
6. A selective paging system will be integrated with the signaling system to allow authorized announcements.
  7. An integrated UL or equivalent listed dedicated two-way fire fighter's telephone system will be provided at each exit stair entry to allow direct communication between the fire fighters and the Fire Command Center.
  8. The main control panel will consist of a central processing unit, printer and color LCD unit annunciator with a complete graphics package identifying all fire zone status.
  9. The printer shall be as an event and status printer; it shall be laser jet type with a minimum speed of 200 characters per second at 10 characters per inch.

## **PART 2. PRODUCTS**

### **A. MANUFACTURERS**

1. Fire Detection and Alarm System components shall be the manufacturer going to be installed in the building complex.
2. Contractor must have at least ten (10) years of experience and existence.

### **B. GENERAL**

1. Alarm and trouble signals shall be digitally encoded by listed electronic devices onto a NFPA Style 6 or 7 (Class A) looped multiplex communication system.
2. Alarm and trouble signals from all addressable devices shall be digitally encoded NFPA Style 6 or 7 (Class A) signaling line conduit.
3. Digitized electronic signals shall employ check digits or multiple polling.
4. Response time between alarm initiation and recording is not to exceed five (5) seconds.
5. The fire alarm control panel (FACP) shall consist of low current, solid-state integrated circuits, and shall be powered from centralized emergency power line source and centralized standby battery power source.
6. Power for initiating and signaling devices may be from the fire alarm control panel to which they are connected.
7. A single ground or open on any system signaling line circuits, i.e., communication network (multiplex loop) shall not cause system malfunction or loss of operating power.

8. Alarm signals arriving at the FACP shall not be lost following a power failure (or outage) until the alarm signal is transmitted and recorded.
9. Speaker circuits shall be electrically supervised for open and short circuit per smoke zone.
10. Two-way telephone communication circuits shall be arranged so as to allow communication between the fire command center and remote telephone locations.
11. It shall be possible to connect the telephone circuits to the speaker circuits to allow voice communication over the speaker circuit from a telephone handset.

### **C. LINE SUPERVISION**

1. All system equipment and wiring shall be supervised.
2. Style 7 wiring shall be arranged so that the system shall not be affected by a single open, short, or ground condition. Report trouble condition and automatically switch over to alternate wiring path.
3. Style Y wiring shall utilize end of line resistors.
4. Addressable Channel Wiring: Style 6.
5. Multiplex Channel Wiring: Style 7.
6. Non Addressable Initiating Device Wiring: Style Y.
7. VCS and FTS Device Wiring: Style Y.

### **D. STANDBY BATTERIES**

1. Provide sufficient battery (NiCad) capacity to operate the entire system upon loss of power under maximum normal load for a minimum period of 24 hours with a minimum of 5 minutes of alarm operation at the end of this period.
2. The system shall automatically transfer to the standby batteries upon power failure. Battery charging and recharging shall be automatic.

### **E. FIRE ALARM CONTROL PANEL (FACP)**

1. Solid state, microprocessor based, modular design, fully supervised. Steel enclosure in standard finish, with hinged, locking door. Integral power supply, standby batteries, and battery charger.
2. Provide power on LED, power failure LED, system trouble LED, system reset switch, alarm silence switch, trouble silence switch, manual evacuation switch, alarm acknowledge switch, trouble acknowledge switch, supervisory service acknowledge switch, lamp test button, tone alert, battery supervision LED, auxiliary relays, and other system indicators and controls necessary for process in alarm and signaling functions. Indicating lamps shall be LED type.
3. Provide appropriate permanent identification labeling of control and indicating functions.

4. Annunciation: Serial annunciator with back lit, alphanumeric, 80-character liquid crystal display indicating clear language information as to the type of alarm (device type), point status (alarm or trouble), number of alarms on the system, and a custom location label. Ability to scroll back through prior system actions.
5. System shall utilize analog type smoke detection with alarm verification, self-test feature, individual sensor automatic timed sensitivity adjustment, individual smoke sensor field adjustable sensitivity set from FACP, and automatic maintenance alarm feature.
6. Provide at least one (1) spare loop for maintenance purposes.
7. Networking Capable Panel (for FACP Interconnection) for integration with other building facilities, for future expansion or for addition of initiating and notification devices during fit-out.

## **F. FIRE ALARM INITIATING DEVICES**

### **1. GENERAL**

- a. Intelligent Addressable type.
- b. Provide auxiliary relays where required to satisfy system operational requirements.
- c. Smoke detectors shall be intelligent analog type.

### **2. AUTOMATIC FIRE DETECTORS (GENERAL)**

#### **GENERAL**

The manufacturer shall have available the following types of analogue addressable automatic sensors, for direct connection to the system addressable loops:

- a. Ionization smoke sensors
- b. Photoelectric smoke sensors
- c. Heat sensors
- d. Multi-sensors

### **A. ADDRESSABLE UNITS**

1. The manufacturer shall be capable of offering two-state addressable versions of the following units, taking only one address from the loop:
  - a. Ionization smoke detectors
  - b. Photoelectric smoke detectors
  - c. Heat detectors
  - d. Photoelectric beam smoke detectors
  - e. Ultra-violet flame detectors
  - f. Conventional detector interface module

- g. Addressable sounder modules
- h. Addressable relay interface modules
- i. Addressable switch monitoring modules
- j. Short circuit isolator modules (no address required)
- k. Loop powered sounders
- l. Manual call points for indoor use
- m. Manual call points for outdoor use
- n. Multiple inputs/outputs
- o. Radio interfaces to detectors and call points

## **B. CONVENTIONAL UNITS**

1. The manufacturer shall have available the following types of conventional automatic detectors, manual call points and ancillary units for connection to the system via suitable interfaces:
  - a. Ionization smoke detectors
  - b. Photoelectric smoke detectors
  - c. Photoelectric beam smoke detectors
  - d. Ultra-violet flame detectors
  - e. Heat detectors
  - f. Manual call points for indoor use
  - g. Manual call points for outdoor use
  - h. Remote indicator units
  - i. Sounders
2. Analogue Addressable and addressable detectors and modules must be able to transmit to the FACP an address to be used in the system configuration.
3. It must be possible to connect and mix automatic detectors, addressable manual call points and addressable modules within the same zone sub-division of an addressable loop.
4. All equipment connected to the system addressable loop, either directly or via interfaces, shall be proofed against electrical noise, high frequency pulses and electromagnetic influences from other equipment.
5. The manufacturer shall have available suitable equipment to test and remove or exchange all three main types of automatic point-type detectors when installed.

## **C. IONISATION SMOKE DETECTORS**

1. The ionization smoke detectors shall be capable of detecting visible and invisible combustion gases emanating from fires, using a dual ionization chamber in which the air is ionized by a single radioactive source.

2. The radioactive source used shall be AM 241 of one micro curie or less.
3. The ionization smoke detectors shall be designed to have high resistance to contamination and corrosion and shall include RFI screening to minimize the effect of radiated and conducted electrical interference.
4. The ionization smoke detectors shall be suitable for operation in air speeds of up to 10m/s and shall incorporate screens to minimize the effects of small insects.
5. The manufacturer shall have available the following versions of the ionization smoke detector to meet different applications:
  - a. Analogue addressable
  - b. Conventional
6. The ionization smoke detector shall incorporate LED's, clearly visible from the outside, to provide indication of alarm actuation.
7. In locations where the detector is not readily visible, remote indicator units shall be provided.

#### **D. PHOTOELECTRIC SMOKE DETECTORS**

1. The photoelectric smoke detectors shall be capable of detecting visible combustion gases emanating from fires and shall employ the forward light-scatter principle.
2. The point-type photoelectric smoke detectors shall be equally sensitive to a wide range of combustible materials.

#### **E. DUCT SMOKE DETECTORS**

1. The manufacturer shall produce standard equipment for the installation of smoke detectors in air ducts. This equipment shall be designed to accommodate the manufacturer's standard smoke detectors and bases:
  - a. Analogue addressable,
  - b. Addressable and conventional.

#### **F. HEAT DETECTORS**

1. The heat detectors shall be capable of detecting rapid rise in temperature and/or fixed absolute temperatures.
2. The heat detectors shall employ two heat-sensing elements with different thermal characteristics to provide a rate of rise dependent response.
3. The heat detectors shall include RFI screening to minimize the effect of radiated and conducted electrical interference.
4. The manufacturer shall have available the following versions of heat detectors to meet different applications:
  - a. Analogue addressable – grade 1, 2 or 3.
  - b. Two state addressable – grade 1

- c. Two state addressable – grade 2
  - d. Conventional – grade 1
  - e. Conventional – grade 2
  - f. Conventional – range 1
  - g. Conventional – static 60°C
  - h. Conventional – static 90°C
5. The heat detectors shall incorporate LED's, clearly visible from the outside, to provide an indication of alarm actuation.
  6. In locations where the detector is not readily visible, remote indicator units shall be provided.

#### **G. DETECTOR BASE:**

1. All detector base shall fit into a common standard type base. Every base shall have a built-in option allowing mechanical locking of the detector head to prevent unauthorized removal or tampering.
2. Detector insertion and removal shall be by simple push-twist movement through the use of an extended tool by one person at the floor level with the detector mounting height up to 7 meter even with the mechanical locking device activated.
3. The base shall be equipped with screw-less terminals capable of securely retaining wires up to 1.5 sq.mm. The base shall be suitable for use for both Class A & Class B wiring.
4. The standard base shall consist of a sealing plate to prevent dirt, dust, condensation or water from the conduit reaching the terminals or detector contact points.
5. The standard base shall be supplied with a removable base cover to protect the contact area during installation stage and to allow checking and commissioning of the individual loops before insertion of the detectors. The dust cover shall be removable by an extended tool up to 7 meters from the floor level.
6. Special base assemblies with sounders from the same manufacturer shall have minimum of 75dBA output

#### **H. DEVICE MONITORING MODULE**

1. The device monitoring module shall permit the use of conventional detecting devices including sprinkler flow switches and supervisory switches on the addressable system. The module can be mounted together in the fire alarm cabinet or be in the standard outlet boxes located near the device being monitored.

#### **I. CONTROL MODULE**

1. Interfaces a controlled device to the addressable system, this enables the fire alarm panel to direct an instruction

## **J. FIRE ALARM NOTIFICATION APPLIANCE**

### **A. Speaker- Strobes**

1.1. Fire lights shall be a xenon-strobe type or equivalent. It shall be low-voltage (24VDC).

- a. The maximum pulse duration shall be 2/10ths of one second (0.2 second with a maximum duty cycle of 40%). A pulse duration is defined as the time interval between initial and final points of 10% of maximum signal.
  - b. The intensity shall be minimum of 75 candelas.
  - c. The flash rate shall be minimum of 1Hz and a maximum of 3Hz.
2. The color shall be clear or nominal white (i.e. unfiltered or clear filtered white light).
  3. Electric, utilizing solid state electronic technology operating on a nominal 24 VDC, with a nominal rating of 82 dB A at 3m.

## **K. ANNUNCIATOR PANEL- BACK LIT GRAPHIC TYPE**

1. Graphic annunciator showing the site plan, and access way shall be provided and installed in FCC room and every Elevator lobby in each floor.
2. Indicating Lamps
3. Provide supervised light emitting diodes (LED's) for indication.

## **L. SPECIAL DETECTION SYSTEM AND DEVICES**

1. Where specified, special detection system, addressable and non-addressable type, such as beam detectors, linear detector, aspirating smoke detection system, gas detector, etc. shall be used. The detection system shall be of a type approved by Bureau of Fire Department/Authorities having Jurisdiction and shall be suitable for a particular application, environmental condition and hazard. The Contractor shall submit detailed equipment catalogue, description, technical data and test certificate for approval. The Contractor shall submit information proving the suitability of the special detection system and devices for a particular application and hazard for approval.
2. Where detection system is required in open-air/outdoor applications, the Contractor shall use and submit suitable detection system approved by Bureau of Fire Department/Authorities Having Jurisdiction for approval. Special detection system shall also be used where necessary to avoid unwanted alarm.

## **PART 3. EXECUTION**

### **A. GENERAL**

1. All equipment shall be installed and connected in accordance with the manufacturer's recommendations. Following the required specifications indicated here.

2. Wiring shall be color coded, and in accordance with the manufacturer's recommendations and Fire Department requirements. Install wiring in an independent, dedicated metallic raceway system.
3. Connections to devices installed in accessible tile ceilings shall be in flexible conduit.
4. Device back boxes shall be securely attached to framing members.
5. Provide wire ways above and/or below equipment cabinets to accommodate large concentrations of wiring. Conductors within equipment cabinets shall be carefully formed and harnessed.
6. Connect equipment to emergency power system.
7. Furnish a fire alarm speaker and a firefighter's plug in jack for each elevator. Coordinate installation with elevator equipment supplier.
8. FCIP and smoke control sequence wiring shall be dedicated and independent from other systems.
9. Provide a 25 mm empty conduit from the FACP to the nearest telecom terminal backboard.
10. Speaker circuits on individual floor are to be wired in alternate pattern e.g. 'a'- 'b'- 'a'- 'b'- 'a'.

## **B. TESTING AND COMMISSIONING**

1. Provide the service of a competent factory-trained engineer or technical authorized by the manufacturer of the fire detection and alarm system equipment to technically supervise and participate during all of the adjustments and tests for the system. Make all adjustments and tests in the presence of the Project Manager.
2. When the system has been completed, and prior to the final inspection, furnish testing equipment and perform the following tests in the presence of the Engineer and the Local authority having jurisdiction.
  - a. Check installation, supervision and operation to ascertain that they will function as specified.
  - b. When any defects are detected, make repairs or install replacement components, and repeat the test.
3. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall perform the required test. In addition, the representative shall demonstrate that the systems function properly in every respect. The demonstration shall be made in the presence of the Owner's Representative, Project Manager, Consultant and the local authority having jurisdiction.

## **B. ADDRESSABLE FIRE ALARM TESTING**

The correctness of cabling with continuity as per the approved shop drawings. System design & configuration check, Access Control & P.A System integration test



## **1. PHOTOELECTRIC SMOKE DETECTOR**

The testing shall be carried out for each loop / zone, initially one detector in a zone and subsequently 2 or more are disassociated detectors in each zone with time lapse between the detectors to test for Alarm Priority, Alarm Queuing and Call Logging.

An identified detector will be subjected to smoke aspiration from burning paper/cigarette puffs, rubber and other materials which give dense smoke held at 0.3 M distance from the detector. The FACP should indicate increased analogue output for that address and after the programmed delay time, a fire alarm signal shall be indicated. This delay shall be utilized for alarm verification.

The same test shall be carried out for two detectors in the same Loop but in different rooms. The FACP shall indicate Pre Alarm higher analogue levels for both detectors in its display with separate identification for both fires. One of the detectors in question be subjected to higher and longer levels of smoke aspiration. The FACP should give priority alarm for this address. The printout shall indicate individual addresses of the detectors with achieved analogue values and the time of event. This test shall be carried out for different Loops as well as for 2 Loops simultaneously. One detector of each type will be disconnected and subjected to slow dust build - up by means as desired by the Bidder and again connected in the circuit. The FACP shall indicate the changed ambient levels and automatically adjust the analogue values for the same. These Detectors shall then be replaced by new Detectors of identical type and the FACP shall then be programmed accordingly and checked. The Bidder will take custody of the removed detectors without additional cost to PSHS (MIMAROPA).

## **2. MANUAL PULL STATION**

Manual Pull Station in each area is opened & tested for its alarm. Every manual call point will be actuated in every zone in all locations to check for the alarm response. One half of the testing shall be made on a stand by battery power.

## **3. LOOP**

Any part of the Loop shall be short circuited. The FACP shall indicate the communication failure of all the devices connected in the short circuited segment. After the short circuit is corrected, the Fault Isolator shall return to its normal status automatically, this being reflected in the FACP. The Loop shall then be in normal operation again. Any part of the Loop shall be de wired and tested as given above.

=== END OF DIVISION 28 ===