TECHNICAL SPECIFICATIONS

NURSING FACILITIES
INTERIM HOUSING

AT

RIO HONDO COLLEGE
3600 Workman Mill Road
Whittier, CA 90601

RIO HONDO COMMUNITY COLLEGE DISTRICT
3600 Workman Mill Road
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W+W Project No. 16040.00
December 7, 2016
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SUMMARY OF WORK

PART 1 – GENERAL

1.01 PROJECT DESCRIPTION

A. Project consists of selective demolition and new construction work to convert existing portable buildings to classroom and office swing spaces and new portable building to house interim nursing program at Rio Hondo, Whittier, California, as shown on Contract Documents prepared by Westberg + White, Inc., Architects.

B. Work includes:
   1. Code required upgrades to existing toilet buildings HS-4 and HS-5.
   2. Remodel of existing portable building HS-6 to house Interim Nursing Program.
   3. New portable building HS-11 to house Interim Nursing Program.
   4. Replacement of accessible ramps for existing portable buildings HS-5 and HS-6.

C. Site Improvement Work Consisting of:
   1. Grinding and resurfacing of existing asphalt paved areas.
   2. Installation of seal coat.
   3. Restriping of existing parking spaces, including new accessible parking spaces.
   4. Improvements to concrete curbs and gutters.

1.02 PROCUREMENT AND CONTRACTING DOCUMENTS

A. Use Division 00 Procurement and Contracting Requirements provided by Rio Hondo Community College District.

1.03 RELATED DOCUMENTS

A. Refer to District’s Division 00 Documents, including General Conditions, and other Division 01 Sections, for additional requirements.

B. Comply with requirements of these specifications and District’s Division 00 documents.
   1. Where differences may occur between specifications and District 00 documents, requirements of District’s 00 documents shall govern, unless otherwise directed.
   2. Changes to approved documents shall be made by addenda or change order approved by Owner/Architect.

C. Contract Documents are complementary and what is required by one shall be as binding as if required by all.
   1. Errors, inconsistencies, or omissions discovered by Contractor shall be reported promptly to Owner/Architect as request for information.
1.04 CONSTRUCTION REQUIREMENTS

   1. Refer to Section 01 4200 for additional references.

1.04 CONTRACTS

A. Construct Work under single fixed-price contract.

1.04 WORK SEQUENCE

A. General: Conform to construction schedule as specified.
   1. Construction time shall start as of date specified in initial "Notice to Proceed" from Architect to Contractor and ends with date of acceptance of Work by Owner.

B. Construction Schedule: Work will be conducted in single phase and provide least possible interference to activities of Owner's personnel and to permit orderly transfer of personnel and equipment to new facilities.

C. Liquidated Damages: Liquidated damages will be assessed under conditions provided in Agreement.

1.06 CONTRACTOR'S USE OF PREMISES

A. General: During construction period, Contractor shall limit his use of premises to immediate area required for construction operations.
   1. Contractor's use of premises is also limited by Owner's right to perform construction operations with its own forces or to employ separate contractors on portions of Project.

B. Contractor shall limit his use of premises for Work and for storage as directed, to allow for:
   1. Work by other Contractors.
   2. Owner occupancy.
   3. Use by Public.

C. Coordinate use of premises under direction of Architect and Owner.

D. Assume full responsibility for protection and safekeeping of products under this contract, stored on Project Site.

E. Move stored products under Contractor's control, which interfere with operations of Owner or separate contractor.

F. Obtain and pay for use of additional storage or work areas needed for operations.

1.07 WORK DURING COLLEGE SESSIONS

A. Work under this contract will be executed in part during regular sessions of College.
   1. Contractor shall cooperate with College authorities in every way to minimize disturbance.
B. In entrance and exit of workers, and in bringing in, storing, and removal of equipment, Contractor shall cooperate with those in authority and prevent interference with functioning of College.
   1. Observe rules and regulations in force and avoid unnecessary dust, mud or accumulated debris, or undue interference with convenience, sanitation or routine of departmental activities.

C. In connecting new utilities to existing, and similar operations, Contractor shall time and coordinate such operations so that there will be no interference with College activities.

1.08 PROTECTION OF EXISTING IMPROVEMENTS

A. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing improvements indicated to remain in place.
   1. Comply with requirements of Section 01 5000.

B. Restore improvements damaged by this Work to their original condition as acceptable to Owner or authorities having jurisdiction.

1.09 HAZARDOUS MATERIALS

A. Asbestos or Hazardous Waste: It is understood and agreed that this contract does not contemplate handling of asbestos or other hazardous waste material.
   1. Should asbestos or other hazardous waste material be encountered, notify Owner immediately.
   2. Do not disturb, handle, or attempt to remove.

PART 2 – PRODUCTS  (Not Applicable)
PART 3 – EXECUTION  (Not Applicable)

END OF SECTION 01 1100
SECTION 01 2610

CONSTRUCTION DOCUMENT MODIFICATION PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section specifies administrative and procedural requirements for handling and processing Construction Document Modifications to Contract.

1.02 MINOR CHANGES IN WORK

A. Supplemental instructions authorizing minor changes in Work, not involving adjustment to Contract Sum or Contract Time, will be issued by Architect on AIA form G710 - Architect's Supplemental Instructions.

1.03 CONSTRUCTION CHANGE DOCUMENT APPROVAL REQUESTS

A. Construction Change Documents will not be allowed without Division of the State Architect (DSA) approval.

B. Owner-Initiated Change Requests: Proposed changes in Work that will require adjustment to Contract Sum or Contract Time will be issued by Architect, with detailed description of proposed change and supplemental or revised Drawings and Specifications, when necessary.
   1. Change requests issued by Architect are for information only.
      a. Do not consider them an instruction either to stop Work in progress, or to execute proposed change.
   2. Unless otherwise indicated in change request, within ten days of receipt of change request, submit to Architect for Owner's review, estimate of cost necessary to execute proposed change.
      a. When no estimate of cost is submitted within 10 days it will be assumed to be "no cost change".
      b. Include list of quantities of products to be purchased and unit costs, along with total amount of purchases to be made.
      c. Provide breakdown of labor cost involved with the proposed change.
         1) Where requested, furnish survey data to substantiate quantities.
      d. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      e. Include statement indicating effect proposed change in Work will have on Contract Time.

C. Contractor-Initiated Change Requests:
   1. When latent or other unforeseen conditions require modifications to Contract, Contractor may propose changes by submitting request for change to Architect.
      a. Contractor shall notify Owner within ten days of occurrence leading to such request or request will be denied and Contractor will not be entitled to additional compensation.
   2. Include statement outlining reasons for change and effect of change on Work.
      a. Provide complete description of proposed change.
b. Indicate effect of the proposed change on Contract Sum and Contract Time.

3. Include list of quantities of products to be purchased and unit costs along with total amount of purchases to be made.
   a. Provide breakdown of labor cost involved with proposed change.
   b. Where requested, furnish survey data to substantiate quantities.

4. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

5. Comply with requirements in Section 01 6000, when proposed change in Work requires substitution of one product or system for product or system specified.

D. Construction Change Document: DSA Form 140 – Application for Approval of Construction Change Document – CCD Category A.
   1. Form will be prepared by Architect for approval by DSA.
   2. Form must be signed by each of following:
      a. A/E of Record.
      b. Structural Engineer, when applicable.
      c. Delegated professional engineer, when applicable.
      d. DSA

1.04 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive:
   1. When Owner and Contractor are not in total agreement on terms of Change Order Proposal Request, Architect may issue Construction Change Directive on AIA Form G714, instructing Contractor to proceed with change in Work, for subsequent inclusion in Contract.
   2. Construction Change Directive will contain complete Construction Change Document and designate method to be followed to determine change in Contract Sum or Contract Time.

B. Documentation: Maintain detailed records on time and material basis of work required by Construction Change Directive.
   1. After completion of change, submit itemized account and supporting data necessary to substantiate cost and time adjustments to Contract.

1.05 CONTRACT CHANGE ORDER PROCEDURES

A. Upon DSA approval of Construction Change Document DSA Form 140, Architect will issue Construction Change Documents for signatures of Owner and Contractor on proper approved form, as provided in General Conditions of the Contract.
SECTION 01 2976

PROGRESS PAYMENT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements governing Contractor's applications for payment.

B. Related Sections:
   1. Section 01 2610: Construction Document Modification Procedures
   2. Section 01 7700: Closeout Procedures
   3. Section 01 7839: Project Record Documents

C. Related Requirements:
   1. Refer to District's Division 00 Documents, including General Conditions, for requirements related to Contractor's Construction Schedule, Submittal Schedule, and Progress Payments Procedures.

1.02 SCHEDULE OF VALUES

A. Coordinate preparation of Schedule of Values with preparation of Contractor's construction schedule.
   1. Correlate line items in Schedule of Values with other required administrative schedules and forms, including:
      a. Contractor's Construction Schedule.
      b. Application for Payment form.
      c. List of Subcontractors.
      d. Schedule of Alternates.
      e. List of products.
      f. List of principal suppliers and fabricators.
      g. Schedule of Submittals.
   2. Submit Schedule of Values to Architect at earliest feasible date, but in no case later than fourteen days before date scheduled for submittal of initial application for payment.
   3. Sub-Schedules: Where Work is separated into phases that require separately phased payments, provide sub-schedules showing values correlated with each phase of payment.

B. Format and Content:
   1. Include following project identification on Schedule of Values:
      a. Project name and location.
      b. Name of Architect.
      c. Project number.
      d. Contractor's name and address.
      e. Date of submittal.
   2. Arrange Schedule of Values in tabular form with separate columns to indicate following for each item listed:
      a. Generic name.
      b. Related specification section.
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c. Name of subcontractor.
d. Name of manufacturer or fabricator.
e. Name of supplier.
f. Change Orders (numbers) that have affected value.
g. Dollar value.
h. Percentage of Contract sum to nearest one-hundredth percent, adjusted to total 100 percent.

3. Provide breakdown of Contract Sum in sufficient detail to facilitate continued evaluation of applications for payment and progress reports.
a. Break principal subcontract amounts down into several line items.

4. Round amounts off to nearest whole dollar; total shall equal Contract Sum.

5. For each part of Work where application for payment may include materials or equipment, purchased or fabricated and stored, but not yet installed, provide separate line items on Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of Work.

6. Margins of Cost: Show line items for indirect costs, and margins on actual costs, only to extent that such items will be listed individually in applications for payment.
a. Each item in Schedule of Values and applications for payment shall be complete including its total cost and proportionate share of general overhead and profit margin.
b. At Contractor's option, temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown as separate line items in Schedule of Values or distributed as general overhead expense.

7. Schedule Updating: Update and resubmit Schedule of Values when Change Orders or Construction Change Directives result in change in Contract Sum.
a. Submit along with updated construction schedule prior to monthly progress payment submittal

1.03 APPLICATIONS FOR PAYMENT

A. Each application for payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
1. Initial application for payment, application for payment at time of Substantial Completion, and final application for payment involve additional requirements.

B. Payment Application Times: Date for each progress payment is 5th day of each month.
1. Period of construction Work covered by each application for payment is period ending fifteen days prior to date for each progress payment and starting day following end of preceding period.

C. Payment Application Forms: Use AIA Document G702 –Application and Certification For Payment as form for application for payment or approved equal.

D. Application Preparation: Complete every entry on form, including notarization and execution by person authorized to sign legal documents on behalf of Owner.
1. Incomplete applications will be returned without action.
2. Entries shall match data on Schedule of Values and Contractor's construction schedule.
a. Use updated schedules if revisions have been made.
3. Include amounts of approved Change Orders issued prior to last day of construction period covered by application.

E. Transmittal: Submit five executed copies of each application for payment to Architect by means ensuring receipt within twenty-four hours.
   1. One copy shall be complete, including waivers of lien and similar attachments, when required.
   2. Transmit each copy with transmittal form listing attachments, and recording appropriate information related to application in manner acceptable to Architect.

F. Waivers of Mechanics Lien: When requested by Architect or Owner, with each application for payment, submit waivers of mechanics lien from every entity who may lawfully be entitled to file mechanics lien arising out of the Contract, and related to Work covered by payment.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first application for payment include following:
   1. List of subcontractors.
   2. List of principal suppliers and fabricators.
   3. Schedule of Values.
   4. Contractor's Construction Schedule (preliminary if not final).
   5. Submittal Schedule (preliminary if not final).
   6. Certificates of insurance and insurance policies.
   7. Performance and Payment Bonds

H. Application for Payment at Substantial Completion: Following issuance of Certificate of Substantial Completion, submit application for payment.
   1. Application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of Work.

I. Administrative actions and submittals that shall proceed or coincide with application include:
   1. Occupancy permits and similar approvals.
   2. Warranties/guarantees and maintenance agreements.
   3. Test/adjust/balance records.
   5. Meter readings.
   7. Changeover information related to Owner's occupancy, use, operation and maintenance.
   8. Final cleaning.
   10. Advice on shifting insurance coverage.
   11. Record Drawings and Specifications.
   12. Final progress photographs.
   13. List of incomplete Work, recognized as exceptions to Architect's Certificate of Substantial Completion.

J. Final Payment Application: Administrative actions and submittals that must precede or coincide with submittal of final payment application for payment include following:
   1. Completion of project closeout requirements.
   2. Completion of items specified for completion after Substantial Completion.
3. Assurance that unsettled claims will be settled.
4. Assurance that Work not complete and accepted will be completed without undue delay.
5. Transmittal of required project construction records to Owner.
6. Proof that taxes, fees and similar obligations have been paid.
7. Removal of temporary facilities, controls, and services.
8. Removal of surplus materials, rubbish and similar elements.
9. Change of door locks to Owner's access.

PART 2 – PRODUCTS  (Not Applicable)

PART 3 – EXECUTION  (Not Applicable)

END OF SECTION 01 2976
SECTION 01 3113

PROJECT COORDINATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and supervisory requirements necessary for Project coordination including, but not necessarily limited to:
      a. Coordination.
      b. Administrative and supervisory personnel.
      c. General installation provisions.
      d. Cleaning and protection.

B. Related Sections:
   1. Section 01 3300: Submittal Procedures; product and material submittals.
   2. Section 01 7423: Cleaning; general project cleaning

C. Related Requirements:
   1. Refer to District’s Division 00 Documents, including General Conditions, for requirements related to Contractor’s Construction Schedule and Submittal Schedule.

1.02 COORDINATION

A. Coordination: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of Work.

B. Coordinate construction operations included under different Sections of Specifications that are dependent upon each other for proper installation, connection, and operation.
   1. Where installation of one part of Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in sequence required to obtain best results.
   2. Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.

C. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
   1. Prepare similar memoranda for Owner and separate Contractors where coordination of their Work is required.

D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of Work.
   1. Such administrative activities include, but are not limited to, following:
      a. Preparation of schedules.
      b. Installation and removal of temporary facilities.
      c. Delivery and processing of submittals.
d. Progress meetings.

e. Project Close-out activities.

E. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water and materials.
   1. Salvage materials and equipment involved in performance of, but not actually incorporated in, Work.
   2. Refer to other sections for disposition of salvaged materials that are designated as Owner’s property.

1.03 SUBMITTALS

A. Staff Names: Within fifteen days of Notice to Proceed, submit list of Contractor’s principal staff assignments, including Superintendent and other personnel in attendance at Project Site
   1. Identify individuals, their duties and responsibilities
      a. List their addresses and telephone numbers.
   2. Post copies of list in Project meeting room, temporary field office and each temporary telephone.

PART 2 – PRODUCTS  (Not Applicable)

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION PROVISIONS

A. Inspection of Conditions: Require installer of each major component to inspect both substrate and conditions under which Work is to be performed.
   1. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Manufacturer’s Instructions: Comply with manufacturer’s installation instructions and recommendations, to extent that those instructions and recommendations are more explicit or stringent than requirements contained in Contract Documents.

C. Inspect materials or equipment immediately upon delivery and again prior to installation.
   1. Reject damaged and defective items.

D. Provide attachment and connection devices and methods necessary for securing Work.
   1. Secure Work true to line and level.
   2. Allow for expansion and building movement.

   1. Arrange joints in exposed Work to obtain best visual effect.
   2. Refer questionable choices to Architect for final decision.

F. Recheck measurements and dimensions before starting each installation.

G. Install each component during weather conditions and Project status that will ensure best possible results.
   1. Isolate each part of completed construction from incompatible material as necessary to prevent deterioration.
H. Coordinate temporary enclosures with required inspections and tests, to minimize necessity of uncovering completed construction for that purpose.

I. Mounting Heights: Where mounting heights are not indicated, install individual components at standard mounting heights recognized within industry for particular application indicated.
   1. Comply with requirements of Chapter 11B of CBC for accessible mounting heights of toilet accessories and like items.
   2. Refer questionable mounting height decisions to Architect for final decision.

3.02 CLEANING AND PROTECTION

A. Comply with requirements of Section 01 7423.

B. During handling and installation, clean and protect construction in progress and adjoining materials in place.
   1. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

C. Clean and maintain completed construction as frequently as necessary through remainder of construction period.
   2. Adjust and lubricate operable components to ensure operability without damaging effects.

D. Limiting Exposures: Supervise construction activities to ensure that no part of construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

END OF SECTION 01 3113
SECTION 01 3119

PROJECT MEETINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for project meetings including but not limited to:
      a. Pre-Construction Conference
      b. Progress Meetings
      c. Scheduling Conference

B. Related Sections:
   1. Section 01 3113: Project Coordination

C. Related Requirements:
   1. Refer to various Sections for pre-construction and pre-installation meeting requirements
   2. Refer to District's Division 00 Documents, including General Conditions, for requirements related to Contractor's Construction Schedule.

1.02 PRE-CONSTRUCTION CONFERENCE

A. Schedule pre-construction conference and organizational meeting at Project Site or other convenient location no later than 15 days after execution of Agreement and prior to commencement of construction activities.
   1. Conduct meeting to review responsibilities and personnel assignments.

B. Attendees: Owner, Architect and their consultants, Contractor and his superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at conference by persons familiar with and authorized to conclude matters relating to Work.

C. Agenda: Discuss items of significance that could affect progress including such topics as:
   1. Tentative construction schedule.
   2. Critical Work sequencing.
   3. Designation of responsible personnel.
   4. Procedures for processing field decisions and Change Orders.
   5. Procedures for processing Applications for Payment.
   7. Submittal of Shop Drawings, Product Data and Samples.
   8. Preparation of Record Documents.
  10. Office, Work and storage areas.
  11. Equipment deliveries and priorities.
  12. Safety procedures.
  13. First aid.
15. Working hours.

1.03 PROGRESS MEETINGS

A. Conduct weekly progress meetings at Project Site.
   1. Coordinate dates of meetings with preparation of payment request.

B. Attendees: In addition to representatives of Owner and Architect, each
   subcontractor, supplier or other entity concerned with current progress or involved in
   planning, coordination or performance of future activities shall be represented at
   these meetings by persons familiar with Project and authorized to conclude matters
   relating to progress.

C. Agenda: Review and correct or approve minutes of previous progress meeting.
   1. Review other items of significance that could affect progress.
   2. Include topics for discussion as appropriate to current status of Project.
   3. Contractor's Construction Schedule: Review progress since last meeting.
      a. Determine where each activity is in relation to Contractor's Construction
         Schedule, whether on time or ahead or behind schedule.
      b. Determine how construction behind schedule will be expedited; secure
         commitments from parties involved to do so.
      c. Discuss whether schedule revisions are required to ensure that current
         and subsequent activities will be completed within Contract Time.
   4. Review present and future needs of each entity present, including such items
      as:
      a. Interface requirements.
      b. Time.
      c. Sequences
      d. Coordination of Work.
      e. Deliveries.
      f. Off-site fabrication problems.
      g. Access.
      h. Site utilization.
      i. Temporary facilities and services.
      j. Hours of Work.
      k. Hazards and risks.
      l. Housekeeping.
      m. Quality and Work standards.
      n. Construction progress
      o. Progress Schedule and Submittals.
      p. Change Orders.
      q. Documentation of information for payment requests.

D. Meeting Records: Owner or Architect shall record minutes of each meeting and
   furnish copies within reasonable time to Owner, Contractor, and other attendees.
   1. Unless written objections to contents of meeting minutes is received by
      Architect within five days of distribution of meeting minutes, it shall be
      understood and agreed that minutes are true and complete record of meeting.
   2. Schedule Updating: Revise construction schedule after each progress meeting
      where revisions to schedule have been made or recognized.
      a. Issue revised schedule within seven calendar days of meeting.
PART 2 – PRODUCTS  (Not Applicable)

PART 3 – EXECUTION  (Not Applicable)

END OF SECTION 01 3119
SECTION 01 3300

SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for submittals required for performance of Work, including:
      a. Submittal schedule.
      b. Product data.
      c. Shop drawings.
      d. Samples
      e. Verified reports

B. Related Sections:
   1. Section 01 3113: Project Coordination
   2. Section 01 4100: Regulatory Requirements; submittals to regulatory agencies.
   3. Section 01 4200: References; submittals to regulatory agencies.
   4. Section 01 4500: Quality Control: inspection and testing submittals
   5. Section 01 6000: Products Requirements; request for substitution submittals.

C. Related Requirements:
   1. Refer to Division 02 through 32 Sections where more specific submittal requirements are indicated
   2. Refer to District’s Division 00 Documents, including General Conditions, and other Division 01 Sections, for additional requirements.

D. Administrative Submittals:
   1. Include, but are not limited to:
      a. Permits.
      b. Applications for Payment.
      c. Performance and Payment Bonds.
      d. Insurance Certificates.
      e. Inspection and Test Reports.
      f. Schedule of Values.
      g. Progress Schedule.
      h. Listing or designation of subcontractors.
      i. Record Drawings.

E. Contractor's submittal and Architect's acceptance of Product Data, Shop Drawings, or Samples that relate to construction activities not complying with Contract Documents does not constitute acceptable or valid request for substitution, nor does it constitute approval.

F. Product Data, Shop Drawing and Sample Submittals containing substitutions for specified items will be rejected and returned as not in compliance with Contract Documents.
1.02 SUBMITTAL PROCEDURES AND REQUIREMENTS

A. Coordination:
   1. Coordinate preparation and processing of submittals with performance of
      construction activities.
   2. Designate in Progress Schedule, or in separate coordinated schedule, dates
      for submission and dates reviewed shop drawings, product data and samples
      will be needed for each product.
      a. Identify items requiring long lead times.
      b. Submittals for long lead time items are to be submitted as soon as
         possible, but not later than fifteen days after Notice of Award of Contract.

B. Timing of Submittals:
   1. Make submittals promptly in accordance with approved schedule, sufficiently in
      advance of performance of related construction activities, and in such
      sequence as to not cause delay in Work or in Work of other contractors.
   2. Schedule submissions at least 21 working days before dates reviewed
      submittals will be needed.

C. Number of Submittals Required:
   1. Number stated in each specification section, or as follows:
      a. Product Data and Shop Drawings: One electronic copy as specified
         under “Electronic Submittals”.
      b. Samples: Number stated in each specification section or, if not stated,
         minimum of four.
      c. Warranties, Maintenance Agreements, Industry Standards, and
         Operation/Maintenance Manuals: Two copies.

D. Submittal Preparation:
   1. Place permanent label or title block on each submittal for identification.
   2. Indicate name of entity that prepared each submittal on label or title block.
   3. Include following information on label for processing and recording action
      taken:
      a. Project name.
      b. Date.
      c. Submittal reference number assigned by Contractor; this number should
         not be specification section number.
      d. Specification section number to which submittal applies.
         1) Do not reference drawing/detail numbers unless accompanied by
            specification section number.
   4. Accompany submittals with transmittal form containing:
      a. Date.
      b. Project title and number.
      c. Name and address of:
         1) Architect.
         2) Contractor.
         3) Subcontractor.
         4) Supplier
         5) Manufacturer.
         6) Separate detailer, when pertinent.
      d. Number of each shop drawing, product data and sample submitted.
      e. Notification of deviations from Contract Documents.
      f. Other pertinent data.
E. Submittals shall include:
   1. Data and revision dates:
   2. Project title and number.
   4. Identification of product or material.
   5. Relation to adjacent structure or materials.
   6. Field dimensions, clearly identified as such.
   7. Specification section number.
   8. Applicable standards, such as ASTM number or Federal Specification.
   9. Blank space, 8 inches x 3 inches, for Contractor and Architect stamps.
   11. Contractor’s stamp, initialed or signed, certifying review of submittal, verification of field measurements, and compliance with Contract Documents.
      a. Submittals without Contractor’s stamp and signature will be returned by Architect without review.

F. Processing:
   1. Allow sufficient review time so that installation will not be delayed as result of time required to process submittals, including time for resubmittals.
   2. Allow minimum of 21 days from date of receipt of complete submittal for Architect’s initial review and return of submittals.
   3. Allow additional time if processing must be delayed to permit coordination with subsequent submittals.
   4. Architect reserves right to withhold action on submittal requiring coordination with other submittals until related submittals are received.
   5. Architect will promptly advise Contractor when submittal being processed must be delayed for coordination.
   6. No extension of Contract Time will be authorized because of failure to transmit submittals to Architect sufficiently in advance of Work to permit processing.

G. Electronic Submittals: Make electronic submittals consisting of one color PDF of each document, Product Data Sheet, or Shop Drawing.
   1. Should full size hard copies of Submittals be required by District, Contractor, or Consultant, Architect will provide one marked-up color copy of PDF to Owner, Contractor, or Consultant for their use in printing additional copies.
   2. Architect will review and return marked-up PDFs to Contractor.
   3. One copy of each PDF shall be marked-up and maintained as "Record Document".

1.03 PRODUCT DATA

A. Collect Product Data into single submittal for each element of construction or system.
   1. Do not include Material Safety Data Sheets/Safety Data Sheets (MSDS/SDS) in submittals to Architect.
      a. MSDS/SDS sheets will not be reviewed by Architect and will not be returned.

B. Product Data includes standard printed information on manufactured products that has not been specially prepared for this Project, including, but not limited to following items:
   1. Manufacturer’s product specifications and installation instructions.
   2. Catalog cuts.
4. Roughing-in diagrams and templates.
5. Standard wiring diagrams.
7. Standard product operating and maintenance manuals.

C. Modify standard data sheets to delete information which is not applicable to Project.
1. Where Product Data must be specially prepared because standard printed data is not suitable for use, submit as shop drawings.
   a. Mark each copy to show applicable choices and options.
   b. Where printed Product Data includes information on several products, some of which are not required, mark copies to indicate applicable information.
   c. Include following information:
      1) Manufacturer's printed recommendations.
      2) Compliance with recognized trade association standards.
      3) Compliance with recognized testing agency standards.
      4) Application of testing agency labels and seals.
      5) Notation of dimensions and clearances required and as verified by Field measurement.
      6) Notation of coordination requirements.

D. Supplement standard information to provide additional information specifically applicable to Project:
1. Clearly mark each copy to show applicable choices and options and identify pertinent materials, products, or models.
2. Show dimensions and clearances required.
3. Show performance characteristics and capacities.
4. Show wiring or piping diagrams and controls.

E. Do not submit Product Data until compliance with requirements of Contract Documents has been confirmed.
1. Unless noncompliance with Contract Document provisions is observed, submittal may serve as the final submittal.

F. Submittals: Make electronic submittals as specified in “General Submittal Procedures and Requirements” Article.

G. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities.
1. Show distribution on transmittal forms.
2. Do not proceed with installation until applicable copy of Product Data is in installer’s possession.

H. Do not permit use of unmarked copies of Product Data in connection with construction.

1.04 SHOP DRAWINGS

A. Shop drawings are technical drawings and data that have been specially prepared for Project, including but not limited to following items:
1. Prepared information, drawn to accurate scale.
2. Fabrication and installation drawings.
5. Templates.
6. Patterns.
7. Coordination drawings (for use on Project Site).
8. Schedules.
9. Design mix formulas.
10. Contractor's engineering calculations.

B. Include following information:
   1. Dimensions.
   2. Identification of products and materials included.
   3. Compliance with specified standards.
   4. Notation of coordination requirements.
   5. Notation of dimensions established by field measurement.
   6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 inch by 11 inch but no larger than 30 inch by 42 inch.

C. Highlight, encircle, or otherwise indicate deviations from Contract Documents.

D. Do not reproduce Contract Documents or copy standard information as basis of Shop Drawings.

E. Standard information prepared without specific reference to Project is not considered Shop Drawings.

F. Submittals: Make electronic submittals as specified in “General Submittal Procedures” Article.

G. Do not use Shop Drawings without appropriate final stamp indicating action taken in connection with construction.

H. Contractor may request use of Architect’s computer-generated drawings in electronic format.
   1. Software for CAD formats requested by Contractor not currently available to Architect will be provided by Contractor at his own expense.
   2. Contractor must complete CAD Drawing Request Form (Attachment A) and submit it to Architect in timely manner.

1.05 SAMPLES

A. Samples are physical examples of Work, including, but not limited to, following items:
   1. Partial sections of manufactured or fabricated work
   2. Small cuts or containers of materials.
   3. Complete units of repetitively-used materials.
   4. Swatches showing color, texture and pattern.
   5. Color Range Sets:
   6. Units of Work to be used for independent inspection and testing.

B. Office Samples:
   1. Sufficient size and quantity to clearly illustrate:
NURSING FACILITIES INTERIM HOUSING
RI O HONDO COLLEGE
RI O HONDO COMMUNITY COLLEGE DISTRICT

a. Functional characteristics of product or material, with integrally related parts and attachment devices.

b. Full range of color, texture and pattern.

2. Where size and quantity are not specified, provide minimum of four samples, 12 inches by 12 inches, minimum size, where samples are required.

C. Field Samples and Mock-Ups:

1. Erect at Project Site in location acceptable to Architect.

2. Construct each sample or mock-up complete, including Work of trades required in finished Work.

3. Size of area as specified in respective specification section.

4. Remove mock-ups at conclusion of Work or when acceptable to Architect.

1.06 VERIFIED REPORTS

A. Submit Verified Reports to Division of State Architect (DSA). Comply with California Code of Regulations, Title 24, Part 1, Sections 4-336 and 4-343.

1.07 MISCELLANEOUS SUBMITTALS – WORK RELATED

A. Including, but not limited to, following types of submittals:

1. Specially prepared warranties/guarantees.

2. Standard printed warranties.


4. Printed industry standards.

5. Collected and bound operating/maintenance manuals.


7. Maintenance tools and spare parts.

1.08 CONTRACTOR RESPONSIBILITIES

A. As defined in General Conditions of the Contract and following:

1. Review shops drawings, product data and samples prior to submission to Architect.

2. Determine and Verify:

3. Field measurements.

4. Field construction criteria.

5. Catalog numbers and similar data.


7. Coordinate each submittal with requirements of Work and of Contract documents.


9. Do not begin fabrication of Work that requires submittals until return of submittals with Architect approval.

1.09 RESUBMITTAL REQUIREMENTS

A. Shop Drawings:

1. Revise initial drawings as required and resubmit as specified for initial submittal.
2. Indicate on drawings changes that have been made other than those requested by Architect.

B. Product Data and Samples: New data and samples, same as required for initial submittal.

1.10 DISTRIBUTION OF SUBMITTALS AFTER REVIEW

A. Distribute reproductions of Shop Drawings and copies of Product Data which carry Architect/Engineer stamp to:
   1. Project Site file.
   2. Record Documents file.
   3. Other affected contractors.
   4. Subcontractors.
   5. Supplier or Fabricator.
   6. Owner's Inspector.

B. Distribute samples that carry Architect’s review stamps as directed by Architect.

1.11 ARCHITECT’S ACTION

A. Except for submittals for record, information or similar purposes, where action and return is required or requested, Architect will review each submittal, mark to indicate action taken, and return promptly.
   1. Compliance with specified characteristics is Contractor's responsibility.

B. Action Stamp:
   1. Architect will stamp each submittal with uniform, self-explanatory action stamp.
   2. Stamp will be appropriately marked, as follows, to indicate action taken:
      a. Final Unrestricted Release: Where submittals are marked "No Exception Taken", that part of Work covered by submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
      b. Final-But-Restricted Release: When submittals are marked "Make Correction Noted", that part of Work covered by submittal may proceed provided it complies with notations or corrections on submittal and requirements of Contract Documents.
         1) Final acceptance will depend on that compliance.
      c. Returned for Re-submittal: When submittal is marked "Revise and Resubmit", do not proceed with that part of Work covered by submittal, including purchasing, fabrication, delivery, or other activity.
         1) Revise or prepare new submittal in accordance with notations.
         2) Resubmit without delay.
         3) Repeat if necessary to obtain different action mark.
         4) Do not permit submittals marked "Rejected" or "Revise and Resubmit" to be used at Project Site, or elsewhere where Work is in progress.
      d. Other Action: Where submittal is primarily for information or record purposes, special processing or other activity, submittal will be returned, marked "Action Not Required".
PART 2 – PRODUCTS   (Not Applicable)

PART 3 – EXECUTION   (Not Applicable)

END OF SECTION 01 3300
ATTACHMENT A – CAD DRAWING REQUEST FORM

Date: _______________________________  Westberg + White Job No. ________________

Project: _____________________________  Project Architect: ____________________

We (Contractor) _____________________________________________________ request the following listed CAD file sheet numbers for use in the execution of our Work under the Contract Documents of the subject project and hereby assume all and sole responsibility of field verification and coordination with the Work of associated trades.

The attached computer-based information for the Project is provided to the Contractor (The User) as a courtesy for their sole convenience. The User recognizes that computer-based information is easily changeable, that changes are difficult to detect and that use or conversion of the information provided may introduce errors, inaccuracies or anomalies that Westberg + White, Inc., and their consultants can neither predict nor control. The delivery of this electronic data does not constitute the delivery of the professional work product of Westberg + White, Inc., and their consultants and Westberg + White, Inc., and their consultants shall not be responsible for any modifications made to the electronic files or any products derived from electronic files that are not prepared by Westberg + White, Inc., and their consultants.

By accepting and utilizing this electronic data in lieu of the corresponding drawings and specifications prepared by Westberg + White, Inc., and their consultants, the User agrees that such data is an instrument of service of Westberg + White, Inc., and their consultants, who shall be deemed to be the authors of the drawings and data and shall retain all common law, statutory law and other rights, including copyrights. The User, by accepting the electronic files, agrees to assume all risk and liabilities associated with the use of the information provided by Westberg + White, Inc., and their consultants and understands that Westberg + White, Inc., and their consultants make no claim or warranty as to the suitability or usefulness of the information for any purpose. The User also agrees, to the fullest extent permitted by law, to hold harmless and indemnify Westberg + White, Inc., and their consultants from and against any and all claims, liabilities, losses, damages and cost, including but not limited to attorney’s fees, arising from or in connection with the use, misuse, modification, or misinterpretation of the electronic data provided by Westberg + White, Inc., and their consultants.

Use of the attached computer-based information indicates acceptance and constitutes agreement to abide by the terms and conditions of this agreement.

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Requested File Format:  Requested File Deliverable:
□ DXF  □ CD Rom
□ DWG (Auto CAD Version 2004,  □ E-Mail (Zipped Files)  unless requested otherwise)

Contractor’s E-mail address ______________________________________________

Signed: _______________________________  Date: _______________
Print Name: __________________________________________ Title: ____________________

Company: ___________________________________________

Address: ____________________________________________

Phone: ___________________

Total payment enclosed herewith at the rate of $30.00 per sheet: $___________________

Make checks payable to Westberg + White, Inc.
SECTION 01 4100

REGULATORY REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. General regulatory requirements pertaining to Work supplementary to other
      regulatory requirements mentioned or referenced elsewhere in Contract
      Documents.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

A. Pertaining statutes, ordinances, laws, rules, codes, regulations, standards, and lawful
   orders of public authorities having jurisdiction of Work are incorporated into these
   Contract Documents same as if repeated in full, and as such are intended where
   reference is made in either singular or plural to Code or Building Code unless
   otherwise specified including, without limitation, those in list below.
   1. Contractor shall make available at Project Site such copies of listed documents
      applicable to Work as Architect or Owner may request including mentioned
      portions of California Code of Regulations (CCR).

B. Project shall be fully governed under State of California's Codes Section Group 1,
   Chapter 4, Part 1, CCR, Title 24, as it pertains to school construction:
   1. Inspector and continuous inspections of Work shall be per Sections 4-333(b) and
      4-342.
   2. Tests and testing laboratory per Section 4-335. (Owner shall pay for testing
      laboratory.)
   3. Special inspection per Section 4-333(c).
   4. Contractor shall submit verified reports per Sections 4-336 and 4-343(c).
   5. Administration:
      a. Duties of Architect and Engineers shall be per Sections 4-333(a) and 4-341.
      b. Duties of Contractor shall be per Section 4-343.
      c. Verified Reports per Section 4-336.
   6. Copies of CCR, Title 24, Part 1, Part 2 Volumes 1 and 2, Part 3, and Part 9, shall
      be made available during construction.

C. Public regulatory requirements: Statutes, ordinances, laws, rules, codes, regulations,
   and standards shall include, but not be limited to, following:
   1. California Code of Regulations (CCR):
      a. Title 19 - Public Safety.
      b. Title 24, Part 1 – 2013 California Administrative Code
      e. Title 24, Part 4 – 2013 California Mechanical Code (CMC).
      g. Title 24, Part 6 – 2013 California Energy Code
      h. Title 24, Part 7 – 2013 California Elevator Safety Construction Code
         (CESCC)
      i. Title 24, Part 9 – 2013 California Fire Code (CFC).
1.03 GOVERNING REGULATIONS/AUTHORITIES

A. Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents
   1. Information may or may not be of significance to Contractor.
   2. Owner and Architect, at request of Contractor, are to contact authorities having jurisdiction directly for information and decisions having bearing on Work.

1.04 SUBMITTALS

A. Permits, Licenses, and Certificates:
   1. Submit for Owner's records, copies of following, including but not limited to:
   2. Permits
   3. Licenses
   4. Certifications
   5. Inspection reports
   6. Releases
   7. Jurisdictional settlements
   8. Notices
   9. Receipts for fee payments
   10. Judgments, and similar documents
   11. Correspondence, and records established in conjunction with compliance with standards and regulations bearing upon performance of Work.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION 01 4100
SECTION 01 4200

REFERENCES

PART 1 - GENERAL

1.01 DEFINITIONS

A. Basic contract definitions are included in General Conditions of the Contract.

B. Indicated: Term “Indicated” refers to graphic representations, notes or schedules on Drawings, or other paragraphs or schedules in Specifications, and similar requirements in contract documents.
   1. Where terms such as “shown”, “noted”, “scheduled”, and “specified” are used, it is to help locate the reference; no limitation of location is intended except as specifically noted.

C. Directed: Terms such as “directed”, “requested”, “authorized,” “selected”, “approved”, “required”, and “permitted” mean “directed by Architect”, “requested by Architect”, and similar phrases.
   1. No implied meaning shall be interpreted to extend Architect’s responsibility into Contractor’s area of construction supervision.

D. Approved: Term “approved,” where used in conjunction with Architect’s action on Contractor’s submittals, applications, and requests, is limited to Architect’s duties and responsibilities as stated in General Conditions of the Contract.

E. Regulations: Term “regulations” includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within construction industry that control performance of Work.

F. Furnish: Term “furnish” is used to mean “supply and deliver to Project Site, ready for unloading, unpacking, assembly, installation, and similar operations.”

G. Install: term “install” is used to describe operations at Project Site including actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimensions, finishing, curing, protecting, cleaning, and similar operations.”

H. Provide: Term “provide” means “furnish and install, complete and ready for intended use.”

I. Installer: “Installer” is Contractor or entity engaged by Contractor, either as employee, subcontractor, or sub-subcontractor, for performance of particular construction activity, including installation, erection, application, and similar operations.
   1. Installers are required to be experienced in operations they are engaged to perform.

J. Project Site: Project Site is space available to Contractor for performance of construction activities, either exclusively or in conjunction with others performing other construction activities as part of Project.
   1. Extent of Project Site is shown on drawings and may or may not be identical with description of land upon which Project is to be built.
K. Testing Laboratories: “Testing Laboratory” is an independent entity engaged to perform specific inspections or tests, either at Project Site or elsewhere, and to report on and, if required, to interpret results of those inspections or tests.

1.02 INDUSTRY STANDARDS

A. Applicability of Standards: Except where Contract Documents include more stringent requirements, applicable construction industry standards have same force and effect as if bound or copied directly into Contract Documents.
   1. Such standards are made part of Contract Documents by reference.
   2. Individual Sections indicate which codes and standards Contractor must make available at Project Site for reference.

B. Publication Dates: Comply with standard in effect as of date of Contract Documents.

C. Copies of Standards: Each entity engaged in construction on Project is required to be familiar with industry standards.
   1. Applicable standards are not bound with Contract Documents.
   2. Where copies of standards are required by individual specification sections or are needed for performance of required construction activity, Contractor shall obtain copies directly from the publication source.

D. Conflicting Requirements: Where compliance with two or more standards is specified, and standards establish different or conflicting requirements for minimum quantities or quality levels, refer requirements that are different, but apparently equal, and uncertainties to Architect for decision before proceeding.

1.03 GOVERNING REGULATIONS/AUTHORITIES

A. Architect has contacted authorities having jurisdiction where necessary to obtain information necessary for preparation of Contract Documents
   1. That information may or may not be of significance to Contractor.
   2. Owner and Architect, at request of Contractor, are to contact authorities having jurisdiction directly for information and decisions having bearing on Work.

1.04 SUBMITTALS

A. Provide copies of following for Owner's records:
   1. Permits
   2. Licenses
   3. Certifications
   4. Inspection reports
   5. Releases
   6. Jurisdictional settlements
   7. Notices
   8. Receipts for fee payments
   9. Judgments and similar documents
   10. Correspondence and records established in conjunction with compliance with standards and regulations bearing upon performance of Work.
PART 2 - PRODUCTS  (Not Applicable)

PART 3 - EXECUTION  (Not Applicable)

END OF SECTION 01 4200
SECTION 01 4500

QUALITY CONTROL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for quality control services.
   2. Quality control services include inspections, and related actions, including reports performed by Contractor, and by governing authorities.
      a. They do not include contract enforcement activities performed by Architect.
   3. Inspection services are required to verify compliance with requirements specified or indicated.
      a. These services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
   4. Requirements for Contractor to provide quality control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

B. Related Sections:
   1. Section 01 7329: Cutting and Patching; requirements for repair and restoration of construction disturbed by inspection activities

C. Related Requirements Specified Elsewhere:
   1. Inspections required by laws, ordinances, rules, regulations or orders of public authorities: General Conditions.
   2. Certification of Products: Respective specification sections.

1.02 SELECTION OF TESTING AGENCY

A. Owner will select and employ consultant, testing laboratory or inspection agency to perform specified services.

B. Employment of Testing Laboratory in no way relieves Contractor of his obligation to perform Work in accord with Contract.

1.03 PROJECT INSPECTOR

A. Owner will select and employ Project Inspector approved by DSA.

1.04 PAYMENT

A. Costs of quality control services will be initially paid for by Owner. following quality control services, chargeable to Contractor, will be reimbursed to Owner by deductive change order:
1. Batch Plant Inspection
2. Taking and testing cores from concrete.
3. Testing of reinforcing steel test specimens.

1.05 DEFICIENCIES

A. Cost of tests or inspections due to following will be reimbursed to Owner by deductive change order.
   1. Retesting because of failure of initial samples.
   2. Additional costs due to overtime work or extra shifts work because of improper scheduling of Work or of delivery of materials by Contractor.
   3. Failure to properly notify laboratory.
   4. Changes in sources, lots or suppliers of materials after original tests.
   5. Changes in methods or materials of construction requested by Contractor that require testing, inspection, or other related services in excess of that required by original design.
   6. Concrete mix designs in excess of first successful design for each concrete type.
   7. Overtime or extra shift work requiring overtime work by Owner's Inspector.

1.06 TESTS AND INSPECTION

A. Testing laboratory or Owner's representative, and not Contractor, will make selection of material required to be tested.

B. Notify Owner's representative sufficient time in advance of manufacture of material to be supplied by him under Contract Documents, which must, by terms of Contract be tested, in order that Owner may arrange for testing of same at source of supply.

C. Material shipped by Contractor from source of supply prior to having satisfactorily passed such testing and inspection or prior to receipt of notice from said representative that such testing and inspection will not be required shall not be incorporated into Project.

1.07 TESTING AGENCY SERVICES

A. Cooperate with Architect and Contractor
   1. Provide qualified personnel promptly on notice.

B. Perform specified inspections, sampling and testing of materials and methods of construction:
   1. Comply with specified standards; ASTM, other recognized authorities, and as specified.

C. Attend pre-construction conference and progress meetings when requested by Architect or Owner.

D. Perform additional services as required by Owner.

E. Submittals: Promptly submit copies of reports of inspections and tests, mill analysis, concrete mix designs and certifications per applicable sections of specification.
1. Submit one copy of test reports to:
   a. Owner.
   b. Architect.
   c. Structural Engineer.
   d. Contractor.
   e. Project Inspector.
2. Include tests made, regardless of whether such tests indicate that material is satisfactory or unsatisfactory.
3. Report samples taken but not tested.
4. Report records of special sampling operations as required.
5. Show in report that material or materials were sampled and tested in accordance with requirements of Title 24 and with approved specifications.
6. Show specified design strength in test reports.
   a. State definitely in test reports whether or not material or materials tested comply with requirements.

F. Report Data: Written reports of each inspection, test, or similar service include, but are not limited to, 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 inspection or test.
   8. Complete inspection or test data.
   9. Test results and interpretation of test results.
   10. Ambient conditions at time of sample taking and testing.
   11. Comments or professional opinion on whether inspected or tested Work complies with Contract Document requirements.
   12. Name and signature of laboratory inspector.
   13. Recommendations on retesting.

G. Testing Agency is not authorized to:
   1. Release, revoke, alter, or enlarge requirements of Contract Documents or approve or accept portions of Work.
   2. Perform duties of Contractor.

1.08 INSPECTION BY OWNER

A. Provide full access to Owner and his representative for purpose of inspection of parts of Work and to shops wherein Work is in preparation
   1. Maintain proper facilities and provide safe access for such inspection.

B. Owner retains right to reject materials and workmanship which are defective, or to require their correction.
   1. Satisfactorily correct rejected workmanship and remove rejected materials from premises without charge to Owner.
   2. When Contractor does not correct such rejected work within reasonable time, fixed by written notice, Owner may correct same and charge expense to Contractor.
C. Should it be considered necessary or advisable by Owner at or before final acceptance of entire Work to make examination of Work already completed by removing or tearing out same, upon request, promptly furnish necessary facilities, labor, and materials.
   1. When such Work is found to be defective due to fault of Contractor or his subcontractor, defray expenses of such examinations and of satisfactory reconstruction.
   2. Should such Work be found to meet requirements of Contract, Contractor will be allowed additional cost of labor and material necessarily involved in examination and replacement.

1.09 WORK BY OWNER'S PROJECT INSPECTOR

   A. Concrete slump tests.

   B. Concrete cylinder samples.

1.10 CONTRACTOR'S RESPONSIBILITIES

   A. Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested.

   B. Provide to agency, selected preliminary representative samples of materials to be tested, in required quantities or assist agency in taking samples.

   C. Furnish incidental labor and facilities:
      1. To provide access to Work.
      2. To obtain and handle samples at Site.
      3. To facilitate inspections and tests.
      4. For agency's exclusive use for storage and curing of test samples.
      5. To provide security and protection of samples and test equipment at Project Site.

   D. Notify testing agency sufficiently in advance of operations to permit assignment of personnel and scheduling of tests.

   E. Coordination: Coordinate sequence of activities to accommodate required services with minimum of delay.
      1. Coordinate activities to avoid necessity of removing and replacing construction to accommodate inspections and tests.
      2. Contractor is responsible for scheduling times for inspections, tests, taking samples, and similar activities.

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION

3.01 REPAIR AND PROTECTION

   A. General: Upon completion of inspection, and similar services, repair damaged construction and restore substrates and finishes.
      1. Comply with requirements of Section 01 7329.
B. Protect construction exposed by or for quality control service activities, and protect repaired construction.

C. Repair and protection is Contractor's responsibility, regardless of assignment of responsibility for inspection or similar services.

3.02 SCHEDULE OF TESTS, INSPECTIONS, AND METHODS

   1. ACI – American Concrete Institute.

B. Concrete (Chapters 17A and 19A):
   1. Materials:
      a. Portland Cement Tests: 1705A.3.1, 1913A.1
      b. Concrete Aggregates: 1705A.3.1, 1903A.4
      c. Reinforcing Bars: 1705A.3.1, 1913A.2
   2. Concrete Quality:
      a. Proportions of Concrete: ACI 318 – Section 5.2, 5.3, and 5.4
      b. Strength Tests of Concrete: 1905A.1.1, ACI 318 – Section 5.6
      c. Mixing: ACI 318
      d. Placing Record: 1704A.4.7
   3. Concrete Inspection:
      a. Job Site: ACI 318 – Section 5.7
      b. Batch Plant and Material Tests: 1705A.3.2
      c. Waiver of Batch Plant and Material Tests: 1705A.3.3
      d. Reinforcing Bar Welding: 1903A.8, Table 1705A.2.1

END OF SECTION 01 4500
TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Temporary facilities required for this Work include, but are not necessarily limited to:
      a. Temporary utilities such as heat, water, electricity, and telephone.
      b. Field offices and sheds
      c. Sanitary facilities.
      d. Construction aids.
      e. Barriers.
      f. Temporary controls.
      g. Project identification and signs.
   2. Equipment furnished by subcontractors shall comply with requirements of pertinent safety regulations.
      a. Ladders, planks, hoists, and similar items normally furnished by individual trades in execution of their own portions of Work are not part of this Section.

B. Related Sections:
   1. Section 02 4113: Selective Site Demolition; additional protection requirements.
   2. Section 02 4119: Selective Demolition; additional protection requirements.

c. Related Requirements:
   1. Refer to District’s Division 00 Documents, including General Conditions, and other Division 01 Sections, for additional requirements.
   2. Permanent installation and hook-up of various utility lines are described in other pertinent sections.

1.02 PROJECT CONDITIONS

A. Use means necessary to maintain temporary facilities in proper and safe condition throughout progress of Work.

PART 2 – PRODUCTS

2.01 UTILITIES

A. Water:
   1. Provide necessary temporary water lines and water supply and upon completion of Work, remove such temporary facility.
   2. Provide and pay for water needed for construction.

B. Electricity:
   1. Provide necessary temporary wiring and upon completion of Work, remove such temporary facility.
   2. Provide area distribution boxes so located that individual trades may furnish and use 100 foot maximum length extension cords to obtain adequate power and artificial lighting at points where needed for work, inspection, and safety.
3. Provide and pay for electricity needed for construction.

C. Heating: Provide and maintain heat necessary for proper conduct of operations needed in Work.

D. Telephone:
   1. Make necessary arrangements and pay costs for installation and operation of telephone service to Contractor’s office on Project Site and Owner’s inspector’s office on Project Site.
   2. Install telephone on separate line for each temporary office.
   a. Where office has more than one occupant, provide telephone for each additional occupant.
   3. Coin operated telephones are not acceptable.

2.02 FIELD OFFICES AND SHEDS

A. Contractor’s Facilities:
   1. Provide field office building and sheds adequate in size and accommodation for Contractor’s offices, supply, and storage.

B. Provide and maintain on premises, where directed, watertight storage sheds for materials which might be damaged by weather, including storage facilities for concrete test samples or other material samples required for Work.

2.03 SANITARY FACILITIES

A. Sanitary facilities include temporary toilets, wash facilities, and drinking water fixtures.
   1. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
   2. Install where facilities will best serve Project's needs.
   3. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility.
   4. Provide covered waste containers for used material.

B. Temporary Toilet Units: Provide self-contained, single-occupant toilet units of chemical, aerated recirculation, or combustion type.
   1. Provide units properly vented and fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
   2. Provide separate facilities for male and female personnel.

C. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel involved in handling materials that require wash-up for healthy and sanitary condition.
   1. Dispose of drainage properly.
   2. Supply cleaning compounds appropriate for each condition.
   3. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.

D. Drinking-Water Facilities: Provide containerized, tap-dispenser, bottled water drinking water units, including paper supply.
2.04 CONSTRUCTION AIDS

A. Provide construction aids and equipment required by personnel and to facilitate execution of Work
   1. Scaffolds, staging, ladders, stairs, ramps, runways, platforms, railings, hoists, cranes, chutes and other such facilities and equipment.

B. Provide necessary facilities and means of access to structure so that Building Inspectors, Special Inspectors, Architect and Structural Engineer may inspect structure or portions of structure as necessary.
   1. Means of access includes, but is not limited to, ladders, scaffolds,

2.05 BARRIERS

A. Temporary Fencing: Provide temporary fence around entire construction area as required for safety and protection.
   1. Construction: Provide chain link fencing not less than six feet in height, complete with metal or wood posts and required bracing, and with suitably locked truck and pedestrian gates as required.
   2. Provide opaque, fabric or plastic windscreen material, full height and run of fencing, including gates.

B. Tree and Plant Protection: Preserve and protect existing trees and plants at Project Site that are designated to remain, and those adjacent to Project Site.
   1. Provide temporary barriers around each, or around each group of trees or plants.

2.06 TEMPORARY CONTROLS

A. Contractor shall be responsible for specific safety requirements by governmental authorities, including requirements of latest Occupational Safety and Health Act (OSHA) and Cal/OSHA.

B. Provide and maintain methods, equipment, and temporary construction, as necessary to provide controls over environmental conditions at construction site and related areas under Contractor’s control.
   1. Remove physical evidence of temporary facilities at completion of Work.
   2. Comply with requirements of authorities having jurisdiction.

C. Dust Control: Provide positive methods and apply dust control materials to minimize raising dust from construction operations, and provide positive means to prevent airborne dust from dispersing into atmosphere.

D. Water Control: Provide methods to control surface water to prevent damage to Project, Site, or adjoining properties.
   1. Control fill, grading and ditching to direct surface drainage away from excavations, pits, tunnels and other construction areas and to direct drainage to proper runoff.
   2. Provide, operate and maintain hydraulic equipment of adequate capacity to control surface water.
   3. Dispose of drainage water in manner to prevent flooding, erosion, or other damage to Project Site or to adjoining areas.
E. Debris Control: Maintain areas under Contractor’s control free of extraneous debris.
   1. Prevent accumulation of debris at construction site, storage and parking areas, or along access roads.
   2. Provide containers for deposit of debris as specified in Section 01 7419.

F. Pollution Control:
   1. Provide methods, means and facilities required to prevent contamination of soil, water and atmosphere by discharge of noxious substances from construction operations.
   2. Provide equipment and personnel to perform emergency measures required to contain spillage, and to remove contaminated soils and liquids.
   3. Take special measures to prevent harmful substances from entering public waters.
      a. Prevent disposal of wastes, effluents, chemicals, and other such substances in sanitary or storm sewers.

G. Temporary Fire Protection: Install and maintain temporary fire protection facilities of types needed to protect against reasonably predictable and controllable fire losses.
   2. Prohibit smoking in construction areas.
   3. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
   4. Develop and supervise overall fire prevention and protection program for personnel at Project Site.
      a. Review needs with local fire department and establish procedures to be followed.
      b. Instruct personnel in methods and procedures.
      c. Post warnings and information.

2.07 PROJECT TEMPORARY SIGNS

A. Prepare project signs of size indicated.
   1. Install signs where indicated to inform public and persons seeking entrance to Project.
   2. Support on posts or framing of preservative treated wood or steel.
   3. Do not permit installation of unauthorized signs.

B. Provide temporary on-site informational signs.
   1. As required by codes, laws and regulatory agencies
   2. To identify key elements of the construction facilities.
   3. To direct traffic.

2.08 OWNERSHIP OF TEMPORARY FACILITIES AND CONTROLS

A. Items provided by Contractor under this Section remain property of Contractor
   1. Remove such items from job site immediately upon completion of Work..
PART 3 – EXECUTION

3.01 MAINTENANCE AND REMOVAL

A. Maintain temporary facilities as long as needed for safe and proper completion of Work.

B. Remove such temporary facilities as rapidly as progress of Work will permit, or as directed by Architect.

END OF SECTION 01 5000
SECTION 01 5713

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Prevention of erosion due to construction activities.

B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.

C. Restoration of areas eroded due to insufficient preventive measures.

D. Performance bond.

E. Compensation of Owner for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 RELATED SECTIONS

A. Section 31 1000: Site Clearing; Limits on clearing; disposition of vegetative clearing debris.

B. Section 31 2316: Excavation; temporary and permanent grade changes for erosion control.

1.03 REFERENCE STANDARDS


B. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.


1.04 PERFORMANCE REQUIREMENTS

A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP).

B. Comply with all requirements of The California State Construction General Permit Order 2009-0009-DWQ for erosion and sedimentation control, even though this project is not required by law to comply.

D. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.

E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.

F. Provide to Owner a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.

G. Timing: Put preventive measures in place prior to disturbance of surface cover and before precipitation occurs.

H. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
   1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
   2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.

I. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
   1. Control movement of sediment and soil from temporary stockpiles of soil.
   2. Prevent development of ruts due to equipment and vehicular traffic.
   3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

J. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
   1. Prevent windblown soil from leaving the project site.
   2. Prevent tracking of mud onto public roads outside site.
   3. Prevent mud and sediment from flowing onto sidewalks and pavements.
   4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to Owner.

K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
   2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.

L. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
   1. If sedimentation occurs, install or correct preventive measures immediately at no cost to Owner; remove deposited sediments; comply with requirements of authorities having jurisdiction.
M. Open Water: Prevent standing water that could become stagnant.

N. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.05 SUBMITTALS

A. Erosion and Sedimentation Control Plan:
   1. Include:
      a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
      b. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
      c. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
      d. Schedule of temporary preventive measures, in relation to ground disturbing activities.
      e. Other information required by law.
      f. Format required by law is acceptable, provided additional information specified is also included.

   2. Obtain approval of Plan by following:
      a. Authorities having jurisdiction (AHJ).
      b. Owner.
      c. Engineer of Record.

B. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.

C. Inspection Reports: Report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Gravel: Conforming to Greenbook standard.

B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.
3.02 PREPARATION

A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.

B. Construction Entrances:
   1. Comply with TC-1 per BMP Handbook.

C. Linear Sediment Barriers: Made of silt fences or gravel bags.
   2. Gravel Bags: Comply with SE-6 per BMP Handbook.

D. Storm Drain Curb Inlet Sediment Trap:

E. Storm Drain Drop Inlet Sediment Traps:

F. Soil Stockpiles: Protect using one of the following measures:
   1. Cover with polyethylene film, secured by placing soil on outer edges.
   2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.

3.04 INSTALLATION

A. Stabilized Construction Entrance:
   1. Comply with TC-1 per BMP Handbook.

B. Silt Fences:

C. Gravel Bags:

3.05 MAINTENANCE

A. As minimum, maintain BMPs as described in BMP Handbook.

B. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.

C. Repair deficiencies immediately.

D. Clean out temporary sediment control structures weekly and relocate soil on site.

E. Place sediment in appropriate locations on Project Site and do not remove from Project Site.
3.06 CLEAN UP

A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Engineer.

B. Clean out temporary sediment control structures that are to remain as permanent measures.

C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION 01 5713
SECTION 01 6000

PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Following Administrative and Procedural Requirements:
      a. Selection of products for use in Project
      b. Product delivery, storage, and handling.
      c. Manufacturers' standard warranties on products.
      d. Special warranties.
      e. Product substitutions.

B. Related Sections:
   1. Section 01 4200: References; for applicable industry standards for products specified.
   2. Section 01 7700: Closeout Procedures; for submitting warranties for contract closeout.

C. Related Requirements:
   1. Specific requirements for warranties on products and installations specified to be warranted are included in appropriate Sections in Divisions 02 through 33 Sections.
   2. Refer to District's Division 00 Documents, including General Conditions, and other Division 01 Sections, for additional requirements.

1.02 QUALITY ASSURANCE

A. To fullest extent possible, provide products of same kind, from single source.

1.03 SUBMITTALS

A. Product Listing Schedule: Prepare schedule showing products specified in tabular form acceptable to Architect.
   1. Include generic names of products required.
   2. Include manufacturer's name and proprietary product names for each item listed.
   3. Form: Prepare Product Listing Schedule with information on each item tabulated under following column headings:
      a. Related Specification Section number.
      b. Generic name used in Contract Documents.
      c. Proprietary name, model number and similar designations.
      d. Manufacturer's name and address.
      e. Supplier's name and address.
   4. Completed Schedule: Within fifteen days after date of commencement of Work, submit four copies of completed Product Listing Schedule.
      a. Furnish written explanation for omissions of data, and for known variations from Contract requirements.
1.04 DEFINITIONS

A. Definitions used in this Article are not intended to change meaning of other terms used in Contract Documents, such as "specialties", "systems", "structure", "finishes", "accessories", and similar terms.
   1. Such terms are self-explanatory and have well recognized meanings in construction industry.

B. Products: Items purchased for incorporating into Work, whether purchased for Project or taken from previously purchased stock. term "product" includes terms "material," "equipment," 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 Contract Documents.
   2. New Products: Items that have not previously been incorporated into another project or facility, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise.
      a. Products salvaged or recycled from other projects are not considered new products.

C. Substitutions: Changes in products, materials, equipment, and methods of construction required by Contract Documents and proposed by Contractor
   1. Following are not considered substitutions:
      a. Substitutions requested during bidding period, and accepted by written Addendum prior to opening of bids or award of Contract.
   2. Revisions to Contract Documents requested by Owner or Architect.
   4. Compliance with governing regulations and orders issued by governing authorities.

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

E. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for particular product and specifically endorsed by manufacturer to Owner.

F. Special Warranty: Written warranty required by or incorporated into Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.05 REQUESTS FOR SUBSTITUTIONS

A. Requests for Substitutions received after award of Contract will be considered only in case of substantiated product unavailability, or other conditions beyond control of Contractor.
B. Substitution Requests: Submit one electronic copy (PDF) of each request for consideration.

1. Identify product or fabrication or installation method to be replaced.
2. Include Specification Section number and title and Drawing numbers and titles.
   a. Refer to Article 2.02, in this Section.
3. Substitution Request Form: Use form provided by Owner; other forms will not be accepted.
   a. Requests received without properly completed substitution request form will be rejected without further review.
4. Documentation: Show compliance with specified requirements for substitutions and following, as applicable:
   a. Statement indicating why specified material or product cannot be provided.
      1) Submit statement on official letterhead of Contractor, supplier, or manufacturer, signed by an officer of the Company.
      2) Statement will be subject to independent verification by Architect.
   b. Product identification, including manufacturer's name and address.
   c. Coordination information, including list of changes or modifications needed to other parts of Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
   d. Detailed, side-by-side comparison of significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   e. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
   f. Structural calculations, where applicable or requested, prepared and signed by Structural Engineer licensed in California.
   g. Samples, where applicable or requested.
   h. List of similar installations for completed projects with project names and addresses and addresses of architects and owners.
   i. Material test reports from qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
   j. Research/evaluation reports evidencing compliance with building code in effect for Project, from model code organization acceptable to authorities having jurisdiction.
   k. Detailed comparison of Contractor’s Construction Schedule using proposed substitution with products specified for Work, including effect on overall Contract Time.
      1) When specified product or method of construction cannot be provided within Contract Time, include letter from manufacturer, on manufacturer’s letterhead, stating lack of availability or delays in delivery.
   l. Cost information, including proposal of change, when occurring, in Contract Sum.
   m. Designation of availability of maintenance services, sources of replacement materials.
   n. Contractor’s certification that proposed substitution complies with requirements in Contract Documents and is appropriate for applications indicated.
   o. Contractor’s waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle products using means and methods that will prevent damage, deterioration and loss, including theft; comply with manufacturer's written instructions.
   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 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 ensure compliance with Contract Documents, and to ensure products are undamaged and properly protected.
   5. Store products in manner to facilitate inspection and measurement of quantity or counting of units.
   6. Store materials in manner that will not endanger Project structure.
   7. Store products subject to damage by elements under cover in weathertight enclosure above ground, with ventilation adequate to prevent condensation.
   8. Comply with product manufacturer’s written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
   9. Protect stored products from damage.

1.07 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by Contract Documents.
   1. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of Contract Documents.

B. Special Warranties: Prepare written document that contains appropriate terms and identification, ready for execution.
   2. Submit draft for approval before final execution.
   3. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   4. Refer to Division 2 through 32 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 01 7700 and General Conditions.

PART 2 – PRODUCTS

2.01 PRODUCT SELECTION

A. General Product Requirements: Provide products that comply with Contract Documents, that are undamaged and, unless otherwise indicated, unused at time of installation.
1. Provide products complete with accessories, trim, finish, safety guards and other devices and details needed for complete installation and for intended use and effect.

2. Standard Products: Where available, provide standard products of types that have been produced and used successfully in similar situations on other projects.

3. Owner reserves right to limit selection to products with warranties not in conflict with requirements of Contract Documents.

4. Where products are accompanied by term "as selected", Architect will make selection.

5. Where products are accompanied by term "match sample", sample to be matched is Architect's.


7. Or Equal: Where products are specified by name and accompanied by term "or equal", or "or approved equal", or "or approved", comply with provisions in "Product Substitutions" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures: Procedures for product selection include following:

1. Product: Where Specification paragraphs or subparagraphs titled "Product" name single product and manufacturer, provide product named.
   a. Substitutions may be considered, unless otherwise indicated.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide product by manufacturer or from source named that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.

3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce list of names of both products and manufacturers, provide one of products listed that complies with requirements.
   a. Where products or manufacturers are specified by name, accompanied by term "or equal", or "or approved equal" comply with provisions in "Product Substitutions" Article to obtain approval for use of unnamed product.

4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce list of manufacturers' names, provide product by one of manufacturers listed that complies with requirements.
   a. Where manufacturers are specified by name, accompanied by term "or equal", or "or approved equal" comply with provisions in "Product Substitutions" Article to obtain approval for use of an unnamed product.

5. Product Options: Where Specification paragraph titled "Product Options" indicate that size, profiles, and dimensional requirements on Drawings are based on specific product or system, provide either specific product or system indicated or comparable product or system by another manufacturer.
   a. Comply with provisions in "Product Substitutions" Article to obtain approval for use of unnamed product.

6. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product" are included and also introduce or refer to list of manufacturers' names, provide either specified product or comparable product by one of other named manufacturers.
   a. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on product named.
   b. Comply with provisions in "Product Substitutions" Article to obtain approval for use of unnamed product.
   c. Substitutions may be considered.
   a. Architect's decision will be final on whether proposed product matches satisfactorily.
   b. Where no product is available within specified category that matches satisfactorily and complies with other specified requirements, comply with provisions of Contract Documents on "substitutions" for selection of matching product.

8. Visual Selection Specification: Where Specifications include phrase "as selected from manufacturer's colors, patterns, textures" or similar phrase, select product and manufacturer that complies with other specified requirements.
   a. Standard Range: Where Specifications include phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that does not include premium items.
   b. Full Range: Where Specifications include phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer's product line that includes both standard and premium items.

9. Performance Specification Requirements: Where Specifications require compliance with performance requirements, provide products that comply with requirements, and are recommended by manufacturer for application indicated.
   a. General overall performance of product is implied where product is specified for specific application.
   b. Manufacturer's recommendations may be contained in product literature, or by manufacturer's certification of performance.

2.02 PRODUCT SUBSTITUTIONS

A. Timing: Requests for Substitutions are restricted to before bid opening as stated in Instruction to Bidders.
   1. Requests received after that time may be considered or rejected at discretion of Architect.
   2. Architect will consider request for substitution after commencement of Work only when specified product or construction method cannot be provided within Contract Time, cannot receive necessary approvals, cannot be provided in manner compatible with or coordinate with other materials or cannot provide required warranty.

B. Conditions: Contractor's substitution request will be received and considered by Architect when following conditions are satisfied, as determined by Architect; otherwise requests will be returned without action except to record noncompliance with these requirements
   1. Burden of proof of merit of proposed substitution is upon proposer.
   2. Extensive revisions to Contract Documents are not required.
   3. Requested substitution is consistent with Contract Documents and will produce indicated results.
   4. Request is timely, fully documented and properly submitted.
   5. Request is directly related to "or equal" clause or similar language in Contract Documents.
   6. Specified product or construction method cannot be provided within Contract Time.
a. Request will not be considered when product or method cannot be provided as result of failure to pursue Work promptly, failure to identify items requiring long lead times, or failure to coordinate activities properly.

7. Specified product or construction method cannot receive necessary approval by governing authority, and requested substitution can be approved.

8. Substantial advantage is offered Owner, in cost, time, energy conservation, or other considerations of merit, after deducting additional responsibilities Owner must assume.
   a. Owner’s additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner or separate Contractors, and similar considerations.

9. Specified product or construction method cannot be provided in manner that is compatible with other materials, and where Contractor certifies that requested substitution will overcome incompatibility.

10. Specified product or construction method cannot be coordinated with other materials, and where Contractor certifies that requested substitution can be coordinated.

11. Specified product or construction method cannot provide warranty required by Contract Documents and where Contractor certifies that requested substitution provide required warranty.

12. When requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of Work, is uniform and consistent, is compatible with other products, and is acceptable to contractors involved.

C. Architects Action: When necessary, within one week of receipt of request for substitution, Architect will request additional information or documentation for evaluation of request for substitution.
   1. Within 2 weeks of receipt of request, or one week of receipt of additional information or documentation, whichever is later, Architect will notify Contractor of acceptance or rejection of requested substitution.
   2. Form of Acceptance: Change Order.
   3. Use product specified when Architect cannot make decision on use of proposed Substitution within time allocated.
   4. Architect will not be responsible for locating or securing information which is not included in substantiating data.
   5. Architect's decision of acceptance or rejection of requested substitution shall be final.

D. Architect's cost for evaluating substitutions requested by Contractor, including making subsequent revisions to drawings, specifications and other resulting documentation, will be paid by Owner with reimbursement from Contractor by deductive change order.

E. Contractor's submittal and Architect's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.
PART 3 – EXECUTION

3.01 INSTALLATION OF PRODUCTS

A. Comply with manufacturer's instructions and recommendations for installation of products in applications indicated.
   1. Anchor each product securely in place, accurately located and aligned with other Work.
   2. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

END OF SECTION 01 6000
SECTION 01 7123

FIELD ENGINEERING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Contractor shall enter into agreement with Civil Engineer of Record for engineering services required for Project.
   2. Survey work required in execution of Project.
   3. Civil, structural or other professional engineering services specified, or required to execute Contractor's construction methods.
   4. Contractor furnished assistance.
   5. Verification of conditions.

B. Related Sections:
   1. Section 01 3300: Submittal Procedures
   2. Section 01 7700: Closeout Procedures.

C. Related Requirements:
   1. Refer to District's Division 00 Documents, including General Conditions, for additional requirements.

1.02 QUALITY ASSURANCE

A. Qualifications of Surveyor or Engineer: Engage registered Civil Engineer or licensed Land Surveyor acceptable to both Contractor and Owner who is qualified to perform land surveying.
   1. Furnish to Owner prior to start of Work, name and license (or registration number) issued by State of California, Board of Registration for Professional Engineers and Land Surveyors.
   2. Provide notice to Owner during course of construction should identification of individual responsible for this work change, and obtain approval of Owner for replacement.

B. Field engineering services furnished during course of this Project shall be under direct supervision and control of named individual civil engineer or land surveyor.

1.03 SUBMITTALS

A. Comply with pertinent provisions of Section 01 3300.

B. Name and address of Surveyor or professional engineer to Architect, including changes as they may occur.

C. Upon request of Architect, submit documentation to verify accuracy of field engineering Work.
D. Submit certificate signed by registered Civil Engineer or Land Surveyor certifying that elevations and locations of improvements are in conformance, or non-conformance, with Contract Documents.

E. Record Drawings:
   1. At Project completion, obtain and pay for CD’s and Files of Project Plans.
      a. Clearly indicate differences between original drawings and completed Work within specified tolerances.
   2. Show as-built locations by coordinates of utilities onsite with top of pipe elevations at major grade and alignment changes.
   3. Completed record drawing transparencies shall be dated, signed and certified as correct by Licensed Surveyor or Civil Engineer.
   4. Comply with requirements of Section 01 7700.

PART 2 – PRODUCTS
   (Not Applicable)

PART 3 – EXECUTION

3.01 SURVEY REFERENCE POINTS

A. Existing horizontal and vertical control points for Project are those designated on Drawings.

B. Locate and protect control points prior to starting site work, and preserve permanent reference points during construction.
   1. Make no changes or relocations without prior written notice to Architect.
   2. Report to Architect when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
   3. Identify and protect survey monuments on Project Site discovered during construction, which are not referenced on Project Drawings.
      a. Tie out such monuments and notify Architect prior to allowing them to be disturbed.
   4. Replace permanent boundary markers disturbed during construction with new permanent monuments and file required Record of Survey or Corner Record in accordance with applicable State and County laws, at no additional cost to Owner.

3.02 PROJECT SURVEY REQUIREMENTS

A. Establish minimum of two permanent horizontal and vertical control points on Project Site, remote from building area referenced to data established by survey control points.
   1. Record locations, with horizontal and vertical data, on Project Record Documents, including description of monuments in place.

B. Establish lines and levels, locations and dimensions, by instrumentation or similar technical appropriate means:
   1. Site Improvements:
      a. Utility lines, including, but not limited to, storm drains, sewers, water mains, gas, electric and telephone lines.
      b. Provide adequate horizontal control to locate lines and provide vertical control in proportion to slope of line as required for accurate construction.
   2. Building Lines and Levels: Furnish building corner offsets as required to adequately locate buildings.
3. Provide control lines and levels required for Mechanical and Electrical Work.
4. Provide grade stakes and elevations as required to construct paved areas, landscaped areas, and other areas as required.
   a. Calculate and layout subgrade elevations and intermediate controls as required to provide smooth transitions between the spot elevations indicated on plans.
   b. From time to time, verify layout of Work by same methods.
5. Provide batter boards or other similar control for drainage, utility, and other onsite structures as required.

3.03 RECORDS

A. Maintain complete, accurate surveyor's log of control and survey work as it progresses.
   1. Make this log available for reference.

END OF SECTION 01 7123
SECTION 01 7329

CUTTING AND PATCHING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes
   1. Administrative and procedural requirements for cutting and patching.

B. Related Sections:
   1. Section 01 1100: Summary of Work
   2. Section 02 4119: Selective Demolition

C. Related Requirements:
   1. Refer to Division 22 and 23 Sections for cutting, patching, or relocating plumbing and mechanical items.
   2. Refer to Division 26 Sections for cutting, patching, or relocating electrical systems.

1.02 QUALITY ASSURANCE

A. Requirements for Structural Work: Do not cut and patch structural elements in manner that would reduce their load-carrying capacity or load-deflection ratio.

B. Operational and Safety Limitations: Do not cut and patch operating elements or safety related components in manner that would result in reducing their capacity to perform as intended or result in increased maintenance or decreased operational life or safety.
   1. Obtain approval before cutting and patching following operating elements or safety related systems:
      a. Shoring, bracing, and sheeting.
      b. Primary operational systems and equipment.
      c. Air or smoke barriers.
      d. Water, moisture, or vapor barriers.
      e. Membranes and flashings.
      f. Fire protection systems.
      g. Noise and vibration control elements and systems.
      h. Control systems.
      i. Communication systems.
      j. Conveying systems.
      k. Electrical wiring systems.

C. Visual Requirements: Do not cut and patch construction exposed on exterior or in occupied spaces, in manner that would, in Architect's opinion, reduce aesthetic qualities, or result in visual evidence of cutting and patching.
   1. Remove and replace Work that has been cut and patched in visually unsatisfactory manner.
   2. Engage recognized experienced and specialized fabricator to cut and patch following categories of exposed Work:
      a. Processed concrete finishes.
      b. Stucco and plaster.
CUTTING AND PATCHING
01 7329 - 2

PART 2 – PRODUCTS

2.01 MATERIALS

A. Use materials that are identical to existing materials.
   1. Where identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to fullest extent possible with regard to visual effect.
   2. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 – EXECUTION

3.01 INSPECTION

A. Before cutting existing surfaces, examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed. Take corrective action before proceeding if unsafe or unsatisfactory conditions are encountered.

3.02 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage.
   1. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Take precautions necessary to avoid cutting existing pipe, conduit or ductwork serving building, but scheduled to be removed or relocated until provisions have been made to bypass them.

3.03 PERFORMANCE

A. General: Employ skilled workmen to perform cutting and patching.
   1. Proceed with cutting and patching at earliest feasible time and complete without delay.
   2. Cut existing construction to provide for installation of other components or performance of other construction activities and subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements to be retained or adjoining construction.
   1. In general, where cutting is required use hand or small power tools designed for sawing or grinding, not hammering and chopping.
   2. Cut holes and slots neatly to size required with minimum disturbance of adjacent surfaces.
      a. Temporarily cover openings when not in use.
   3. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed surfaces.
4. Cut through concrete and masonry using cutting machine such as carborundum saw or diamond core drill.
5. By-pass utility services such as pipe or conduit, before cutting, where services are shown or required to be removed, relocated or abandoned.
6. Cut-off pipe or conduit in walls or partitions to be removed.
   a. Cap, valve or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible.
   1. Comply with specified tolerances.
      a. Where feasible, inspect and test patched areas to demonstrate integrity of installation.
      b. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that will eliminate evidence of patching and refinishing.

3.04 CLEANING

A. Thoroughly clean areas and spaces where cutting and patching is performed or used as access.

END OF SECTION 01 7329
SECTION 01 7419

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. References.
   2. System description for construction and demolition waste management.

B. Related Sections:
   1. Section 01 3300 – Submittal Procedures.
   2. Section 01 4100 – Regulatory Requirements.
   3. Section 01 5000 – Temporary Facilities and Controls.
   4. Section 01 7423 – Cleaning.
   5. Section 01 7700 – Closeout Procedures.

1.02 REFERENCES


B. California Code of Regulations, Title 14 – Natural Resources
   1. Division 7 – Department of Resources Recycling and Recovery

1.03 SYSTEM DESCRIPTION

A. Collection and separation of construction and demolition waste materials generated on-site as follows:
   1. Re-use or recycling on-site.
   2. Transportation to approved recyclers or re-use organizations.
   3. Transportation to legally designated landfills for purpose of recycling, salvaging, or reusing minimum of 50 percent of construction and demolition waste generated.

1.04 SUBMITTALS

A. Construction and Demolition Waste Management Plan (Exhibit 1):
   1. Within 10 calendar days after Notice to Proceed and prior to waste removal, submit following to Owner for review and approval:
      a. Materials to be recycled, re-used, or salvaged, either on-site or off-site.
      b. Estimates of construction and demolition waste quantity (in tons) by type of material.
         1) When waste is measured by volume, give factors for conversion to weight in tons.
      c. Procedures for recycling/re-use program.
      d. Permit or license and location of Project waste disposal areas.
      e. Site Plan for placement of waste containers.

B. Construction and Demolition Waste Management Monthly Progress Report (Exhibit 2):
   1. Submit Summary of waste generated by Project, monthly with Application for Payment. Include following:
a. Firms accepting recovered or waste materials.
b. Type and location of accepting facilities (landfill, recovery facility, or used
materials yard).
   1) When materials are re-used or recycled on job site, location should be
designated as "On-site Re-use/Recycling."
c. Type of materials and net weight (tons) of each.
d. Value of materials or disposal fee paid.
e. Attach weigh bills and other documentation confirming amount and disposal
location of waste materials.

C. Construction and Demolition Waste Management Final Compliance Report:
1. Final update of Waste Management Plan to provide summary of total waste
generated by Project.

D. Waste management Report for Contractors (Exhibit 3):
1. Complete attached form and submit to Owner.

E. Solid Waste Management and Recycling Plan (Exhibit 4):
1. Complete attached form and submit to Owner.

PART 2 – PRODUCTS  (Not Applicable)

PART 3 – EXECUTION

3.01 IMPLEMENTATION

A. Implement approved Waste Management Plan including collecting, segregating,
storing, transporting and documenting each type of waste material generated, recycled
or re-used, or disposed in landfills.

B. Designate on-site person to be responsible for instruction workers and overseeing
sorting and recording of waste/recyclable materials.

C. Include waste management and recycling in worker orientation and as agenda item for
regular job meetings.

D. Limit recycle and waste bin areas to approved areas indicated on Waste management
Plan.
   1. Keep recycle and waste bins neat and clearly marked to avoid contamination of
materials.

3.02 ATTACHMENTS

A. Exhibit 1: Construction and Demolition Waste Management Plan.


END OF SECTION 01 7419
EXHIBIT 1

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT PLAN

CONSTRUCTION/MAINTENANCE/ALTERATION AND DEMOLITION PROJECTS

PROJECT NAME: __________________________________________________________

PROJECT NO: ___________________________________________________________

NAME OF COMPANY:
________________________________________________________

CONTACT PERSON: _______________________________________________________

TELEPHONE: _____________________________________________________________

PROJECT SITE LOCATION: ________________________________________________

PROJECT TYPE:

___ New Construction    ____ Demolition   ___ Maintenance/Alteration Projects

PROJECT SIZE (SQ.FT.): ___________________________________________________

DATE AND ESTIMATED PERIOD    _____________________________________________
**EXHIBIT 1 FORM**

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Tons Estimated Recycle</th>
<th>Tons Estimated Reuse</th>
<th>Tons Estimated Salvage</th>
<th>Tons Estimated Landfill</th>
<th>Proposed Disposal or Recycling Facility</th>
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**Total**

Diversion Rate: Column\([2]+(3)+(4)] / [(2)+(3)+(4)+(5)\] =

**Signature** | **Title** | **Date**
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Column 1: “Material Type” – Enter type of materials targeted for recycling, reuse, or requiring disposal.

Columns 2 through 4: “Estimated Generation” – Enter estimated quantities (tons) of recyclable, reusable, or salvageable waste materials anticipated to be generated and state number of salvageable items.

Column 5: “Estimated Landfill” – Enter quantities (tons) of materials to be disposed in landfill.

Column 6: “Disposal Location” – Enter end-destination of recycled, salvaged, and disposed materials.

General:  
1. Attach proposed Recycling and Waste Bin Location Plan.  
2. Attach name and contact data for each recycling or disposal destination to be used.
EXHIBIT 2

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT MONTHLY PROGRESS REPORT

CONSTRUCTION/MAINTENANCE/ALTERATION AND DEMOLITION PROJECTS

PROJECT NAME: __________________________________________________________

PROJECT NO: __________________________________________________________

NAME OF COMPANY: ______________________________________________________

CONTACT PERSON: ______________________________________________________

TELEPHONE: ___________________________________________________________

PROJECT SITE LOCATION: __________________________________________________

PROJECT TYPE:

___New Construction   _____Demolition    ___Maintenance/Alteration Projects

PROJECT SIZE (SQ.FT.): __________________________________________________

DATE AND ESTIMATED PERIOD: ____________________________________________
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<tr>
<th>Material Type</th>
<th>Tons Actual Recycle</th>
<th>Tons Actual Reuse</th>
<th>Tons Actual Salvage</th>
<th>Landfill Name</th>
<th>Disposal or Recycling Facility (e.g. Onsite, of Facility)</th>
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Total

Diversion Rate: \(\frac{(2)+(3)+(4)}{(2)+(3)+(4)+(5)}\)

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<th>Date</th>
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</table>

Column 1: “Material Type” – Enter type of materials targeted for recycling, reuse, or requiring disposal.

Columns 2 through 4: “Estimated Generation” – Enter estimated quantities (tons) of recyclable, reusable, or salvageable waste materials anticipated to be generated and state number of salvageable items.

Column 5: “Estimated Landfill” – Enter quantities (tons) of materials to be disposed in landfill.

Column 6: “Disposal Location” – Enter end-destination of recycled, salvaged, and disposed materials.

General: (1) Attach proposed Recycling and Waste Bin Location Plan.
(2) Attach name and contact data for each recycling or disposal destination to be used.
EXHIBIT 3

WASTE MANAGEMENT REPORT FOR CONTRACTORS

Complete this form each time materials are removed from

Project Site or reused onsite.
Submit to Owner’s Project Manager.

PROJECT SITE LOCATION:________________________________________ DATE:___________

COMPANY:______________________________________________________

–

MATERIAL:_____________________________________________________

____________________________________________________________________________

____________________________________________________________________________

WAS THE MATERIAL RECYCLED: YES_____NO_____

VOLUME/WEIGHT:________________________________________________

RECYCLING COMPANY OR DISPOSAL
SITE:____________________________________________________________

SUBMITTED
BY:___________________________________________________________

PHONE NUMBER:________________________________________________
EXHIBIT 4

SOLID WASTE MANAGEMENT AND RECYCLING PLAN

Prepare Waste Management and Recycling Plan by completing the following form for Construction and Demolition materials produced because of Work performed at Citrus Community College District. Owner requires that Contractors recycle materials when there is viable recycling company available.

Owner’s Environmental Health and Safety Supervisor will assist applicants in developing and implementing Waste Management and Recycling Plan.

COMPANY NAME: _____________________ CONTACT: _____________________________

ADDRESS: __________________________ PHONE: ________________________________

PROJECT SITE: ____________________________

Please fill out following form for submittal. Form will help to identify types of materials, estimated quantities of materials, and how material will be transported and recycled or disposed.

Should you have questions regarding this form or recycling and disposal, please call James Poper, Director of Facilities Services at 562.908.3441
EXHIBIT 4 FORM

Circle the material that will be generated at the construction site, estimate the quantity, list how the materials will be transported, and write in where the materials will be taken.

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>ESTIMATED QUANTITY (in yards and tons)</th>
<th>HAUler (List hauler’s name When not self–haul)</th>
<th>RECYCLING COMPANY OR DISPOSAL SITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salvage and used building</td>
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<td>Wood</td>
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<td>Plant Debris</td>
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<td>Wallboard</td>
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<td>Glass</td>
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<td>Soil</td>
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<td>Corrugated cardboard</td>
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<td>Metals</td>
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<tr>
<td>Masonry/Tile</td>
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<tr>
<td>Concrete/Asphalt</td>
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<td>Toilets (porcelain)</td>
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<td>Carpet Padding (foam)</td>
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<td>Other</td>
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<tr>
<td>Mixed Loads (i.e. trash)</td>
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FOR DISTRICT USE ONLY:

Approval Status:

_____ Approved

_____ Further explanation needed, see attached

_____ Denied

Reviewed by:__________________________ Date:__________________________
SECTION 01 7423
CLEANING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Performance of cleaning, during progress of Work, and at completion of Work, as required by General Conditions.

B. Related Sections:

C. Related Requirements:
   1. Refer to District’s Division 00 Documents, including General Conditions, for additional requirements.

1.02 QUALITY ASSURANCE

A. Verify that requirements of cleanliness are being met.

B. Final Cleaning: Use only professional cleaning company experienced in commercial cleaning.

1.03 DISPOSAL REQUIREMENTS

A. Conduct cleaning and disposal operations in compliance with applicable codes, ordinances, regulations, and anti-pollution laws.

B. In addition to specified requirements, comply with applicable requirements of fire and governing authorities having jurisdiction.

1.04 PAYMENT WITHHELD

A. Architect reserves right to withhold certification of payment requests for failure on part of Contractor to regularly clean Project in conformance with requirements of this Section.

PART 2 – PRODUCTS

2.01 CLEANING MATERIALS AND EQUIPMENT

A. Use only those cleaning materials which will not create hazards to health or property and which will not damage surfaces.

B. Use only those cleaning materials and methods recommended by manufacturer of surface material to be cleaned.

C. Use cleaning materials only on surfaces recommended by cleaning products manufacturer.
PART 3 – EXECUTION

3.01 PROGRESS CLEANING DURING CONSTRUCTION

A. Execute periodic cleaning to keep Work, Project Site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.
   1. Maintain stored items in orderly arrangement allowing maximum access and providing required protection of materials.
      a. Provide on-site containers for collection of waste materials, debris and rubbish.
   2. Provide adequate storage for waste materials awaiting removal from Project Site, observing requirements for fire protection and protection of environment.
   3. Handle hazardous, dangerous or unsanitary waste materials separately from other waste material by placing it in proper containers.
   4. Burying or burning of waste materials is not permitted.
   5. Remove waste materials, debris and rubbish from Project Site periodically and dispose of at legal disposal areas away from Project Site.

B. Project Site:
   1. Inspect Project Site daily and pick up scrap, debris, and waste material.
      a. Place waste material in designated containers.
   2. Flammable waste shall be kept in sealed metal containers until removed from Project Site.
   3. Maintain Project Site clear of debris so as not to impede construction and fire department access

C. Structures:
   1. Weekly, and more often if necessary, inspect structures and pick up scrap, debris, and waste material.
      a. Remove items and place in designated container.
   2. Weekly, sweep interior spaces clean. Space shall be free from dust and other material capable of being removed by handheld broom, (i.e.: “broom clean”).
   3. As required preparatory to installation of succeeding material, clean structures or pertinent portions thereof to degree of cleanliness recommended by manufacturer of succeeding material.
   4. Following installation of finish floor materials, clean finish floor daily, and more often if necessary.
      a. Provide adequate protection of finish where Work is being performed in space in which finish materials have been installed.
      b. “Clean”, for purpose of this subparagraph, shall be interpreted as meaning free from foreign materials that, in opinion of Architect, may be injurious to finish floor material, (i.e.: “vacuum clean”).

3.02 DUST CONTROL

A. Clean interior spaces prior to start of finish painting and continue cleaning on as-needed basis until painting is finished.

B. Schedule operations so that dust and other contaminants resulting from cleaning process will not fall on wet or newly-coated surfaces.
3.03 FINAL CLEANING

A. Prior to completion of Work, remove from Project Site, tools, surplus materials, equipment, scrap, debris, and waste.

B. Employ experienced workers or professional cleaners for final cleaning.
   1. Comply with manufacturer's instructions.

C. Complete following cleaning operations before requesting inspection for Certification of Substantial Completion:
   1. Site: Clean Site, including landscape development areas, of rubbish, litter and other foreign substances.
      a. Sweep paved areas broom clean, including public paved areas directly adjacent to Project Site.
      1) Remove stains, spills and other foreign deposits.
      b. Rake grounds that are neither paved nor planted, to smooth even-textured surface and remove resultant debris.
   2. Exterior and Interior: Clean exposed exterior and interior hard-surfaced finishes to dust-free condition.
      a. Remove traces of soils, waste material, smudges and other foreign matter.
      b. Remove traces of splashed material from adjacent surfaces.
      c. Remove materials using equipment as instructed by manufacturer of surface materials to be cleaned.
      d. Leave concrete floors broom clean.
   3. Carpeted Surfaces:
      a. Use only dry-chemical method of cleaning.
      b. Do not use steam cleaning or water based cleaning on carpet.
      c. Use materials and methods fully approved by carpet manufacturer, as instructed in manufacturer's published literature.
      d. Vacuum carpet.
   4. Labels: Remove labels that are not permanent labels.
   5. Transparent Materials: Clean transparent material, including mirrors and glass in doors and windows.
      a. Remove glazing compound and other substances that are noticeable vision obscuring materials.
      b. Replace chipped or broken glass and other damaged transparent materials.
      c. Restore reflective surfaces to their original reflective condition.
      d. Clean glass inside and outside.
   e. Polished Surfaces:
      1) Apply polish recommended by manufacturer of material being polished to surfaces requiring routine application of buffed polish.

D. Ventilating Systems:
   1. Clean permanent filters and replace disposable filters if units were operated during construction.
   2. Clean ducts, blowers and coils if units were operated without filters during construction.

E. Wipe surfaces of mechanical and electrical equipment.
   1. Remove excess lubrication and other substances.
   2. Clean plumbing fixtures to sanitary condition.
   3. Clean light fixtures and lamps.
F. Comply with regulations of authorities having jurisdiction and safety standards for cleaning.
   1. Do not burn waste materials.
   2. Do not bury debris or excess materials on Owner's property.
   3. Do not discharge volatile, harmful or dangerous materials into drainage systems.
   4. Remove waste materials from Project Site and dispose of in lawful manner.
   5. Where extra materials of value remaining after completion of associated Work have become Owner's property, arrange for disposition of these materials as directed.

G. Prior to final completion, or Owner occupancy, Contractor shall conduct inspection of sight-exposed interior and exterior surfaces, and work areas, to verify that entire Work is clean.

3.04 CLEANING DURING OWNER’S OCCUPANCY

A. Should Owner occupy portion of Project prior to its completion by Contractor, acceptance by Owner/Architect shall be in accordance with General Conditions.

END OF SECTION 01 7423
SECTION 01 7700

CLOSEOUT PROCEDURES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for Project Closeout, including but not limited to:
      a. Inspection procedures.
      b. Substantial Completion
      c. Final Acceptance

B. Related Sections:
   1. Section 01 7423: Cleaning
   2. Section 01 7839: Project Record Documents

C. Related Requirements:
   1. Closeout requirements for specific construction activities are included in appropriate Sections in Divisions 02 through 32

1.02 BENEFICIAL OCCUPANCY AND ACCEPTANCE OF SUBSTANTIAL COMPLETION

A. Comply with CCR, Title 24, Part 1 - Administrative Code, Section 4-336 CCR (Schools) Requirements for Closeout Procedures.

B. Related Sections:
   1. Section 01 7423: Cleaning
   2. Section 01 7839: Project Record Documents

C. Related Requirements:
   1. Closeout requirements for specific construction activities are included in appropriate Sections in Divisions 02 through 32

1. Comply with additional requirements in District’s Division 00 Sections and General Conditions of the Contract.

B. Preliminary Procedures: Before requesting inspection for certification of Substantial Completion, complete following (List exceptions in request):

1. In application for payment that coincides with, or first follows, date Substantial Completion is claimed, show one hundred percent completion for portion of Work claimed as substantially complete.
   a. Include supporting documents for completion as indicated in Contract documents and statement showing accounting of changes to Contract sum.
   b. If one hundred percent completion cannot be shown, include list of incomplete items, value of incomplete construction, and reasons Work is not complete.

2. Make required submittals of specific warranties, workmanship bonds, maintenance agreements, final certifications and similar documents, along with record drawings and similar final record information in accordance with requirements in Section 01 7839.

3. Complete final clean up requirements in accordance with Section 01 7423, including touch-up painting.
   a. Touch-up and otherwise repair and restore marred exposed finishes.

C. Inspection Procedures: Upon receipt of request for inspection, Architect will either proceed with inspection or advise Contractor of unfilled requirements.

1. Should Architect and Owner determine that Work is not substantially complete:
CLOSEOUT PROCEDURES
01 7700 - 2

1.01 INTERIM HOUSING

1.02 CLOSING PROCEDURES

a. Architect will promptly notify Contractor in writing, giving reason(s) for his determination.
b. In conjunction with Inspector of Record and Construction Manager, Architect will prepare list of items (Punch List) to be completed or corrected.
   1) Punch List may be developed for less than entire project, when approved by Architect and Owner.
c. Contractor shall remedy deficiencies and notify Architect when Work is ready for re-inspection.
d. Architect will prepare Certificate of Substantial Completion, accompanied by Punch List, following inspection, or advise Contractor of construction that must be completed or corrected before certificate will be issued.

2. Architect will repeat inspection when requested and if assured that Work has been substantially completed in each phase, will submit Certificate of Substantial Completion to Contractor and Owner for their written acceptance of responsibilities assigned them in Certificate.

   a. Owner reserves right to occupy each completed phase upon issuance of Certificate of Substantial Completion.

3. Results of completed inspection will form basis of requirements for final acceptance.

D. Mandatory Substantial Completion Submittals include, but are not necessarily limited to:

1. Redlined As-Built Set (marked up drawings).
2. On As-Built Set and Specifications manual record revisions to original contract document with contrasting color.
3. Operation and Maintenance Manuals for items specified in pertinent Sections and for other items approved by Architect.
4. Warranties and Guarantees.
5. Training.
7. Evidence of payment and release of liens, when requested by Owner.
8. List of Subcontractors, service organizations and principal vendors, including current names, addresses and telephone numbers, where they may be contacted for emergency service, including nights, weekends, and holidays.

1.03 FINAL ACCEPTANCE

A. Preliminary Procedures: Before requesting final inspection for certification of final acceptance and final payment, complete following (List exceptions in request):

1. Contractor shall prepare and submit notice (Project Closeout Request) that Work is ready for final inspection and acceptance.
2. Architect, and Owner’s Inspector to verify that Punch List items are complete.
3. Should Architect or Owner’s Inspector determine Work is incomplete or defective:
   a. Architect or Owner’s Inspector will promptly notify Contractor in writing, listing incomplete or defective work.
   b. Contractor shall remedy deficiencies promptly and notify Owner’s Inspector when ready for re-inspection.

B. Reinspection Procedure: Architect will reinspect Work upon receipt of notice that Work, including inspection list items from earlier inspections, has been completed, except items whose completion has been delayed because of circumstances acceptable to Architect.
1. Upon completion of reinspection, Architect will prepare certificate of final acceptance, or advise Contractor of work that is incomplete, or of obligations that have not been fulfilled but are required for final acceptance.
2. If necessary, reinspection will be repeated.
3. When Architect determines Work is acceptable under Contract Documents, he will notify Owner's Inspector that Project is complete per Contract Drawings and Specifications.
4. Upon acceptance, Contractor must certify that Project has been completed in compliance with Contract Documents.
   a. Copy of this report shall be submitted to following:
      1) Architect.
      2) Owner's Inspector.

C. Final Payment Procedure.
1. Submit following in accordance with requirements of Section 01 7839:
   a. Final payment request with releases and supporting documentation not previously submitted and accepted.
   b. Include certificates of insurance for products and completed operations where required.
2. Updated final statement, accounting for final additional changes to Contract Sum.
3. Certified copy of Architect's final inspection list of items to be completed or corrected, stating that each item has been completed or otherwise resolved for acceptance, and list has been endorsed and dated by Architect.
4. Consent of surety to final payment.
5. Comply with additional requirements in District's Division 00 Sections and General Conditions of the Contract.

PART 2 – PRODUCTS  (Not Applicable)
PART 3 – EXECUTION  (Not Applicable)

END OF SECTION 01 7700
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for preparing, maintaining, and submitting following:
      a. Project Record Documents.
      b. Operating and Maintenance Data and Manuals.
      c. Warranties, Guarantees, and Bonds.
      d. Spare parts and Maintenance Materials.
      e. Instructions to Owner’s Personnel.

B. Related Sections:
   1. Section 01 7700: Closeout Procedures

C. Related Requirements:
   1. Refer to District’s Division 00 Documents, including General Conditions, for additional requirements.
   2. Separate Specification Sections requiring Record Documents.

1.02 PROJECT RECORD DOCUMENTS

A. Dedicated Record Set: Maintain one set of Contract Drawings and one copy of Project Specifications for use during construction to record changes made during construction.
   1. Revisions shall be recorded with contrasting color.
   2. Do not use record documents for construction purposes.

B. Record Documents and Shop Drawings:
   1. Record in concise and neat manner and on continual basis actual revisions to Work.
   2. Include reference to appropriate document with date revision/change was approved or directed.
   3. Changes/Revisions to Drawings and Specifications include, but are not limited to:
      a. Changes made by RFI and CO.
      b. Changes made to shop drawings.
   4. Mark set to show actual installation where installation varies substantially from Work as originally shown.
      a. Mark whichever drawing is most capable of showing conditions fully and accurately.
      b. Where shop drawings are used, record cross-reference at corresponding location on Contract drawings.
      c. Give particular attention to concealed elements that would be difficult to measure and record at later date.
5. Mark record sets with red erasable pencil; use other colors to distinguish between variations in separate categories of Work.

6. Mark new information that is important to Owner, but was not shown on Contract Drawings or shop drawings.

7. Note related Change Order numbers where applicable.

8. Label each document “PROJECT RECORD” in neat large printed letters.

9. Record information concurrently with construction progress.
   a. Do not conceal Work until required information is recorded.

10. Legibly mark each item to record actual construction including:
   b. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
      1) Identify drains and sewers by invert elevation.
   c. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of Work.
   d. Identify ducts, dampers, valves, access doors and control equipment wiring.
   e. Field changes of dimension and detail.
   f. Details not on original Drawings.

C. Store Record Documents and Samples in Contractor’s Field Office, separate from documents used for construction.
   1. Protect record documents from deterioration and loss in secure, fire-resistant location.
   2. Provide access to record documents for Architect’s reference during normal working hours.
   3. Provide files and racks for storage of Documents.
   4. Provide secure storage space for storage of samples.
   5. Maintain documents in clean, dry, legible condition and in good order.
      a. Replace soiled or illegible documents.

D. Record Specifications: Maintain one complete copy of Project Manual, including addenda, and one copy of other written construction documents such as Change Orders and modifications issued in printed form during construction.
   1. Legibly mark these documents and record at each product section description of actual products installed to show substantial variations in actual Work performed in comparison with text of specifications and modifications including following:
      a. Manufacturer's name, trade name, product model and number and supplier.
      b. Give particular attention to substitutions, selection of options and similar information on elements that are concealed or cannot otherwise be readily discerned later by direct observation, including following:
         1) Authorized product substitutions or alternates utilized.
         2) Changes made by Addenda and Modifications.
   2. Note related record drawing information and product data.
   3. Upon completion of Work, submit record specifications to Architect for Owner's records.

E. Owner’s Project Inspector will verify that Project Record Documents are fully updated prior to approving Payment Applications.
   1. Obtain Owner’s Inspector’s signature on record set verifying information.
F. Record drawings will be reviewed by Architect for completeness and acceptance.

G. As-Built Drawings: Shall be turned over to Owner in following manner:
   1. Separate each discipline (i.e. Civil, Architectural, Mechanical, Electrical, Plumbing, and so on)
   2. Identify disciplines of Drawings by adding white tag.
   3. Tag each discipline.
   4. Tag shall be size No. 8, 8-11/16 by 2-3/4 inches.
   5. Legibly write on tag name of Project, and discipline inside tube.
   6. Each discipline shall be separately tubed by using U-Line tube or equal.
   7. Size of tube: 4 inches minimum and 6 inches maximum.

H. Record of Electronic (Digital) Files: Immediately before inspection of Substantial Completion, review marked-up Record Set with Architect and Owner's Inspector.
   1. When authorized, prepare full set of corrected digital files of Record Documents.
   2. Submit following documents:
      a. Scan sheets in As-Built Set, furnish annotated PDF electronic files.
      b. CD or CD’s of PDF files and file labeling is to include following information:
         1) Project name.
         2) Date.
         3) Name of Architect.
         4) Name of Contractor
         5) Disciplines included in CD (i.e. Title sheet, Civil, Architectural, Structural, Mechanical, and so on)
         6) Labeling and indexing of files contain within CD shall be in Sequential order to match Title Sheet of Contract Documents.

I. RFI’s: Furnish one copy of RFI’s questions and answers submitted on Project.
   1. Submit RFI binder in following manner:
      a. Provide binders as specified in Article 1.04.
      b. Identify Project Name/Building Name, and Project Number on cover. Label binder on cover and spine: RFI’s.
      c. Furnish tab for each individual RFI.

1.03 OPERATING AND MAINTENANCE DATA AND MANUALS

A. Submit two sets prior to Substantial Completion inspection for Architect’s review and approval.

B. Manual Format:
   1. Prepare data in form of instructional manual for use by Owner’s personnel.
      a. Provide binders as specified in Article 1.04.
      b. Identify Project Name/Building Name and Project Number on cover of manual.
   2. Table of Contents: Include in each volume, neatly typewritten.
      a. Identify Contractor, name of responsible principal, address, and phone number.
      b. List each product included, indexed to content of volume.
c. List, with each product, name, address, and telephone number of subcontractor or installer and maintenance contractor, as appropriate and nearest source of supply for parts and replacement.

d. Identify location of installed equipment.
e. Submit M&O Manuals inside “Bankers Boxes” as specified in Article 1.04

3. Product Data:
   a. Include only those sheets which are pertinent to specific product.
   b. Annotate each sheet to clearly identify specific product or part installed.
   c. Include CD with Product Data information.
      1) Maintenance schedules and equipment list must be in editable Word or Excel spreadsheet format.

4. Drawings:
   a. Supplement product data with Drawings as necessary to clearly illustrate relations of component parts of equipment and systems.
   b. Coordinate Drawings with information in Project Record Documents to ensure correct illustration of completed installation.
   c. Do not use Project Record Documents as maintenance drawings.
   d. Full size and half size hard copies of Drawings are required.

5. Copy of each warranty and service contract as specified.

1.04 RECORD DOCUMENT STORAGE

A. Binders:
   1. Commercial quality, heavy-duty, three-ring D binders with durable and cleanable vinyl-covers at front and spine, with internal pockets to hold CD.
   2. Size: 8-1/2 by 11 inches.
   3. Provide new white binders.

B. Storage Boxes:
   1. Include two labels on face and side of box.
   2. Label boxes as follows:
      a. Use Avery Label 6573 or equal size.
      b. Type information on label, including Bid No., Project Name, and Number of boxes (i.e. Box 1 of 5).
      1) Refer to attached sample label at end of this Section.
      2) Font for Labels:
         a) Vernada, 48 point for Bid No.
         b) Vernada, 16 point for remainder of content on label.

1.05 WARRANTIES, GUARANTEES, AND BONDS

A. Disclaimers and Limitations: Manufacturer’s disclaimers and limitations on product warranties do not relieve Contractor of warranty on Work that incorporates products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

B. Manufacturer’s warranties and guarantees notwithstanding, warrant entire Work against defects in materials and workmanship for twelve months from Date of Acceptance of Substantial Completion.
   1. Warranties and guarantees between Contractor and manufacturers and Contractor and suppliers shall not affect warranties or guarantees between Contractor and Owner.
1.05 WARRANTY REQUIREMENTS

A. Related Damages and Losses: When correcting warranted Work that has failed, remove and replace other Work that has been damaged as result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

B. Reinstatement of Warranty: When Work covered by warranty has failed and been corrected by replacement or rebuilding, reinstate warranty by written endorsement.
   1. Reinstated warranty shall be equal to original warranty with equitable adjustment for depreciation.

C. Replacement Cost: Upon determination that Work covered by warranty has failed, replace or rebuild Work to an acceptable condition complying with requirements of Contract documents.
   1. Contractor is responsible for cost of replacing or rebuilding defective Work regardless of whether Owner has benefited from use of Work through portion of its anticipated useful service life.

D. Owner's Recourse: Written warranties made to Owner are in addition to implied warranties, and shall not limit duties, obligations, right and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which Owner can enforce such other duties, obligations, rights, or remedies.
   1. Rejection of Warrants: Owner reserves right to reject warranties and to limit selections to products with warranties not in conflict with requirements of Contract Documents.

E. Owner reserves right to refuse to accept Work for Project where special warranty, certification, or similar commitment is required on such Work or part of Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

F. Warranties and guarantees shall be submitted to Contractor for Architect’s review and approval prior to final payment.

G. For warranty items delayed, warranty period shall not start until items have been completed.

H. Furnish two original copies with wet signatures of warranties and guarantees on Project.

I. Organize warranties/guarantees into orderly sequence base on Table of Contents by Project Specifications:
   1. Bind warranties/guarantees in 8-1/2 by 11 inch heavy-duty, three ring binders, same as specified in Article 1.03.
   2. Identify each binder on front and spine with printed sheet “WARRANTIES”, project name and name of contractor.
   3. Contractor to issue Contractor’s and Subcontractor’s Warranties/Guarantees using attached Warranties/Guarantees form found on Page 8 of this Section.
1.06 SUBMITTALS

A. Submit written warranties to Architect prior to date certified for Substantial Completion.
   1. When Architect's Certificate of Substantial Completion designates commencement date for warranties other than date of Substantial Completion for Work, or designated portion of Work, submit written warranties upon request of Architect.

1.07 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit (2) copies of final approved manual to Owner's Inspector prior to final payment.

B. Content for each unit of mechanical equipment and each mechanical system, as applicable and appropriate, including but not limited to following:
   1. Description of units, or system and component parts.
   2. Operating procedures.
   4. Servicing and lubrication schedule, with list of lubricants required.
   5. As-installed control diagrams by controls manufacturer.
   6. Other data as required in various specification sections.

C. Content, for each electrical and electronic system, as applicable and appropriate, including but not limited to following:
   1. Description of system and component parts.
   2. Circuit directories of panel boards.
   3. As-installed color-coded wiring diagrams.
   4. Operating procedures.
   5. Maintenance procedures.
   6. Other data as required in individual sections.

D. Prepare and include additional data as may be required for instruction of Owner's personnel.

E. Additional requirements for operating and maintenance data: As may be specified in individual Sections.

F. Provide complete information for products specified in individual Sections.

1.08 INSTRUCTION OF OWNER'S PERSONNEL

A. Provide instruction/training to Owner personnel as indicated in individual specification sections and as required.

B. Provide to Owner, date and list (signatures) of Owner personnel who attended training.
   1. Schedule instructional meeting or meetings after instructional manuals have been submitted, reviewed, and approved by Architect.
   2. Coordinate meetings to include tier subcontractors.

C. Instruction sessions will be held in Owner designated area on Project Site and at Owner's convenience.
1. Amount of time required for each session shall be as specified in individual sections.

D. Review contents of Manuals with Owner’s personnel in full detail to explain every aspect of operation and maintenance.

1.09 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

PART 2 – PRODUCTS  (Not Applicable)

PART 3 – EXECUTION  (Not Applicable)

END OF SECTION 01 7839
WARRANTY / GUARANTEE FORM

FOR.................................................................................................................. WORK

We, the undersigned, do hereby warranty and guaranty that the parts of the Work described above which we have furnished or installed for:

Project Name: (Insert Project Name)

Owner: (Insert Owner’s Name)

Location: (Insert Project Location)

Are in accordance with the Contract Documents and that all said work as installed with fulfill or exceed all the Warranty and Guaranty requirements. We agree to repair or replace work installed by us, together with any other work which is displaced or damaged by so doing, that proves to be defective in workmanship, material, or operation within a period of:

(Insert written years) year(s)

from the date of filing of the Notice of Completion, ordinary wear and tear and unusual neglect or abuse excepted.

In the event of our failure to comply with the above-mentioned conditions within a reasonable time period determined by the Owner, after notification in writing, we, the undersigned, all collectively and separately, hereby authorize the Owner to have said defective work repaired and/or replaced and made good, and agree to pay to the Owner upon demand all monies that the Owner may expend in making good said defective work, including all collection costs and reasonable attorney fees.

Date:

(Insert Name of Contractor) (Insert Name of Subcontractor, Manufacturer or Supplier)

Signature: Signature:

Name: Name:

Title: Title:

State License No. State License No.: 

Local Representative: For maintenance, repair, or replacement service, contact:

Name:

Address:

Phone:
Bid No. XXXX

[Project Name]  DSA No. N/A

RFI BINDERS 01 OF 04

BINDERS 01 OF 04: RFI’S 001 THRU 5
BINDERS 02 OF 04: RFI’S 051 THRU 100
BINDERS 03 OF 04: RFI’S 101 THRU 150
BINDERS 04 OF 04: RFI’S 151 THRU 200

Box 1 of 5
SECTION 02 4113

SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing labor, materials and equipment necessary for selective site demolition, dismantling, cutting, and alterations as indicated, specified, or required for completion of Work.
   2. Includes items such as following:
      a. Protection of existing improvements to remain.
      b. Cleaning existing improvements to remain.
      c. Disconnecting and capping utilities.
      d. Removing debris, waste materials, and equipment.
      e. Removal of existing items, where indicated, for performance of Work, including, but not limited to:
         1) Existing ramps scheduled to be replaced.
         2) Asphalt paving and parking striping.
      f. Removal of existing curbs and gutters, where indicated.

B. Related Sections:
   1. Section 01 1100: Summary of Work.
   2. Section 01 5000: Temporary Facilities and Controls.
   3. Section 01 5713: Temporary Erosion and Sedimentation Controls.
   4. Section 01 7329: Cutting and Patching
   5. Section 01 7423: Cleaning

C. Related Requirements:
   1. Refer to Plumbing, HVAC, and Electrical Drawings for Work related to upgrades to existing modular units and installation for new modular unit.
   2. Refer to Division 22, 23, and 26 sections

1.02 QUALITY ASSURANCE

A. Prior to commencement of Work, schedule walkthrough with Owner’s Authorized Representative and Architect to confirm Owner property items have been removed from scheduled Work areas.
   1. Identify and mark remaining property items and schedule their removal.
   2. Review limits of demolition and items indicated on shop drawings.

B. Perform Work of this section by workers skilled in demolition of site improvements.
   1. Perform Work of this section under full time direct supervision.

C. Coordinate demolition for correct sequence, limits, and methods.
   1. Schedule demolition Work to create least possible inconvenience to public and facility operations.

1.03 SUBMITTALS

A. Shop Drawings: Indicating extent of items and systems to be removed.
1. Indicate items to be salvaged or items to be protected during demolition.
2. Indicate locations of utility terminations and extent of abandoned lines to be removed.
   a. Include details indicating methods and location of utility terminations.

1.04 PROJECT CONDITIONS

A. Drawings may not indicate in detail entire demolition Work to be performed.
   1. Examine existing conditions to determine full extent of required demolition.
   2. Existence and location of underground utility pipes or structures shown are obtained by search of available records.
      a. Contractor is required to take due precautionary measures to protect utilities shown and other lines or structures not shown
      b. Design Professional is not responsible for location of underground utilities or structures whether or not shown on and installed by Contract Documents.
      c. It is Contractor’s responsibility to examine conditions before commencing operations.
   3. Immediately notify Owner and Architect, should such unidentified conditions be discovered.

B. Repair damage to existing improvements or damage due to excessive demolition.

C. Provide necessary measures to avoid excessive damage from inadequate or improper means and methods, improper shoring, bracing or support.

D. Should conditions be encountered that vary from those indicated, promptly notify Architect for clarification before proceeding.

PART 2 – PRODUCTS

2.01 HANDLING OF MATERIALS

A. Deliver items scheduled for salvage by Owner to location designated by Owner’s authorized representative.
   1. Clean, package and label items for storage.

B. Store items scheduled for reuse on Project Site and protected from damage, theft, and other deleterious conditions.

PART 3 – EXECUTION

3.01 GENERAL

A. Prior to start of selective site demolition work, ensure that BMPs are in place in accordance with requirements of Section 01 5713.

B. Protection:
   1. Do not commence demolition until safety partitions, barricades, warning signs and other forms of protection are installed.
      a. Comply with requirements of Section 01 5000.
   2. Provide safeguards, including warning signs, lights, and barricades, for protection of workers, occupants, and public.
C. When safety of existing construction appears to be endangered, take immediate measures to correct such conditions.
   1. Cease operations and immediately notify Architect and Owner.

3.02 SITE DEMOLITION – GENERAL

   A. Remove existing construction only to extent necessary for proper installation of Work and interfacing with existing construction.
   1. Cut back finished surfaces to straight, plumb or level lines as required for smooth transition.

   B. Where openings are cut oversize or in improper locations, replace or repair to required condition.

3.03 CONCRETE AND ASPHALT PAVING REMOVAL

   A. Prior to cutting concrete and asphalt paving, determine locations of hidden utilities or other existing improvements and provide necessary measures to protect them from damage.

   B. Perform cutting of concrete or asphalt paving as indicated or as reviewed by Architect.
   1. Replace concrete and asphalt paving demolished in excess of amounts indicated.

   C. Break up and completely remove existing concrete curbs and gutters, and asphalt paving to indicated limits.
   1. Perform cutting to neat and even line with proper tools or concrete cutting saw.
      a. Minimum Depth of Cut: 1-1/2 inches, unless otherwise indicated.
   2. Do not damage concrete or asphalt intended to remain.

   D. Remove concrete broken beyond indicated limits to nearest joint or score line and replace with new concrete to match existing.
   1. Refer to additional requirements in Section 31 1000.

3.04 REMOVAL OF EXISTING PLUMBING SERVICE CONNECTIONS

   A. Disconnect existing plumbing service connections to existing modular unit and cap, to facilitate upgrade of unit.
   1. Reconnection of plumbing services to new modular unit is indicated on Plumbing Drawings.

3.05 REMOVAL OF EXISTING ELECTRICAL EQUIPMENT AND SERVICES

   A. Remove existing electrical equipment fixtures and services not indicated for reuse and not necessary for completion of Work.

   B. Remove abandoned conduit and cap unused portions of existing conduit.

3.06 REMOVAL OF OTHER MATERIALS

   A. Remove existing improvements not specifically indicated or required but necessary to perform Work.
   1. Cut to clean lines, allowing for installation of Work.
3.07 PATCHING

A. Patch or repair materials to remain when damaged by performance of this Work.
   1. Finish material and appearance of patch or repair Work shall match existing.
   2. Refer to Section 01 7329 for additional requirements.

3.08 CLEANING

A. Comply with requirements of Section 01 7423 and following:
   1. Clean existing materials to remain with appropriate tools and equipment.
   2. Protect existing improvements during cleaning operations.
   3. Dampen debris by fog water spray prior to transporting by truck.
   4. Keep debris pick-up area broom-clean and washed daily with clean water.
   5. Remove waste and debris, other than items to be salvaged.
      a. Turn over salvaged items to Owner, or store and protect for reuse where required.
      b. Continuously clean up and remove items as demolition Work progresses.
   6. Remove and legally dispose of rubbish, debris, and waste materials off Project Site.
      a. Comply with requirements of Section 01 7419.

END OF SECTION 01 4113
SECTION 02 4119
SELECTIVE DEMOLITION

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing labor, materials and equipment necessary for performance of selective demolition as indicated, specified, or required, but not limited to, following:
      a. Protection of existing improvements to remain.
      b. Cleaning existing improvements to remain.
      c. Disconnecting and capping utilities.
      d. Removing debris, waste materials, and equipment.
      e. Removal of items for performance of Work.
      f. Removal of salvageable items to be retained by Owner.

B. Section requires selective removal and subsequent legal off-site disposal of following:
   1. Portions of existing interior walls, doors, and windows.
   2. Mechanical equipment.
   3. Electrical conduit, wiring and panels.
   4. Plumbing fixtures and fittings.
   5. Floor finishes and wall coverings.
   6. Ceiling tiles and metal ceiling grid systems.
   7. Coordinate removal from Project Site of debris removed by other trades.
   8. Refer to Plumbing, Mechanical, and Electrical Specifications and Demolition Drawings.

C. Related Sections:
   1. Section 01 1100: Summary of Work
   2. Section 01 3119: Project Meetings
   3. Section 01 5000: Temporary Facilities and Controls
   4. Section 01 7329: Cutting and Patching
   5. Section 01 7423: Cleaning

D. Related Requirements:
   1. Refer to respective Sections of Divisions 22, 23, and 26 through 28; for cutting, patching, or relocating plumbing, mechanical, and electrical items.

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24, 2013 edition:
   1. Part 2, California Building Code (CBC), Volumes 1 and 2.
   2. Part 9, California Fire Code (CFC).

1.03 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Engage experienced firm that has successfully completed selective demolition work similar to that indicated for this Project.
B. Pre-Demolition Conference: Conduct conference at Project Site to comply with Pre-Installation Conference requirements of Section 01 3119.
   1. Conduct walkthrough with Owner’s Project Representative to confirm Owner property items have been removed from scheduled Work areas.
   2. Identify and mark remaining property items and schedule their removal and delivery to Owner.

C. Coordinate demolition for correct limits and methods.
   1. Schedule demolition work to minimize inconvenience to public, and Owner’s facility operations.

1.04 SUBMITTALS

A. Prior to cutting which affects structural safety, submit written request to Architect for permission to proceed with cutting.

B. Shop Drawings: Indicating extent of items and systems to be removed.
   1. Indicate items to be salvaged or items to be protected during demolition.
   2. Indicate locations of utility terminations and extent of abandoned lines to be removed.
      a. Include details indicating methods and location of utility terminations.

C. Schedule of Removal: Indicate elements to be demolished and removed and proposed timing for Work.
   1. Coordinate with Work of other trades.

D. Record Drawings: At project closeout according to Section 01 7839.
   1. Identify and accurately locate capped utilities and other subsurface structural, plumbing, mechanical, or electrical conditions.

1.05 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain Owner's property.

B. Remove and Salvage: Items indicated to be removed and salvaged remain Owner's property.
   1. Remove, clean, and pack or crate items to protect against damage.
   2. Identify contents of containers and deliver to Owner's designated storage area.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage.
   1. Reinstall items in same locations or in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.
   1. When permitted by Architect, items may be removed to suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.
1.06 PROJECT CONDITIONS

A. Occupancy: Owner will occupy portions of campus immediately adjacent to areas of selective demolition.
   1. Conduct selective demolition work in manner that will minimize need for disruption of Owner’s normal operations.
   2. Provide minimum of 48 hour advance notice to Owner of demolition activities that will affect Owner’s normal operation.

B. Protections: Ensure safety of Contractor, Owner personnel, and general public.
   1. Institute measures designed to avoid physical harm to public or property damage to facilities from inadequate or improper means and methods; improper shoring, bracing and structural support; or poorly fenced off areas.

C. Traffic: Conduct demolition operations and debris removal in manner to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.
   1. Do not close, block or otherwise obstruct streets, walks or other occupied or used facilities without written permission from authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways where required by governing regulations.
   3. Refer to Section 01 5000 for additional requirements.

D. Drawings may not indicate in detail Demolition Work to be performed.
   1. Examine existing conditions to determine full extent of required demolition.
   2. When conditions are encountered that vary from those indicated, promptly Notify Architect for direction or clarification before proceeding.

E. Condition of Structures: Owner assumes no responsibility for actual condition of items or structures to be demolished.
   1. Conditions existing at time of contractor inspection for bidding purposes will be maintained by Owner insofar as practicable.
   2. Minor variations within structure may occur by Owner’s removal and salvage operations prior to start of selective demolition work.

F. Asbestos or Hazardous Waste: It is understood and agreed that this contract does not contemplate handling of asbestos or hazardous waste material.
   1. Should asbestos or other hazardous waste material be encountered, notify Owner immediately.
   2. Do not disturb, handle or attempt to remove.

G. Damages: Promptly repair damages caused to adjacent facilities by demolition Work.
   1. Repair damage to existing improvements or damage due to excessive demolition.

1.07 REGULATORY REQUIREMENTS

A. Intent of Drawings and Specifications is that Work of selective demolition is to be in accordance with CCR, Title 24.
   1. Should existing conditions such as deterioration or noncomplying construction be discovered which is not covered by Contract Documents, and finished Work will not comply with CCR, Title 24:
a. Architect will submit Construction Change Document (CCD) - DSA Form 140, or separate set of plans and specifications, detailing and specifying required Work to, and approved by Division of the State Architect before proceeding with Work.

2. Comply with CCR Title 24, Part 2 - CBC, and Part 9 - CFC, Article 87 – “Fire Safety During Construction, Alteration or Demolition of a Building.”

3. Comply with governing EPA notification regulations before starting selective demolition Work.

4. Comply with requirements of Section 01 500 and hauling and disposal regulations of authorities having jurisdiction.

1.08 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, demolished materials become Contractor's property and shall be removed from Project Site in accordance with requirements of Section 01 7419.

PART 2 – PRODUCTS

2.01 HANDLING OF MATERIALS

A. Items scheduled for salvage by Owner shall be delivered to location designated by Owner.
   1. Items shall be cleaned, packaged and labeled for storage.

B. Items scheduled for reuse shall be stored on Project Site, secured from theft, and protected from damage, and other deleterious conditions.

C. District is responsible for removal and testing of materials suspected of asbestos or lead contamination.
   1. Asbestos abatement reports are available from District.
   2. Cease material removal and alert District immediately if suspect materials are discovered.

2.02 PRODUCTS FOR PATCHING, EXTENDING AND MATCHING

A. Provide same products or types of construction as that in existing structure, as needed to patch, extend or match existing Work.
   1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible.
   2. Use materials whose installed performance equals or surpasses that of existing materials.
   3. Generally Contract Documents will not define products or standards of workmanship present in existing construction
   4. Determine products by inspection and necessary testing, and workmanship by use of existing as sample of comparison.

B. Presence of product, finish, or type of construction, requires that patching, extending, or matching, be performed as necessary to make Work complete and consistent to identical standards of quality.
PART 3 – EXECUTION

3.01 GENERAL

A. Preparation:
   1. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain.
   2. Provide safeguards, including warning signs, lights and barricades, for Owner and protection of workers, occupants, and public and to ensure safe passage of people around selective demolition area.
   3. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, complying with requirements of Section 01 5000, and where required by authorities having jurisdiction.
   4. Protect existing site improvements, appurtenances, and landscaping to remain.
      a. Erect plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
   5. Provide temporary weather protection, during interval between demolition and removal of existing construction, on exterior surfaces and new construction, to ensure that no water leakage or damage occurs to structure or interior areas.
      a. Protect walls, ceilings, floors, and other existing finish work that are to remain and are exposed during selective demolition operations.

B. Protection:
   1. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement or collapse of structures to be selectively demolished and to protect adjacent facilities to remain.
   2. Should human safety appear to be threatened by conditions of existing construction or that existing construction appears to be endangered take immediate measures to ensure human safety.
      a. Cease operations in threatened area and immediately notify Project Inspector.
      b. Take precautions to support structure until determination is made for continuing operations.
      c. Strengthen or add new supports when required during progress of selective demolition.
   3. Always have fully charged, portable fire extinguisher with each demolition crew on-site.

3.02 EXAMINATION

A. Examine existing conditions, including elements subject to movement or damage during remodeling work.
B. After uncovering Work, examine conditions affecting installation of new work.
C. Discrepancies:
   1. Where uncovered conditions are not as anticipated, immediately notify Architect and secure needed directions.
   2. Do not proceed in areas of discrepancy until such discrepancies have been fully resolved.
D. Time extensions or increase or decrease of costs resulting from such changes will be adjusted in manner provided in General Conditions.
3.03 UTILITY SERVICES

A. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.
   1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction.
   2. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.
   3. Provide not less than 72 hours notice to Owner if shutdown of service is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to be selectively demolished.
   1. Owner will arrange to shut off indicated utilities when requested by Contractor.
   2. Arrange to shut off indicated utilities with utility companies.
   3. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of building before proceeding with selective demolition.
   4. Cut off pipe or conduit in walls or partitions to be removed.
   5. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

C. Utility Requirements: Refer to Division 21 through 23, 26 through 28, 31, and 33 Sections for shutting off, disconnecting, removing, and sealing or capping utility services.
   1. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.04 POLLUTION CONTROLS

A. Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt.
   1. Comply with governing environmental protection regulations.
   2. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as flooding and pollution.

B. Remove and transport debris in manner that will prevent spillage on adjacent surfaces and areas.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations.
   1. Return adjacent areas to condition existing before start of selective demolition.

3.05 SELECTIVE DEMOLITION

A. Adhere to Project Schedule and notify Owner of changes to Schedule imposed by unforeseen site conditions or Owner operational activities.

B. Perform selective demolition in systematic manner.
   1. Use such methods as required to complete Work indicated in accordance with Project Schedule and governing regulations.
C. Remove existing construction only to extent necessary for proper installation of new work and interfacing with existing construction.
   1. Cut back finished surfaces to straight, plumb or level lines as required for smooth transition.
   2. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.
      a. Do not throw or drop materials.

3.06 CUTTING EXISTING CONCRETE

A. Cutting of existing concrete shall be performed by skilled workers familiar with requirements and space necessary for placing concrete.
   1. Perform concrete cutting with concrete cutting wheels and hand chisels.
   2. Do not damage concrete intended to remain.

B. Extent of cutting of concrete shall be as indicated or as required by existing field conditions.
   1. Replace concrete demolished in excess of amounts indicated.

C. Prior to cutting or coring concrete, determine locations of hidden utilities or other existing improvements and provide necessary measures to protect them from damage.

3.07 REMOVAL OF EXISTING PLUMBING AND ELECTRICAL EQUIPMENT AND SERVICES

A. Remove existing plumbing and electrical equipment, fixtures, and services not indicated for reuse or necessary for completion of Work.
   1. Remove abandoned lines and cap unused portions of active lines.
   2. Comply with additional requirements specified in Divisions 21 through 28 Sections.

3.08 REMOVAL OF OTHER MATERIALS

A. Woodwork: Cut or remove to joint or panel line.

B. Roofing: Remove as required, including accessory components such as insulation and flashings.
   1. At penetrations through existing roofing, trim cut edges back to sound roofing with openings restricted to minimum size necessary to receive Work.

C. Sheet Metal: Remove back to joint, lap, or connection.
   1. Secure loose and unfastened ends or edges and provide watertight condition and reseal as required.

D. Glass: Remove broken or damaged glass and clean rebates and stops of glazing channels.

E. Modular Materials: Acoustical ceiling panels, resilient tile, and ceramic tile.
   1. Remove to natural joint without leaving damaged or defective Work where joining new construction.
   2. After flooring removal, clean substrates to remove setting materials and adhesives.
F. Gypsum Board: Remove to panel joint line on stud or support line.

G. Plaster: Saw cut plaster on straight lines, leaving minimum 2 inch width of firmly attached metal lath for installing new lath and plaster.

H. Carpet: Remove and recycle damaged and worn material.

I. Vinyl Tile: Prior to removal, confirm with District that tile and mastic contain no asbestos or other hazardous material.

J. Remove existing improvements not specifically indicated or required but necessary to perform new Work.
   1. Cut to clean lines, allowing for installation of new Work.

3.09 PATCHING

A. Review Section 01 7329 for additional requirements.
   1. Patch or repair materials to remain when damaged by performance of Work.
   2. Finish material and appearance of patch or repair Work shall match existing.

3.10 CLEANING

A. Clean existing materials to remain with appropriate tools and equipment.

B. Protect existing improvements during cleaning operations.

C. Debris shall be dampened by fog water spray prior to transporting by truck.

D. Debris pick-up area shall be kept broom clean and shall be washed daily with clean water.

E. Remove waste and debris, other than items to be salvaged.
   1. Turn over salvaged items to Owner, or store and protect for reuse where required.
   2. Comply with additional requirements in Section 01 7419.

F. Continuously clean up and remove items as Work progresses and legally dispose of off Project Site.
   1. Comply with requirements of Section 01 7423.

END OF SECTION 02 4119
SECTION 06 1053

MISCELLANEOUS CARPENTRY

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Carpentry work not specified elsewhere and generally intended for support of other work.
   2. Wood furring.
   3. Miscellaneous blocking, grounds, nailers, and panels.

B. Related Sections:
   1. Section 07 0150: Roof Repairs

1.02 REFERENCES


B. American Plywood Association (APA):
   1. Guide to Plywood Grades

C. ASTM International (ASTM):

D. UL, LLC (UL):
   1. Fire Hazard Classification – FR-S

E. West Coast Lumber Inspection Bureau (WCLIB):

F. Western Wood Products Association (WWPA):
   1. Standard Grading Rules for Western Lumber.

G. American Wood Preservers Association Standards (AWPA)

1.03 QUALITY ASSURANCE

A. Wood Product Quality Standards:
   1. Lumber Standards: Comply with West Coast Lumber Inspection Bureau (WCLIB).
   3. Factory-mark each piece of lumber and plywood with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.
B. Single-Source Responsibility for Fire Retardant Treated Wood:
   1. Obtain each type of fire-retardant-treated wood product from one source and by single producer.

1.04 SUBMITTALS

A. Wood treatment data from chemical treatment manufacturer.
   1. Include chemical treatment manufacturer's instructions for handling, storing, installing, and finishing treated material:
      a. Preservative Treatment: Include certification by treatment plant stating type of solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.
      b. Waterborne Preservative Treatment: Include certification that moisture content of treated wood was reduced to levels specified prior to shipment to Project Site.
      c. Fire-Retardant Treatment: Include certification by treating plant that treated wood complies with specified requirements.
      d. Include warranty of chemical treatment manufacturer for each type of treatment.

1.05 DELIVERY, STORAGE AND HANDLING

A. Delivery and Storage: Keep materials under cover and dry.
   1. Protect against exposure to weather and contact with damp or wet surfaces.
   2. Stack material above ground level on uniformly spaced supports to prevent deformation.
   3. For material pressure treated with waterborne chemicals, place spacers between each bundle for air circulation.

PART 2 – PRODUCTS

2.01 LUMBER, GENERAL

A. Standards: Furnish lumber manufactured to comply with PS 20 - American Softwood Lumber Standard, with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review.

B. Grade Stamps: Furnish lumber with each piece factory marked with grade stamp of inspection agency that indicates grading agency, grade, species, moisture content at time of surfacing, and mill.

C. Sizes: Provide nominal sizes indicated, complying with PS 20, except where actual sizes are specifically noted as being required.

D. Surfacing: Dressed lumber, S4S, unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED CONDITIONS

A. Species: Wood species listed by PS 20.

B. Moisture Content: S-DRY, KD 19 or MC 19 (19 percent maximum moisture content).

C. Grade: No.2, or standard grade.
D. Grade: No.3, or utility grade.

2.03 PLYWOOD

A. Each panel shall be identified with appropriate trademark of APA, and shall meet requirements of latest edition of Voluntary Product Standard PS 1, Voluntary Product Standard PS 2

B. Panel size, thickness, and grade shall be at least equal to that indicated.

C. Electrical/Telephone Backing Panels:
   1. Fire-retardant plywood with exterior glue containing no urea formaldehyde.
   2. Grade: C-D Plugged, Exposure 1,
   3. Thickness: As indicated, but not less than 1/2 inch nominal.

2.04 FASTENERS

A. Nails, Wire, Brads and Staples: ASTM F 1667.

B. Bolts: ASTM A 307, Grade A; with ASTM A 563 hex nuts and flat washers.

2.05 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

   1. Mark each treated item with AWPB or SPIB Quality Mark Requirements.
   2. Coat surfaces cut after treatment to comply with AWPA M4.

B. Above-Ground Wood Treatment: Pressure treat with waterborne preservatives to minimum retention of 0.25 pcf.
   1. Kiln-dry interior dimension lumber after treatment to 19 percent maximum moisture content.
   2. Treat wood items indicated and in following circumstances:
      a. In contact with roofing, flashing, or waterproofing.
      b. In contact with masonry or concrete.
      c. Within 18 inches of grade.

C. Ground Contact Wood Treatment: Pressure treat with waterborne preservatives to minimum retention of 0.40 pcf.

2.06 FIRE-RETARDANT TREATMENT BY PRESSURE PROCESS

A. Identify treated wood with appropriate classification marking of Underwriters Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

B. Dimension Lumber: Comply with AWPA C20.
   1. Treatment Types:
      a. Interior Type A for protected wood.
      b. Exterior Type for wood exposed to weather.

C. Plywood: Comply with AWPA C27.
   1. Treatment Types: Interior Type A for protected wood

D. Inspect each piece after drying and discard damaged or defective pieces.
PART 3 – EXECUTION

3.01 INSTALLATION – GENERAL

A. Discard units of material with defects that impair quality of miscellaneous carpentry and in sizes that would require excessive number or poor arrangement of joints.

B. Cut and fit miscellaneous carpentry accurately.
   1. Install members plumb and true to line and level.

C. Coat cut edges of preservative-treated wood to comply with AWPA M4.

D. Securely fasten miscellaneous carpentry as indicated and according to applicable codes and recognized standards.

E. Countersink nail heads on exposed carpentry work and fill holes.

F. Use fasteners of appropriate type and length.
   1. Predrill members when necessary to avoid splitting wood.

3.02 WOOD GROUNDS, NAILERS, AND BLOCKING

A. Install where shown and where required for screeding or attachment of other work.
   1. Cut and shape to required size.
   2. Coordinate location with other work involved.

B. Attach to substrates as required to support applied loading.
   1. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 WOOD FURRING

A. Install at spacing indicated, with closure strips at edges and openings.
   1. Shim with wood as required for tolerance of finished Work.

B. Furring to Receive Plywood Paneling: Install 1 by 3 inch furring at 2 feet on center, horizontally and vertically.
   1. Select furring strips for freedom from knots that could cause bent-over nails and damage to paneling.

C. Furring to Receive Gypsum Board: Install 1 by 2 inch furring at 16 inches on center, vertically.

END OF SECTION 06 1053
SECTION 06 8300

FIBERGLASS REINFORCED PANELS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fiberglass reinforced wall paneling, including accessory trim.

B. Related Sections:
   1. Section 07 9200: Joint Sealants
   2. Section 09 2900: Gypsum Board

1.02 REFERENCES

A. ASTM International (ASTM):

B. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1168 – Adhesive and Sealant Applications

1.03 QUALITY ASSURANCE

A. Field Constructed Mockup:
   1. Install at Project Site in space where Work is scheduled to be installed, acceptable to Architect.
   2. Construct mockup consisting of one complete panel to show workmanship and joint treatment.
   3. Notify Architect one week in advance of date and time when mockup will be installed.
   5. Retain and maintain mockup during construction in undisturbed condition as standard for judging completed unit of Work.
      a. Accepted mockups in undisturbed condition at time of Substantial Completion may become part of completed unit of Work.

1.04 SUBMITTALS

A. Samples: Minimum of four, 4 inch square panel samples and 6 inch long trim samples in color and texture specified and scheduled.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Subject to compliance with specified requirements, provide products of following, or approved equal:
   1. Fire-X Glasbord; Crane Composites
   2. Marlite; Class A; Marlite
2.02 MATERIALS

A. Panels: Fiberglass reinforced resin panel, 0.090 inch thick
   1. USDA and FDA accepted for food processing and storage
   2. Textured surface one side

B. Fire-Test-Response Characteristics: ASTM E 84, Class A.

C. Adhesive: Non-flammable water resistant type recommended by panel manufacturer.
   1. Use adhesive materials complying with SCAQMD Rule 1168 for VOC content.

D. Trim: Panel manufacturer's standard vinyl moldings in color matching panel
   1. Inside corner with cove
   2. J-cap for exposed edges
   3. H-shaped divider, where required.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Adhesive apply panels and trim following manufacturer's instructions.
   1. Provide trim at edges and joints.
   2. No horizontal joints.
   3. Seal joints with silicone sealant.
      a. Comply with requirements of Section 07 9200.

B. Clean panels and trim after installation using cleaning materials and methods recommended by panel manufacturer.

END OF SECTION 09 8300
SECTION 07 0150
ROOFING REPAIRS

PART 1 – GENERAL

1.01 SUMMARY

A. Section includes following:
   1. Patching and repairs to existing bituminous membrane roofing where required.
   2. Work includes roofing, composition flashing, stripping and roofing accessories integrally related to roofing.
   3. Coordination with other trades that directly influence roof system application to provide watertight installation of roof flashing.
   4. Verification of condition of substrate, curbs, penetrations, flashing, equipment supports.
      a. Notify Architect of discrepancies in Scope of Work as indicated prior to submission of bid.

B. Related Sections:
   1. Section 01 7329: Cutting and Patching
   2. Section 02 4119: Selective Demolition
   3. Section 06 1053: Miscellaneous Carpentry; wood blocking and nailers.
   4. Section 07 9200: Joint Sealants

C. Related Requirements:
   1. Refer to Division 23 Sections for exhaust vent installation requirements related to roofing and flashing.

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM D41 – Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
   2. ASTM D1079 – Standard Terminology Relating to Roofing and Waterproofing

C. Sheet Metal & Air Conditioning Contractors’ National Association (SMACNA):

D. UL, LLC (UL):

E. National Roofing Contractors Association (NRCA):
   1. NRCA Roofing and Waterproofing Manual
2. NRCA Quality Control Guidelines for Application of Built-Up Roofing.

F. South Coast Air Quality Management District (SCAQMD):
   1. SCAQMD Rule 1168 – Adhesive and Sealant Applications

G. Asphalt Roofing Manufacturers Association (ARMA):
   1. NRCA/ARMA – Quality Control Recommendations for Polymer Modified Bitumen Roofing.

1.03 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Provide primary products, including each type of roofing sheet, bitumen, composition flashing produced by single manufacturer, which has produced that type product successfully for not less than fifteen years.
   1. Provide secondary products only as recommended by manufacturer of primary products for use with roofing system.

B. Installer Qualifications: Single installer shall perform Work of this section and shall be firm with not less than 5 years of successful experience in installation of built-up roofing systems similar to those required for this Project, and is acceptable to, licensed, or certified by manufacturer of primary roofing materials.

C. Fire Test Response Characteristics: Provide roofing materials with fire test response characteristics indicated as determined by testing identical products per test method below by UL or FMG.
   1. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
   2. Exterior Fire-Test Exposure: ASTM E 108, Class A.
      a. For application and roof slopes indicated

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include following:
      a. Manufacturer’s technical product information, installation instructions, and recommendations for roofing product required.
      b. Data substantiating that materials comply with specified requirements.

B. Installer Certificates: Signed by roofing system manufacturer certifying that installer is approved, authorized, or licensed by manufacturer to install roofing system.

C. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of meeting performance requirements.

D. Qualification Data: For installer and manufacturer.

E. Maintenance Data: For roofing system to include in maintenance manuals.

F. Warranties: Special warranties as specified.

G. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.
1.05 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA Manual for definition of terms related to roofing work specified.

1.06 DESCRIPTION OF WORK

A. Modifications and Repairs:
   1. Patching of areas of roofing where indicated on Drawings.

1.07 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project Site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storage.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources
   1. Store in dry location.

D. Handle and store roofing materials and place equipment in manner to avoid permanent deflection of deck.

1.09 WARRANTY

A. Special Project Warranty: Roofing installer's warranty, covering Work of this section, including components of roofing system such as roofing membrane, base flashing, roof insulation, and fasteners, for following warranty period:
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers offering products that may be incorporated into Work include following:
2.02 BASE-SHEET MATERIALS

A. Base Sheet: ASTM D 4601, Type II, SBS modified asphalt impregnated and coated sheet, with polyester/glass-fiber/polyester trilaminate-reinforcing mat, dusted with fine mineral surfacing on both sides.

2.03 BASE FLASHING SHEET MATERIALS

A. Backer Sheet: Exceeds ASTM D 4601, SBS-modified coated base sheet, with glass-fiber reinforcing mat:

B. Flashing Sheet: ASTM D 6163, Type I, Grade S polyester-reinforced, SBS-modified asphalt sheet; smooth surfaced; suitable for application method specified.

C. Elastomeric Mastic: single component roof elastomer asbestos free.

2.04 AUXILIARY ROOFING MEMBRANE MATERIALS

A. Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing membrane.

B. Asphalt Primer: ASTM D 41.

C. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.

D. Mastic Sealant: Polyisobutylene, plain or modified bitumen, no hardening, no migrating, no skinning, and nondrying.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roofing membrane components to substrate, tested by manufacturer for required pullout strength, and acceptable to roofing system manufacturer.

F. Metal Flashing Sheet: Metal flashing sheet is specified in Section 07 6200.

G. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

2.05 PERFORMANCE REQUIREMENTS

A. Provide installed roofing membrane and base flashings that remain watertight; do not permit passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with existing roofing materials and with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with installer present, for compliance with following requirements and other conditions affecting performance of roofing system:
   1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
   2. Verify that wood cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3.02 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions; remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction.
   1. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Roofing applicators using open flame tools or equipment must be trained and registered in the MRCA CERTA (Certified Roofing Torch Applicator) program.
   1. Each applicator shall carry his card as evidence of proper training.

D. Roofing applicators must follow safety guidelines and procedures written in "Torch Applied/Do's and Don'ts", published and distributed by Asphalt Roof Manufacturers Association (ARMA).
   1. Do not begin application until roofing applicators fully understand these safety guidelines and procedures.

E. Identify potential combustible materials in and around the roof system construction area.
   1. Remove or protect these materials prior to beginning roofing material installation using open flames or heated air.

F. Do not heat weld near or into vents, openings, cracks, corners, voids or other penetrations or near equipment.
   1. Instruct Owner to shut off fans and cover openings.

G. Do not leave lighted torches unattended.

H. Maintain at least one twenty pound ABC type dry chemical fire extinguisher immediately available on roof for each roofing employee on Project.

I. Conduct fire watch for at least one hour after last torch has been turned off.
   1. Conducting fire watch must be primary activity of person conducting fire watch.
   2. The fire watch must be active process, with employee walking and monitoring entire area, which was installed that day.
   3. Contact local fire department immediately for smolders and fires detected before attempting to extinguish.
3.03 ROOFING MEMBRANE REPAIR – GENERAL

A. Install roofing repairs, restoration and flashing details according to roofing system manufacturer's written instructions and applicable recommendations of ARMA/NRCA's "Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing."

B. Start installation of repairs to membrane in presence of roofing system manufacturer's technical personnel.

C. Where roof slope is 1/4 per foot or less, installation of one ply of polyester shall be incorporated into restorative system per manufacturer’s written instructions.

D. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

E. Coordinate installing roofing system/flashing so components of system or building are not exposed or subjected to precipitation or left uncovered at end of workday or when rain is forecast.
   1. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.
   2. Remove and discard temporary seals before beginning work on adjoining roofing.

F. Substrate Joint Penetrations: Prevent roofing asphalt from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.04 ROOF MEMBRANE REPAIRS

A. At roof exhaust vents, plumbing vents, pipe supports, and other penetrations:
   1. Trowel flashing adhesive to roof surface 15 inches wide, 1/16 inch thick.
      a. Extend flashing adhesive up plumbing vent 2 inches.
      b. Seal base into new roofing with reinforcing membrane embedded between alternate courses of specified mastic.

3.05 FLASHING SHEET INSTALLATION

A. Install base flashing over sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer's written instructions.

B. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.

3.06 BITUMINOUS MEMBRANE INSTALLATION

A. Install bituminous roofing membrane according to roofing manufacturer's written instructions.
   1. Extend roofing membrane sheets over existing roof, installing as follows:
      a. Mechanically fasten modified composite base sheet of decking.
      b. Heat weld SBS Base plies over modified composite base sheet.
      c. Heat weld SBS modified bitumen smooth membrane over base ply; additional ply may be needed.
d. Membrane patch must match thickness of existing membrane.

3.07 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period.
   1. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 0150
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Sheet metal flashings and trim not part of roofing work.
   2. Miscellaneous metal flashing and counter flashing as required
   3. Drip flashings.
   4. Other sheet metal items, not necessarily specified, but required to prevent penetration of water into building.

B. Related Sections:
   1. Section 06 1053: Miscellaneous Carpentry
   2. Section 07 9200: Joint Sealants.
   3. Section 09 9100: Painting; field painting of sheet metal flashing.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

B. Sheet Metal & Air Conditioning Contractors’ National Association (SMACNA):
   1. SMACNA Architectural Sheet Metal Manual

1.03 QUALITY ASSURANCE

A. Standards: Comply with material and installation requirements of Sheet Metal and Air Conditioning Contractor's National Association (SMACNA), Architectural Sheet Metal Manual, unless otherwise indicated or specified.

B. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, or fastener disengagement.

1.04 SUBMITTALS

A. Shop Drawings: Showing fabrication, jointing and securing of metal to form flashings and trim.
   1. Show expansion joint details and waterproof connections to adjoining work and at obstructions and penetrations.
   2. Identify material, thickness, weight and finish for each item and location in Project.
3. Details for forming sheet metal flashing and trim, including profiles, shapes, seams and dimensions.
4. Details for fastening, joining, supporting and anchoring sheet metal flashing and trim, including fasteners, clips, cleats and attachments to adjoining work.

B. Samples for Verification: For each type of sheet metal flashing and trim indicated with factory-applied color finishes, minimum of four 6 inch square samples.

1.05 SEQUENCING

A. Coordinate metal flashing and trim work with adjacent work, including installation of roofing, waterproofing, drains, piping, blocking, nailers, reglets, framing at openings, curbs and parapets.

B. Coordinate installation with interfacing and adjoining construction to provide leakproof, secure, and non-corrosive installation.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged.
   1. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store and install sheet metal flashing materials and fabrications in manner to prevent bending, warping, twisting and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering.
   1. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

PART 2 – PRODUCTS

2.01 SHEET METAL MATERIALS

A. Galvanized Steel: ASTM A 653 with G90 coating, structural quality, minimum 0.0299 inch thickness (22 U.S. standard gage) unless otherwise indicated
   1. Field painted.
      a. Color: As selected by Architect

2.02 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Fasteners: Same metal as flashing/sheet metal or other corrosion resistant metal as recommended by sheet manufacturer.
   1. Match finish of exposed heads with material being fastened.

B. Metal Accessories: Provide sheet metal clips, straps, anchoring devices and similar accessory unit as required for installation of Work, matching or compatible with material being installed, corrosion resistant, size and gage required for performance.

C. Epoxy Seam Sealer: 2-part noncorrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior nonmoving joints including riveted joints.
D. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

E. Isolation Between Dissimilar Materials:
   1. Provide single-component, inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities; VOC compliant.
   2. Elasto-Deck BT as manufactured by Pacific Polymers, div. ITW Polymers Sealants North America, or equivalent product acceptable to Architect.

F. Roofing Cement: ASTM D 4586, asphaltic, compatible with roofing materials.

G. Elastomeric Sealant: Generic type recommended by manufacturer of metal and fabricator of components being sealed; comply with ASTM C 920 and requirements of Section 07 9200.


2.03 FABRICATION

A. Sheet metal work is not necessarily individually described.
   1. Descriptions included are major items or those requiring detail.
   2. Provide other work, as indicated or necessary.

B. Shop fabricate Work to greatest extent possible.
   1. Comply with details shown, applicable requirements of SMACNA Manual, and other recognized industry practices.
   2. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of Work.
   3. Form work to fit substrates.
   4. Comply with material manufacturer instructions and recommendations for forming material.
   5. Form exposed sheet metal work without excessive oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

C. Seams: Fabricate non-moving seams in sheet metal with flat-lock seams.
   1. For metal other than aluminum, tin edges to be seamed, form seams, and solder.

D. Expansion Provisions: Where lapped or bayonet-type expansion provisions in Work cannot be used, or would not be sufficiently water/weatherproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

E. Separations: Provide for separation of metal from non-compatible metal or corrosive substrates by coating concealed surfaces at locations of contact, with isolation coating or other permanent separation as recommended by manufacturer/fabricator.

F. Counterflashing, copings and edgings in stock patterns, conforming substantially to details and design as shown, are acceptable.
   1. Manufacturers: Fry Reglet Corp., Lane-Aire Corp., or approved equal.
3.01 GENERAL

A. Inspect substrates and conditions under which metal flashing and trim will be installed.
   1. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Except as otherwise indicated, comply with manufacturer’s installation instructions and recommendations, and with SMACNA Manual.
   1. Anchor units of work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated.
   2. Install Work with laps, joints and seams which will be permanently watertight and weatherproof.
   3. Use fasteners, solder, welding rods, protective coatings, separators, sealants and other miscellaneous items as required to complete sheet metal flashing and trim system.
   4. Anchor sheet metal flashings in accordance with Factory Mutual Loss Prevention Data Sheet 1-49.
   5. Drive exposed fasteners through steel/neoprene washers.

C. Bed flanges of Work in thick coat of isolation coating where required for waterproof performance.

D. Metal Protections: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with isolation coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

E. Install exposed sheet metal flashing and trim without excessive oil canning, buckling and tool marks.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
   1. Space movement joints at maximum of 10 feet with no joints allowed within 24 inches of corner or intersection.
   2. 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 1 inch deep, filled with elastomeric sealant concealed within joints.

G. Seal joints with elastomeric or butyl sealant as required for watertight construction.

3.02 ROOFING WORK

A. General: Install sheet metal work and accessories under direct supervision, and to complete satisfaction of roofing installer.
   1. Install Work watertight and weatherproof throughout.
   2. Provide for expansion and contraction, free from undue stress in any part of completed Work using lap-type expansion joints bedded in flashing compound.
B. For embedment of metal flashing flanges in roofing or composition flashing or stripping, extend flanges for minimum of 4 inch embedment.

C. Pipe and Conduit Penetrations of Roofing:
   1. Flash with zinc flashing.
   2. Flanges stripped in by roofer.
   3. At short vent pipes, flash per SMACNA, Figure 4-158, with top of flashing turned down 2 inches inside vent pipe.
   4. At pipes extending above roof too far to completely cover with zinc, extend zinc flashing up pipe minimum 8 inches and counterflash with storm collar with draw band per SMACNA, Figure 4-15C.  
      a. Seal top of storm collar against pipe with elastomeric sealant.

3.03 CLEANING

A. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.

END OF SECTION 07 6200
SECTION 07 9200

JOINT SEALANTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Joint sealants required to seal exterior and interior joints to make buildings weather and water tight.

B. Related Sections:
   1. Section 09 2900: Gypsum Board; acoustic sealant.
   2. Section 09 9100: Painting; paintable caulk.

1.02 REFERENCES

A. ASTM International (ASTM):

B. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1168 – Adhesive and Sealant Applications

1.03 QUALITY ASSURANCE

A. Use only qualified workers thoroughly skilled and specially trained in techniques of installing sealant, who can acceptably demonstrate to Architect their ability to fill joints solidly and neatly.

B. Compatibility Tests: Prior to start of sealant work, sealant manufacturer and sealant installer shall conduct compatibility tests of sealant for each different sealing condition and substrate for entire Project.

C. Pre-Installation Meeting:
   1. Arrange meeting when sealant contractor and sealant manufacturers have been selected, but prior to award of contracts.
   2. Schedule meeting with Owner, Architect and General Contractor; arrange for attendance by sealant contractor and sealant manufacturers’ technical representatives
   3. Meeting to include, but not limited to, following:
      a. Review of preliminary test results on sealants.
      b. Details of sealant joints.
      c. Sealant application instruction and training of installers.
      d. Scheduling and procedures for periodic field inspections by sealant manufacturers’ technical representatives.
   4. Record minutes of meeting and promptly distribute copies of minutes to attendees and other interested parties as may be necessary.
   5. Record issues resolved during meeting.
      a. Include copies of Drawings and application instructions used in meeting.
b. Record changes on Drawings and application instructions made at meeting.

D. Pre-installation Field Testing:
   1. Field test adhesion of joint sealant material to Project substrates.
   2. Verify joint sealant materials will satisfactorily adhere to substrates.
   3. Arrange field testing with manufacturer or designated representative.
   4. Notify parties minimum 7 days prior to field testing.

1.04 SUBMITTALS

A. Product Data: Manufacturer’s specifications, performance test data, recommendations, handling, installation and curing instructions for each type of sealant, and associated miscellaneous material required.

B. Samples: Minimum of four, 3 inch long samples of each color required (except black) for each type of sealant exposed to view.

C. Compatibility Tests: Results of each compatibility test to Architect and Contractor for approval prior to start of sealant Work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project Site in original unopened containers bearing manufacturer's name, product designation, date of manufacturer and mixing instructions.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Compatibility: Provide joint sealants, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside building envelope that comply with following limits for VOC content complying with SCAQMD Rule 1168.: 
   1. Architectural Sealants: Not more than 250 g/L.
   2. Sealant Primers for Nonporous Substrates: Not more than 250 g/L.
   3. Sealant Primers for Porous Substrates: Not more than 775 g/L

C. Colors: Provide color of exposed joint sealant indicated or as selected by Architect from manufacturer’s standard colors.

D. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those referenced for Type, Grade, and Class,
E. **Sealant No. 1**: Silicone rubber based, one-part, low-modulus, non-acid curing sealant; Type S, Grade NS, Class 50.
   1. Provide one of following product:
      a. Dow Corning 790; Dow Corning Corp.
      b. General Electric Silpruf SCS 2000; Momentive Performance Products
      c. Pecora 890; Pecora Corp.
   2. Apply Sealant No.1 to following exterior joints:
      a. Joints between metal frame and poured-in-place concrete, or masonry
      b. Joints between poured-in-place concrete sections
      c. Vertical expansion and control joints
      d. Horizontal ceiling/soffit joints
      e. Sills, jambs, and heads of window frames, door frames, louvers and similar openings, and where metal, wood, or other materials abut or join concrete, or each other
      f. Other exterior joints
   3. Apply Sealant No. 1 to following interior joints:
      a. Hidden metal to metal storefront joints expected to undergo minimal movement
      b. Under door thresholds
      c. Vertical expansion and control joints
      d. Horizontal ceiling/soffit joints

F. **Sealant No.2**: Two-Component Polyurethane Sealant; Type M, Grade P, Class 25.
   1. Provide one of following products:
      b. MasterSeal SL 2 Sealant: BASF Corporation, Construction Systems
      c. Urexpan NR-200: Pecora, Corp.
   2. Apply Sealant No.2 to following exterior joints:
      a. Horizontal control and expansion joints in concrete slabs and concrete paving
   3. Apply Sealant No.2 to following interior joints:
      a. Horizontal control and expansion joints in concrete slabs and tile flooring.

G. **Sealant No.3**: Mildew-Resistant One-Part Silicone Rubber Sealant; Type S, Grade NS, Class 25; compounded specifically for mildew resistance and recommended by manufacturer for interior joints in wet areas; passing ANSI A 136.1 test for mold growth.
   1. Provide one of following products:
      a. Dow Corning 786: Dow Corning Corp.
      b. General Electric Silicone Sanitary 1702 Sealant: Momentive Performance Products
      c. Pecora 898; Pecora Corp.
   2. Apply Sealant No. 3 to following interior joints:
      a. Joints between plumbing fixtures and other elements

2.02 MISCELLANEOUS MATERIALS

A. Joint Primer: Provide type of joint primer recommended by sealant manufacturer for joint surfaces to be primed or sealed.

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

C. Sealant Backer Rod: Compressible rod stock of polyethylene foam, polyethylene jacketed polyurethane foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended by sealant manufacturer for compatibility with sealant.
   1. Provide products by one of following, or approved equal.
      a. Denver Foam by Backer Rod Mfg. Inc.
      b. Sof-Rod by Nomaco, Inc.
      c. Sealtight Kool-Rod by W.R. Meadows, Inc.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine joints, with installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint sealant performance.
   1. Correct improper conditions.

3.02 JOINT PREPARATION

A. Clean joint surfaces immediately before installation of sealant or calking compound.
   1. Remove dirt, insecure coatings, moisture and other substances which could interfere with bond of sealant or calking compound.
   2. Etch concrete and masonry joint surfaces as recommended by sealant manufacturer.
   3. Roughen vitreous and glazed joint surfaces as recommended by sealant manufacturer.

B. Prime joint surfaces where recommended by sealant manufacturer.
   1. Do not allow primer to spill or migrate onto adjoining surfaces.

3.03 INSTALLATION OF SEALANT

A. Comply with manufacturer’s printed instructions except where more stringent requirements are shown or specified, and except where manufacturer’s technical representative directs otherwise.

B. Set joint filler units at proper depth or position in joint to coordinate with other work, including installation of bond breakers, backer rods and sealant.
   1. Do not leave voids or gaps between ends of joint filler units.

C. Install sealant backer rod for sealants, except where recommended to be omitted by sealant manufacturer for application indicated.

D. Install bond breaker tape where required by manufacturer’s recommendations to ensure that elastomeric sealants will perform properly.

E. Employ only proven installation techniques, which will ensure that sealants are deposited in uniform, continuous ribbons without gaps or air pockets, with complete wetting of joint bond surfaces equally on opposite sides.
1. Except as otherwise indicated, fill sealant rabbet to slightly concave surface, slightly below adjoining surfaces.
2. Where horizontal joints are between a horizontal surface and vertical surface, fill joint to form slight cove, so that joint will not trap moisture and dirt.
3. Tool joints to form smooth, uniform beads with slightly concave surfaces, with finished joints straight, uniform, smooth and neatly finished.
4. Remove excess sealant from adjacent surfaces of joint, leaving work in neat, clean condition.
5. Do not use tooling agents unless recommended by sealant manufacturer.

F. Seal joints before adjacent surfaces are waterproofed or painted.

G. Install sealant to depths recommended by sealant manufacturer but within following general limitations, measured at center (thin) section of bead:
1. For sidewalks, pavements and similar joints sealed with elastomeric sealant and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but neither more than 1/2 inch deep nor less than 3/8 inch deep.
2. For normal moving joints sealed with elastomeric sealant but not subject to traffic, fill joints to depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.
3. For joints sealed with non-elastomeric sealants, fill joints to depth in range of 75 percent to 125 percent of joint width.

H. Where irregular surface or sensitive joint border exists apply masking tape at edge of joint to insure joint neatness and protection.
1. Remove masking tape after sealant is applied.

I. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces.
1. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage.

J. Recess exposed edges of exposed joint fillers slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.

K. Bond ends of joint filler together with adhesive or join by other means as recommended by manufacturer to ensure continuous watertight performance.

3.04 PROTECTION AND CLEANING

A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of substantial completion.
1. When, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealant immediately and reseal joints with new materials to produce joint sealant installations with repaired areas indistinguishable from original work.
B. Clean off excess sealant or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 07 9200
SECTION 09 2216
NON-STRUCTURAL METAL FRAMING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Non-load bearing steel stud partition system
   2. Metal furring

B. Related Sections:
   1. Section 06 1053: Miscellaneous Carpentry; wood blocking for wall-hung items.
   2. Section 09 2216: Non-Structural Metal Framing
   3. Section 09 2900: Gypsum Board.

1.02 REFERENCES

A. California Code of Regulations (CCR), Title 24:
      a. Chapter 22A – Steel
         1) Section 2211A – Cold-Formed Steel Light-Frame Construction
      b. Chapter 25 – Gypsum Board and Plaster

B. ASTM International (ASTM):
   1. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
   3. ASTM A 1003 – Standard Specification for Steel Sheet, Carbon, Metallic- And Nonmetallic-Coated for Cold-Formed Framing Members
   4. ASTM C 11 – Standard Terminology Relating to Gypsum and Related Building Materials and Systems
   6. ASTM C 1002 – Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
   7. ASTM C 1513 – Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections.

C. American Iron and Steel Institute (AISI):
   1. AISI S100 – North American Specification for the Design of Cold-Formed Steel Structural Members.

D. American Welding Society (AWS):
   1. AWS D1.1 – Structural Welding Code Steel
   2. AWS D1.3 – Structural Welding Code Sheet Steel
1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Current member of SFIA Code Compliance Certification Program.

B. Installer Qualifications: Minimum 2 years experience in performing work of this Section on similar projects.

C. Welder Certification:
   1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

D. Coordinate with related Work to provide blocking for items mounted on finished surfaces and to provide allowances for pipes and other items inside partitions and walls.

E. Tolerances: Install walls and partitions on straight lines, plumb, free of twists or other defects, and contacting 10 foot straightedge for its entire length at any location within 1/8 inch tolerance.
   1. Install horizontal framing level within tolerance of 1/8 inch in 12 feet in any direction.

1.04 SUBMITTALS

A. Product Data: Manufacturer's product literature and data sheets and installation recommendations for specified products.

B. Certificates:
   1. Manufacturer's certification that materials meet or exceed specification requirements.
   2. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.

1.05 DEFINITIONS

A. Gypsum Board Construction Terminology: Refer to ASTM C11 for definition of terms for gypsum board construction not defined in this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be delivered in their original unopened packages and stored inside in dry, ventilated space, protected from damage.
   1. Do not store material directly on grade.
   2. Provide adequate support to prevent bowing of material prior to installation.

1.07 REGULATORY REQUIREMENTS

A. Comply with following as minimum requirements:
   1. CBC, Chapter 22A, Section 2211A
2. AWS D1.1 and D1.3.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, provide cold-formed metal framing by current members of one of following:
   1. Steel Framing Industry Association (SFIA):
      a. Comply with ICC ES Legacy Report No. ESR-2620 or ESR-3016
   2. Steel Stud Manufacturers Association (SSMA):
      a. Comply with ICC ES Legacy Report No. ESR-3064P.

2.02 MATERIALS

A. Galvanized Steel:
   1. Meet or exceed requirements of ASTM A 653 or ASTM A 1003.
   2. Coating Class: Galvanized G40 coating minimum, complying with ASTM C645.

B. Stud Punch-outs: Minimum 10 inches between end of bearing point and near edge of web punch-out and 24 inches on center thereafter.

2.03 COMPONENTS

A. Metal Studs:
   1. Cold-Formed Nonstructural Studs: Galvanized, minimum G40 coating steel C studs complying with ASTM A645 and following:
      b. Web Depth: 4 inches
      c. Return Lip: 1/4 inch
      d. Minimum Material Thickness: 20 gage (0.0375 inch), unless otherwise noted.
      e. Minimum Yield Strength: 33 ksi.

B. Nonstructural Track:
   1. Cold-Formed galvanized steel runner tracks, minimum G40 coating complying with ASTM C645 and following:
      b. Web depth: 4 inches.
      c. Minimum Material Thickness: 16 gage (0.0625 inch), unless otherwise noted.
      d. Minimum Yield Strength: 33ksi.

C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2 inch deep flanges.
   1. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above
      a. In thickness indicated for studs and in width to accommodate depth of studs.
      b. Subject to compliance with specified requirements, provide one of following:
         1) Slotted Track by Metal-Lite, Inc., conforming to OSHPD Report No. R-0370
         2) Slotted Track by Sliptrack Systems, conforming to ICC ES Report No. ESR-1042
2.04 METAL FURRING

A. General—Provide vertical furring complying with following requirements:
   2. Channel Furring and Braces: Cold-rolled steel, minimum 0.0598 inch thick base (uncoated) metal and 3/4 inch deep by 7/16 inch wide flanges, 300 lb/1000 feet.
   3. Hat Channels: Hat-shape screwable furring channels, 7/8 inch deep, formed from zinc-coated (galvanized) steel sheet, minimum 0.0179 inch thick, Grade 33.
   4. Furring Brackets: Serrated-arm type, minimum 0.0329 inch thick base (uncoated) metal, adjustable from 1/4 to 2-1/4 inch wall clearance for channel furring.

2.05 ANCHORS, CLIPS AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36 (ASTM A 36M), zinc coated by hot-dip process according to ASTM A 123.

B. Welding Electrodes: Comply with AWS standards.

G. Framing Accessories: Provide standard related accessories including floor and ceiling tracks, clips, web stiffeners, anchors, and similar items, of same manufacture as each type of stud specified, and as required for complete installation.

D. Fasteners: Wafer-head screws, self-drilling type for 20 gage (0.0375 inch) metal and heavier.
   1. ASTM C 954 self-drilling, self-tapping screws, Type S-12 pan head, 1/2 inch long unless noted otherwise.

E. Fasteners for Floor Track:
   1. Wood Screws: Flat head carbon steel, corrosion-resistant coated, complying with ASME B 18.6.1

F. Galvanizing Repair Paint: Organic zinc rich paint complying with SSPC-Paint 20, with dry film containing not less than 94 percent zinc dust by weight.
   1. Provide for touch-up of galvanized surfaces.

G. Steel Backing: Provide minimum 6 inch wide by 16 gage sections of studs or stud track, welded or fastened to web of studs, except as otherwise indicated.
   1. Finish same as for studs.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Inspect supporting substrates and structures for proper conditions for installation and performance of cold-formed structural framing.

B. Verify that attachment surfaces are plumb, level, and in proper alignment to accept cold-formed structural framing.
3.02 FABRICATION

A. Cut framing components square for attachment to perpendicular members or as required for angular fit against abutting members.

B. Plumb, align and securely attach studs to flanges of both upper and lower runners,
   1. Interior, Non-Load Bearing Walls: Studs need not be attached to upper or lower runners, except where otherwise indicated.

C. Splices in members other than top and bottom runner track are not permitted, unless noted otherwise.

D. Provide temporary bracing where required, until erection is complete.

3.03 INSTALLATION

A. General – Walls and Partitions, unless noted otherwise:
   1. Fasten floor runners for interior partitions to concrete slab with required power driven fasteners.
      a. Spacing of fasteners not to exceed 24 inches on center, unless noted otherwise.
      b. Fasten ceiling runners to structure as indicated.
   2. Space studs not over 16 inch on center unless indicated otherwise.
      a. Studs shall be located approximately 2 inches from door frame jambs, abutting partitions and partition corners.
   3. Furnish and install manufacturer's standard floor track.
      a. Fasten track to floor by means of No. 8 wood screws at 16 inches on center.
      b. Embed screws 7/8 inch into existing plywood flooring.
   4. Studs shall be seated squarely in track with stud web and flanges abutting track web, plumbed and securely fastened with sheet metal screws, to flanges or web of both floor and top tracks.
      a. Provide 4 screws per stud.
   5. Where there is no suspended ceiling, tops of stud walls shall be provided with track and shoes and be fastened as indicated.
      a. Welding of studs to ceiling track will not be permitted except where bearing studs are installed.
   6. Bridging or horizontal bracing of 1-1/2 inch, cold-rolled channels shall be fastened in manner to prevent stud rotation.
      a. Bridging shall be furnished as follows:
         1) Walls up to 10 feet high: One row at mid-height
         2) Walls exceeding 10 feet high: Bridging or bracing rows spaced not to exceed 5 feet on center.

3.04 CLEANING

A. Remove and legally dispose of debris, rubbish, and waste material off Project Site.
   1. Comply with requirements of Section 01 7419.
3.03 PROTECTION

   A. Protect Work until Substantial Completion.

END OF SECTION 09 2216
SECTION 09 2900
GYPSUM BOARD

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Gypsum board systems and accessory components for gypsum board partitions, and soffits.
      a. Gypsum Board attached to metal framing.
      b. Gypsum board finishing.

B. Related Sections:
   1. Section 09 2216: Non-Structural Metal Framing
   2. Section 09 9100: Painting; priming and finish painting of gypsum board.

1.02 REFERENCES


B. ASTM International (ASTM):
   4. ASTM C 1002 – Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

C. Gypsum Association (GA):
   1. GA 214 – Recommended Levels of Gypsum Board Finish.
   2. GA-216 – Application and Finishing of Gypsum Panel Products.

1.03 QUALITY ASSURANCE

A. Qualifications:
   1. Installer: Minimum 5 years experience in installing and finishing gypsum board.

B. Finishes: Gypsum wallboard finish shall conform to requirements of GA 214, and as specified herein.
   1. Levels used on Project are described as follows:
NOTE:

(1) At completion of specified taping and finishing, apply one coat of high solids primer as specified in Section 09 9100 for non-textured surfaces scheduled to receive finish paint per Section 09 9100.

C. Preinstallation Conference: Conduct conference at Project Site.
   1. Review methods and procedures for Work related to:
      a. Gypsum Board partition assemblies.

1.04 SUBMITTALS

A. Product Data: Manufacturer's catalog data for each product proposed for use.

B. Shop Drawings:
   1. Details of proprietary or non-proprietary components when included.

1.05 SYSTEM DESCRIPTION

A. Design Requirements: Provide systems capable of deflection as required by 2013 CBC and authorities having jurisdiction.

1.06 PROJECT CONDITIONS

A. Install gypsum panels following environmental conditions, room temperatures and ventilation specified.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, factory sealed packages, containers or bundles bearing brand name and name of manufacturer.

B. Materials shall be kept dry.
   1. Gypsum board shall be neatly stacked flat; avoid sagging and damage to edges, ends and surfaces.

C. Use means necessary to protect gypsum board systems before, during and after installation.

1.08 REGULATORY REQUIREMENTS

A. Comply with following standards (Code):

<table>
<thead>
<tr>
<th>Level</th>
<th>Joints</th>
<th>Interior Angles</th>
<th>Accessories</th>
<th>Fasteners</th>
<th>Surface</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>After taping, cover with 2 separate coats of joint compound</td>
<td>After taping, cover with one separate coat of joint compound</td>
<td>Covered by 3 separate coats of joint compound</td>
<td>Covered by 3 separate coats of joint compound</td>
<td>Smooth and free of tool marks and ridges (1)</td>
</tr>
</tbody>
</table>
1. CBC, Chapter 25:
   a. Table 2506.2 – Gypsum Board Materials and Accessories.
   b. Table 2508.1 – Installation of Gypsum Construction.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with specified requirements, provide products by one following, or approved equal:
   1. Georgia-Pacific Gypsum, LLC.

2.02 GYPSUM BOARD PRODUCTS

A. Gypsum Board: ASTM C 1396.
   1. Moisture and Mold Resistant Gypsum Panels:
      a. Width: 48 inches.
      b. Thickness: 5/8 inch.
      c. Edges: Tapered.
      d. Type X (UL Type SCX).
      e. Fire Resistance: Class A as defined in CBC Section 803.1
         1) When tested in accordance with ASTM E 84:
            a) Flame Spread Index: 15
            b) Smoke Developed Index: 0
      f. Average Water Absorption, ASTM C 473: Not greater than 5 percent by weight after two-hour immersion.

2.03 TRIM ACCESSORIES

A. Accessories for Interior Installation: Paper faced metal trim and corner bead fabricated from minimum 26 gage galvanized steel
   1. Trim units shall be of size and type to fit gypsum board construction and shall include corner beads, edge trim, control joints, and other shapes indicated and required.complying with ASTM C 1047 and requirements indicated below:
   2. Material: Steel sheet zinc coated by hot-dip process or rolled zinc.
   3. Shapes indicated below by reference to Figure 1 designations in ASTM C 1047:
      a. Corner bead on outside corners, unless otherwise indicated.
      b. LC-bead with both face and back flanges; face flange formed to receive joint compound.
         1) Use LC-beads for edge trim, unless otherwise indicated.
      c. L-bead with face flange only; face flange formed to receive joint compound.
         1) Use L-bead where indicated.
      d. U-bead with face and back flanges; face flange formed to be left without application of joint compound.
         1) Use U-bead where indicated.
      e. One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
      f. Crimp-on type trim is not allowed.
2.04 MISCELLANEOUS MATERIALS

A. Fastenings:
   1. ASTM C 1002 self-drilling, self-tapping bugle-head drywall screws:
      a. Type S, 1-5/8 inches long bugle head for steel framing (for single-layer panels).
      b. Screws shall be given corrosion-resistant treatment.

B. Metal Trim: ASTM C 1047, Paper-Face metal trim and corner bead fabricated from minimum 26 gage galvanized steel.
   1. Trim units shall be of size and type to fit gypsum board construction and shall include corner beads, casings, edge trim and other shapes indicated and required.
      a. USG, Beadex, National Gypsum Company, or approved equal.
      c. Crimp-on type trim is not allowed.

C. Finishing Materials:
   1. High solids primer as specified in Section 09 9100.

2.05 PERFORMANCE

A. Air Pressure Loads: 5 psf, unless indicated otherwise, based on project requirements.

B. Deflection Limit: L/240, unless indicated otherwise, based on project requirements.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Metal Framing: Refer to Section 09 2216.

B. Metal Trim:
   1. Provide following:
      a. Corner beads at outside corners and angles
      b. Metal casing where gypsum board terminates at uncased openings
      c. Metal edge trim where board edges abut horizontal and vertical surfaces of other construction.
   2. Install trim in accordance with manufacturer’s directions and secure to framing with joint compound.
      a. Apply trim in longest practical pieces.

C. Gypsum Board:
   1. Install gypsum board in conformance with ASTM C840 and the manufacturer’s recommendations.
   2. Gypsum board shall be cut by scoring and breaking or by sawing, working from face side.
      a. Where board meets projecting surfaces it shall be scribed and neatly cut.
      b. Unless conditions require otherwise, board shall be applied first to ceilings, then to walls.
      c. End joints shall occur over support.
d. Use panels of maximum practical length so that minimum number of end joints occur.

3. End joints shall be staggered and joints on opposite sides of partition shall be arranged to occur on different studs.
   a. Joint layout at openings shall be made so that no end joints will align with edges of openings.

4. Except where specified otherwise, fasteners shall be spaced not less than 3/8 inch from edges and ends of gypsum board.
   a. Do not stagger fasteners at adjoining edges and ends.

5. Install gypsum board vertically or horizontally.
   a. Attach board with drywall screws spaced not to exceed 8 inches on center around perimeter of boards and 12 inches on center on intermediate studs.
   b. Space screws at 8 inches on centers along top and bottom runners.
   c. Screws shall be driven to provide screwhead penetration just below gypsum board surface without breaking surface layer.
   d. Where electrical outlet and switch boxes are indicated, provide adjustable attachment brackets between studs.
   e. Nails are not permitted.

6. Install gypsum board to heights indicated, with long dimension at right angles to steel framing members.
   a. Attach with specified drywall screws spaced 6 inch to 7 inch on centers across board.
   b. Screws shall be not less than 1/2 inch from side joints and 3/8 inch from butt end joints.
   c. Abutting end joints shall occur over steel framing and end joints of boards shall be staggered.

3.02 TOLERANCES

A. Install gypsum board flat within 1/8 inch in 10 feet.

3.03 JOINT TREATMENT AND FINISHING

A. Conform to GA 214 and following.

B. Each Level: Apply tape bedding compound, tape, and finishing cement on joints in board as required for specified levels of finish.

C. Required Levels of Finish :
   1. Level 4: Exposed, painted gypsum board in classrooms, utility rooms, and corridors.
      a. Apply joint cement and finishing cement over screw heads.
         1) Treat inside corners with joint cement, tape, and finishing cement.
         2) Treat outside corners with corner beads and finishing cement.
      b. Provide metal casing beads at edges of gypsum board which abut ceiling, wall, or column finish, and elsewhere as required.
         1) Make exposed joints, trims and attachments non-apparent following application of paint or other finishes.
         2) Where joints and fasteners are apparent, correct defects as directed.
      c. Seal raw edges of plumbing openings and boards that have been cut to fit with brushed on sealing compound.
2. When entire installation is completed and prior to installation of finish materials by other trades, correct and repair broken, dented, scratched or damaged gypsum board.
3. Apply one coat of high solids primer over entire surface.

3.04 CLEANING

A. Upon completion, repair damage caused by Work and remove debris, surplus materials and tools of Work from Project Site.
   1. Promptly remove any residual joint compound from adjacent surfaces.
   2. Comply with requirements of Section 01 7419
   3. Leave installation clean and ready for finishing.

3.05 REPAIR OF DAMAGED GYPSUM BOARD

A. Prior to Substantial Completion, inspect exposed gypsum board surfaces and perform following repairs as necessary:
   1. Reset protruding or loose fasteners.
   2. For each screw in fractured area or protruding screw, replace with specified screws placed in undamaged area near loose screw.
   3. Remove loose gypsum, paper, and joint compound.
   4. Refinish surfaces to match existing texture.
   5. Repaint entire wall plane to match existing in texture nad color.

3.06 PROTECTION

A. Provide final protection and maintain conditions, in manner acceptable to installer, that ensure gypsum board assemblies are without damage or deterioration at time of acceptance by Owner.

END OF SECTION 09 2900
SECTION 09 5100

ACOUSTICAL CEILINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Lay-in acoustical ceiling systems and related suspension systems

B. Related Sections:
   1. Section 06 1053:  Miscellaneous Carpentry.
   2. Section 09 2216:  Non-Structural Metal Framing
   3. Section 09 2900:  Gypsum Board.

C. Related Requirements:
   1. Refer to respective Sections of Divisions 23 and 26 for related ceiling work.

1.02 REFERENCES

   1. Chapter 8 – Interior Finishes. Section 808 – Acoustical Ceiling Systems

B. ASTM International (ASTM):
   4. ASTM C 636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels

C. UL, LLC (UL):

D. The Ceilings & Interior Systems Construction Association (CISCA):
   2. Acoustical Ceilings Use & Practice.
1.03 QUALITY ASSURANCE

A. Qualifications of Installer: Minimum 5 years experience in installing acoustical ceiling systems of types specified.

B. Design Criteria:
   1. Deflection of finished surface to 1/360 of span or less.
   2. 1/8 inch maximum permissible variation from true plane measured from 10-foot straightedge placed on surface of finished acoustical fiber units.

1.04 SUBMITTALS

A. Samples:
   1. Lay-in panels, 6 inch x 6-inch minimum size.
   2. Lay-in Systems: Sample of assembly system to indicate all typical members, connections, splices, wall angle, and colors.

B. Shop Drawings:
   1. Indicate complete plan layouts and installation details.
   2. Indicate related Work of other sections that is installed in, attached to, or penetrates ceiling areas, such as air distribution and electrical devices.

C. Product Data:
   1. Suspension System for Lay-in Ceiling: Printed data for all suspension system components, including load tests.

D. Maintenance Materials: Provide extra panels equal to 1 percent of area of each typical module size of acoustical panel, but not less than 8 of each size, style and color.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original sealed packages.

B. Storage: Store materials in building area where they will be installed, in original package. Keep clean and free from damage due to water or deteriorating elements.

C. Handle in manner to prevent damage during storage and installation.

1.06 PROJECT CONDITIONS

A. Environmental Requirements: Maintain temperature in space at 55 degrees F or above for 24 hours before, during and after installation of materials.

B. Scheduling:
   1. Before concealing Work of other sections, verify required tests and inspections have been completed.
   2. Coordinate with related Work of other sections. Coordinate location and symmetrical placement of air distribution devices, electrical devices, and penetrations with related Work section.

1.07 REGULATORY REQUIREMENTS

A. Comply with requirements of CBC, Chapter 8, Section 808 and UL 723.
1.08 WARRANTY

A. Provide manufacturer's written 10 year material warranty.

B. Provide installer’s written 2 year labor warranty.

PART 2 – PRODUCTS

2.01 ACOUSTIC CEILING PANEL TYPE 1 (ACP-1)

A. Acoustical Ceiling Panel: ASTM E 1264, Type III, Form 2, Pattern C E
   2. Fire Resistance: UL Class A when tested per ASTM E 84.
      a. Flame Spread Index: 25 or less
      b. Smoke Developed Index: 50 or less
   3. NRC: 0.55
   4. CAC: 35
   5. Light Reflectance: 0.85
   7. Edge: Square
   8. Mold and Mildew Resistance: Panels and faces shall be treated with BioBlock coating biocide paint additive to inherently inhibit mold and mildew.

B. Suspension System for ACP-1: Exposed direct hung.
   1. Main runner and cross tee, conforming to Heavy Duty Classification of ASTM C 635, of cold rolled steel double-web construction, 15/16 inch face, with white factory applied paint finish.
   2. Product and Manufacturer: Prelude XL, by Armstrong World Industries, or approved equal by USG Interiors, Inc., Ceilings Division.

2.02 ACCESSORIES

A. Hanger Wires: Galvanized carbon steel, ASTM A 641, soft temper, prestretched, yield-stress load of at least 3 times design load, but not less than 12 gage.

B. Edge Moldings: Manufacturer's standard channel molding for edges and penetrations of ceiling, with single flange of molding exposed.
   1. Finish: Baked enamel.
      a. Color to match main runner.

C. Brace Attachment Clip: Manufacturers' standards to fit system furnished for acoustical panels, as indicated.

D. Vertical Compression Strut: USG Donn Compression Post, or approved equal, or as indicated.
   1. Provide types and designs complying with requirements of authorities having jurisdiction and seismic requirements.
E. Hanger Wire: Minimum 12 gage or larger as indicated or required.
   1. Minimum 9 gage for pendant fixtures.
   2. Galvanized carbon steel per ASTM A 641, soft tempered, prestretched.

2.03 SOURCE QUALITY CONTROL

A. Single-Source Responsibility for Ceiling Units and Suspension Systems:
   1. Obtain each type of acoustical ceiling panel and suspension system from single
      source with resources to provide products of consistent quality in appearance and
      physical properties without delaying Work.

2.04 PERFORMANCE

A. Fire Performance Characteristics:
   1. Provide acoustical ceiling components that are identical to those tested for
      specified fire performance characteristics, according to ASTM test method
      indicated, by UL, or other testing and inspecting agency acceptable to authorities
      having jurisdiction.
      a. Identify acoustical ceiling components with appropriate marking of applicable
         testing and inspecting agency.

B. Fire Test Response Characteristics:
   1. Provide acoustical panel ceilings that comply with following requirements:
      a. Surface-burning characteristics of acoustical panels comply with ASTM E
         1264 for Class A materials as determined by testing identical products in
         accordance with ASTM E 84.

PART 3 – EXECUTION

3.01 PREPARATION

A. Furnish layouts for inserts, clips, or other supports and struts required to be installed
   as Work of other trades that depend upon support by suspended ceiling system.

B. Coordinate related Work to ensure completion prior to installation of clips or fasteners.

C. Lay-In Ceiling Systems:
   1. Compare layouts with construction conditions.
   2. Space ceiling panels symmetrically about centerlines of room or space.
      a. start with panel as required to avoid narrow panels at finish edges unless
         indicated otherwise.

3.02 INSTALLATION OF SUSPENSION SYSTEMS

A. General:
   1. Provide complete system with joints neatly and tightly joined and securely
      fastened.
      a. Install suspension members so they are square, in true, flat, level plane and
         securely interlocked with one another.
      b. Remove and replace dented, bent, or kinked members.
   2. Suspend ceiling hangers from building’s structural members and as follows:
a. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

3. Attachment of Wires:
   a. Fasten wires with tight turns:
      1) Make turns in 1-1/2 inch maximum distance.

B. Hanger Wires – General:
   1. Secure hanger wires to ceiling suspension members and to supports above with minimum of three tight turns.
      a. Connect hangers directly either to structures or to inserts, screw eyes, or other devices that:
         1) Are secure
         2) Are appropriate for substrate
         3) Will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   2. Splay hangers only where required to miss obstructions.
   3. Maintain wires 6 inches minimum clear of non-braced ducts, pipes, and other items.
   4. Install wire within 6 inches of ends of main runners and cross-tees at ceiling perimeters.
   5. Where obstructions prevent direct suspension, provide trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
      b. Minimum 1-1/2 inch cold-rolled channels back to back may be installed for spans up to 6 feet max.
   6. Wire to be straight, without extraneous kinks or bends, and tolerate 200 pound pull without stretching or shifting suspension clip.

C. Bracing Wires to Resist Seismic Forces:
   1. System for Bracing Ceilings:
      a. Lay-In Ceiling Systems: Install one four-wire set of sway-bracing wires and vertical compression strut for each 144 square feet maximum of ceiling area.
         1) Locate wire-sets and struts at 12 feet maximum on center.
         2) At ceiling perimeters, locate wire-sets within 6 feet of walls.
      2. Install four-wire sets and struts within 2 inches of cross-runner intersection with main runner.
         a. Space wires 90 degrees from each other.
      3. Do not install sway bracing wires at angle greater than 45 degrees with ceiling plane.
      4. Make wires tight, without causing ceiling to lift.
      5. Secure bracing wires to ceiling suspension members and to supports with minimum of four tight turns.
         a. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs.
         b. Fasten bracing wires into concrete with cast-in-place or post installed anchors.
      6. Fasten compression struts in accordance with CBC requirements.
7. Provide additional wires, 12 gage minimum, necessary to properly support suspension at electrical devices, air distribution devices, vertical soffits, and other concentrated loads.

D. Suspension:
1. Fasten suspension members to 2 adjacent walls and minimum 1/2 inch clear of other walls.
2. Interconnect suspension members not fastened to walls to prevent spreading near their free end, with horizontal metal strut or 7445 stabilizer bar or 16 gage taut tie wire.
3. Provide additional tees or sub-tees to frame openings for lights, air distribution devices, electrical devices, and other items penetrating through ceiling, which do not have integral flange to support and conceal cut edges of acoustic panels.
   a. Provide cross-bracing necessary to securely support surface mounted fixtures or other items.

E. Edge Moldings and Trim:
1. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

B. Suspension System for 24 inch x 48 inch, Lay-in Acoustical Ceilings:
1. Main Runners: Install main runners 48 inches apart with 12 gage hanger wires spaced 48 inches on center maximum along runners, and within 6 inches of ends.
2. Install wall moldings.
4. Sub-Tees: Install at edges of penetrations.

3.03 INSTALLATION OF ACOUSTICAL PANELS

A. Install acoustical panel ceilings into suspension system.
1. Comply with ASTM C 636, referenced publications, and manufacturer's written instructions.
2. Neatly cut partial panels and fit to suspension system and around penetrations and obstructions.
3. Duplicate edges at partial panels and cut to be straight.
4. Repaint cut tiles to match color or as directed by manufacturer for Mylar facing at visually exposed conditions, or as required by Architect.

B. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings.
1. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
2. Arrange directionally patterned acoustical panels as follows:
   a. Install panels with pattern running in one direction parallel to long axis of space.
3. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

C. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings.
1. Space as recommended by panel manufacturer's written instructions, unless otherwise indicated or required.
3.04 AIR DISTRIBUTION DEVICES

A. Refer to and coordinate with Division 23 Sections.

B. Install air distribution grilles and other devices into suspension system. Install 4 taut wires, each 12-gage minimum, to each device within 3 inches of device corners, to support their weight independent of suspension system.

3.05 LIGHT FIXTURES

A. Refer to and coordinate with Division 26 Sections.

B. Fixtures Weighing Less Than 56 Pounds:
   1. Install fixtures into suspension systems and fasten earthquake clips to suspension members.
   2. Install minimum 2 slack safety wires, each 12 gage minimum, to each fixture at diagonally opposite corners, to support their weight independent of system.

C. Fixtures Weighing More Than 56 Pounds:
   1. Install fixtures into suspension system and fasten earthquake clips to suspension system members.
   2. Install not less than 4 taut 12 gage wires capable of supporting four times fixture load.

3.06 CLEANING

A. General: After installation of acoustical material has been completed, clean all surfaces of material, removing any dirt or discolorations.

B. Acoustical Panels: Touch up minor abraded spots and cut edges with same paint as used for factory applied finish of lay-in panels.

3.07 CLEAN UP

A. Remove and legally dispose rubbish, debris and waste materials off Project Site.
   1. Comply with requirements of Section 01 7419.

3.08 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 09 5100
SECTION 09 6516
RESILIENT SHEET FLOORING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Labor, materials and other services necessary to complete resilient sheet flooring, slip resistant sheet vinyl safety flooring systems and accessories Work.

1.02 REFERENCES


B. ASTM International (ASTM):

C. Resilient Floor Covering Institute (RFCI):
   1. RFCI Standard Slab Moisture Test Method (Calcium Chloride Method) as supplementary test method to ASTM F2170.

D. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1168 – Adhesive and Sealant Applications

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Installer experienced in performing Work of this section who has specialized in installation of work similar to that required for this Project.
   1. Training: Installer who has attended manufacturer’s flooring installation training clinic.

B. Pre-installation Meeting: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer’s installation instructions, manufacturer’s warranty requirements, and installer qualifications.
1.04 SUBMITTALS

A. Product Data: Submit manufacturer’s current printed product literature, specifications, installation instructions, and field reports in accordance with Section 01 3300.

B. Shop Drawings: Submit shop drawings to indicate materials, details, and accessories in accordance with Section 01 3300, including but limited to the following:
   1. Cut diagram indicating seam locations and roll direction.
      a. Use mitered seam layouts for corners when changing directions 180 degrees (e.g. when running material down corridors which bisect at right angle), unless approved otherwise.

C. Samples:
   1. Minimum of four of each of following:
      a. 12 inch x 12 inch sample pieces of sheet material,
      b. 12 inch gulley edge, cap strip, joint cover strip, and cove former in accordance with Section 01 3300.

D. Closeout Submittals:
   1. Operation and maintenance data for installed products in accordance with Section 01 7700.
   2. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

1.05 PROJECT CONDITIONS

A. Temperature Requirements: When storage temperature is below 65 degrees F, or floor temperature is below 50 degrees F, sheet flooring product must be moved to warmer place and allowed to reach this temperature before unrolling or installation.
   1. Refer to flooring manufacturer’s current Installation instructions.

B. Maintain air temperature and structural base temperature at flooring installation area between 68 degrees F and 80 degrees F for 48 hours before, during, and 24 hours after installation.

C. Waste Management and Disposal: Comply with requirements of Section 01 7419.

1.06 DELIVERY, STORAGE, AND HANDLING

A Ordering: Comply with manufacturer’s ordering instructions and lead time requirements to avoid construction delays.

B Deliver, store, and handle resilient flooring materials in accordance with 01 6000.

C Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.

D Store materials protected from exposure to harmful weather conditions, at temperature and humidity conditions recommended by manufacturer.
E. Store rolls in dry location.
   1. Stand rolls on end.
   2. Protect and secure rolls from falling.

1.07 REGULATORY REQUIREMENTS

A. Provide slip resistant sheet vinyl safety flooring in compliance with following:
   1. CBC, Chapter 11B.

1.08 WARRANTY

A. Provide manufacturer’s warranty period for period of 12 years commencing on date of Substantial Completion.

PART 2 – PRODUCTS

2.01 RESILIENT SHEET FLOORING

A. Product and Manufacturer:
   1. Homogeneous Vinyl Sheet Floor Covering by Johnsonite, Inc., Chagrin Falls, OH.

B. Acceptable Material:
   1. iQ OPTIMA complying with ASTM F 1913 and following physical properties:
      a. Slip Resistance (ASTM D 2047): Dry - 0.92 / Wet - 0.88
      b. Thickness: 3 mm (0.12 inch)
      c. Roll/Sheet Width: 6 feet – 6 inches (2 m)
      d. Roll Length: 82 feet – 7 inches (25 m)
      e. Wear layer/Overall thickness: 0.080 inch (2.0 mm).
      f. Static Coefficient of Friction, ASTM D 2047: 6.0 or greater.
      g. Static Load Limit (ASTM F 970): 250 psi.
      h. Critical Radiant Flux (ASTM E 648): 0.45 watts/cm² or greater, Class I
      i. Smoke Density (ASTM E 662): Less than 450

C. Color: 860 Malt.

2.02 RESILIENT BASE

A. Rubber base: Conform to ASTM F 1861; Group 1, solid (homogeneous); Type TS, thermoset vulcanized rubber; 4-inch high unless otherwise indicated, integral colors as selected, non-shrinking, 1/8 inch thick, with matching molded corners and end stops.
   1. Acceptable Manufacturers:
      a. Johnsonite
      b. Burker Flooring
      c. Roppe
   2. Thickness: 1/8-inch minimum.
   3. Height: As indicated.
   4. Length: Provide in rolls. Pre-cut 4-foot strips are not acceptable.
   5. Style:
      b. Toe-less straight base at carpet.
B. Base Adhesive: Water based, low odor type formulated specially for use with rubber base, and manufactured or recommended by manufacturer of rubber base.

2.03 ACCESSORIES

A. Vinyl Welding Rod: Material acceptable to flooring manufacturer.

B. Cove Former: Material acceptable to flooring manufacturer.
   1. Sized to suit application:

C. Cap Strip: Material acceptable to flooring manufacturer.
   1. Sized to suit application
   2. Material: Vinyl

D. Subfloor Filler and Leveler:
   1. Where required, use only gray Portland cement-based, moisture tolerant underlayments, and patching compounds.
   2. Use for filling cracks, holes or leveling.
   3. White gypsum materials are not acceptable.

E. Metal edge strips:
   1. Aluminum extruded, smooth, mill finish stainless steel with lip to extend over flooring.

F. Adhesives:
   1. Flooring manufacturer’s standard 2 part polyurethane, comply with requirements of SCAQMD Rule 1168 for VOC content.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Comply with manufacturer’s product data, including product technical bulletins, product catalog, and installation instructions.

B. Site Verification of Conditions: Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer’s instructions.

3.02 PREPARATION

A. When patching, moisture tolerant patching compound must always be used.

3.03 INSTALLATION

A. Install resilient sheet flooring in accordance with manufacturer’s current installation instructions.

B. Seams shall be heat welded with manufacturer’s approved welding rod.
   1. Failure to install resilient sheet flooring in accordance with manufacturer’s recommended procedures will void manufacturer’s product warranty.
C. Coved Installation: Where resilient sheet flooring is coved up wall surfaces and other abutments, installation shall be in accordance with resilient sheet flooring manufacturer’s installation instructions.
   1. Install sheet flooring with integral cove base in toilet room spaces.

D. At standard wall finishes, use recommended vinyl cap strip to accommodate sheet vinyl to height as indicated
   1. Adhere with contact tape.

E. When coving up wall at juncture of vertical and horizontal surfaces, use Vinyl Cove Former.
   1. Install with contact tape.

F. Cove Base:
   1. Where required, install top set cove base, as specified in this Section, in accordance with manufacturer’s instructions.

3.04 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.
   1. Repair or replace damaged installed products.
   2. Clean installed products in accordance with manufacturer’s instructions prior to Owner’s acceptance.

B. Protection:
   1. Sweep or vacuum construction debris and dust first, then clean the flooring with manufacturer’s approved cleaning material, using an auto scrubber.

3.05 PROTECTION

A. Cover and protect finished installation from damage from other trades using suitable non-staining, temporary floor protection system, such as reusable textured plastic sheeting, without taping to surface of flooring.

END SECTION 09 6516
SECTION 09 6800

CARPET

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Carpet

B. Carpet installation accessories

1.02 RELATED SECTIONS

A. Section 09 6516: Resilient Sheet Flooring; rubber wall base and carpet edge guard

1.03 REFERENCES


B. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1168 – Adhesive and Sealant Applications.

1.04 SUBMITTALS

A. Product Data: Manufacturer's product data for each type of carpet material and installation accessory required.
   1. Include written data on physical characteristics, durability, resistance to fading, and flame resistance characteristics.

B. Samples for Verification Purposes: Showing full range of color, texture, and pattern variations expected.
   1. Prepare samples from same material to be used for Project.
   2. Minimum of four 24 by 24 inch samples of each type of carpet.

C. Accessories: Minimum of four 12 inch long sample of carpet edge guard.

D. Certification: Manufacturer's written certification that carpet has passed required flame spread tests and achieved specified flame spread rating.

E. Maintenance Data: Manufacturer's printed recommendations for care, cleaning and maintenance of carpeting in optimum conditions under anticipated traffic and use conditions.

F. Seam Diagram: Submit carpet layout and seaming drawings, clearly indicating carpet directions, locations and methods of joining seams, and locations and types of edge strips.
   1. Indicate columns, doorways, enclosing walls/partitions, built-in cabinets and locations where cut-outs are required in carpet.
   2. Revise seam diagrams as required.
3. Do not install carpet until written acceptance of seaming diagram has been received.

G. Reports:
1. Provide test results for concrete moisture vapor emission and pH testing in chart form listing test dates, start/stop times, start/stop weight, weight gain in grams, moisture vapor emission values, and pH levels
2. Provide test results for concrete in-situ relative humidity and pH testing in chart form listing test dates, time, depth of test well, in-situ temperature, relative humidity, and pH levels
3. List test locations on chart and show same on 8-1/2 by 11 inch site map
   a. Make such map available to testing agency
4. Deliver results to Owner, Architect, Construction Manager, and flooring contractor.

1.05 QUALITY ASSURANCE

A. Manufacturer's Representative: Obtain carpeting materials from only manufacturers who will, when requested, send qualified technical representative to Project Site, to advise installer of proper installation procedures.

B. Work is to be performed by competent mechanics directly employed by Contractor, and fully experienced in first class commercial installation of type required by these specifications.

C. Provide only carpet which has passed following tests:
   2. Critical Radiant Flux (Flame Spread): ASTM E 648 Class 1

D. Substitutions: Carpet submitted for approval as equal to specified carpet must be equal in every respect, including color selection.
   1. Include full range of carpet colors and manufacturer's written specification.

E. Pre-Installation Meeting:
   1. Schedule meeting with Owner, Architect and General Contractor; arrange for attendance by carpet installer and carpet manufacturers' technical representatives.
   2. Meeting to include, but not limited to, following:
      a. Review of calcium chloride and pH test results on floor slabs.
      b. Adhesive application instruction.
      c. Scheduling and procedures for periodic field inspections by carpet manufacturers' technical representatives.
   3. Record minutes of meeting and promptly distribute copies of minutes to attendees and other interested parties as may be necessary.
   4. Record issues resolved during meeting; include copies of Drawings and application instructions used in meeting; record changes on Drawings and application instructions made at meeting.
1.06 PROJECT CONDITIONS

A. Space Enclosure and Environmental Limitations: Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver carpet and accessories until notification is received that buildings or spaces are ready for installation of carpet.

B. Deliver carpeting materials in original mill protective wrapping with mill register numbers and tags attached.
   1. Store inside, in well ventilated area, protected from weather, moisture and soiling.
   2. Lay flat with continuous blocking off ground.
   3. Deliver tags to job inspector along with a sample of carpet cut from each bale.

1.08 REMNANTS

A. Leave usable carpet remnants with Owner.
   1. Tag each piece by size and prepare inventory of materials.
   2. Provide secure vandalproof storage until Owner accepts materials.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.
   1. Provide required overrun exclusive of carpet needed for proper installation, waste and usable scraps.
   2. Deliver and store at Owner's direction.
   3. Carpet: Before installation begins, furnish quantity of full size units equal to 5 percent of amount installed, but not less than 10 square yards.

1.10 WARRANTY

A. Provide special project warranty, signed by Contractor, installer and manufacturer (Carpet Mill), agreeing to repair or replace defective materials and workmanship of carpeting work during specified warranty periods following substantial completion; attach copies of product warranties.
   1. 25 year non-prorated limited warranty against excessive surface wear and static delamination, edge ravel, zipperning, and backing resiliency loss

B. Adhesive: Provide manufacturer's warranty for pressure sensitive adhesive to be free from manufacturing defects for period of one year from date of substantial completion.
PART 2 – PRODUCTS

2.01 CARPET

A. Carpet Data: Detailed requirements for each required type of carpet is specified in Article 3.06 at end of Section.
   1. Extent of each type of carpet is shown on Drawings and scheduled.
   2. Provide carpet complying with CBC Chapter 11B.

B. Carpet Color/Pattern Texture: Match Architect's samples or match specified manufacturer's stock carpet color, pattern and texture.

C. Dyeing: Yarn to be from same dye lot.

D. Environmental Requirements: Provide carpet that complies with testing and product requirements of Carpet and Rug Institute (CRI) Green Label Plus testing program.

2.02 ACCESSORIES

A. Carpet Edge Guard, Nonmetallic: Comply with requirements in Section 09 6516 and CBC Chapter 11B.

B. Trowelable Underlayment and Patching Compounds: Latex-modified, Portland cement based formulation
   1. Henry 547 Universal Underlayment with Henry 546 Feather Edge Additive, when required, by W.W. Henry Company, or approved equal as recommended by flooring manufacturer.

C. Adhesives:
   1. Carpet Adhesive: Water resistant, mildew resistant, nonstaining type adhesive as recommended by carpet manufacturer to suit products and subfloor conditions indicated, which complies with flammability requirements for installed carpet.
   2. VOC Content: Comply with requirements of SCAQMD Rule 1168.

D. Seaming Cement: Hot-melt seaming adhesive or similar product recommended by carpet manufacturer, for taping seams and buttering cut edges at backing to form secure seams and prevent pile loss at seams.

E. Miscellaneous Materials: Provide types of adhesives and other accessory items recommended by carpet manufacturer and installer for conditions of installation and use, without failure during life of carpet.

PART 3 - EXECUTION

3.01 EXAMINATION AND TESTING

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance.
1. Verify that substrates and conditions are satisfactory for carpet installation and comply with requirements specified.
2. Report to Architect, in writing, prevailing conditions that will adversely affect satisfactory execution of Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Starting Work constitutes acceptance of existing conditions.
   2. Correction of unsatisfactory and defective work subsequently encountered will be responsibility of Contractor at his expense.

3.02 PREPARATION – GENERAL

A. Clear away debris and scrape up cementitious deposits from concrete surfaces to receive carpet.

B. Comply with CRI 104, Section 6.2, "Site conditions; Floor Preparation", and carpet manufacturer's written installation instructions for preparing substrates indicated to receive carpet installation.

C. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

D. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents.
   1. Use mechanical methods recommended by carpet adhesive manufacturer.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet.
   1. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust.

F. Sequence carpeting with other work so as to minimize possibility of damage and soiling of carpet during remainder of construction period.

3.03 INSTALLATION – GENERAL

A. Install carpet in following manufacturer's instructions, including manufacturer's instructions and recommendations for seam locations and direction of carpet.
   1. Maintain uniformity of direction and lay of pile.

B. Provide cut-outs where required, and bind cut edges properly where not concealed by protective edge guards or overlapping flanges.

C. Extend carpet into following areas:
   1. Under open-bottomed and raised-bottoms obstructions, and under removable flanges of obstructions.
   2. Into closets and alcoves of rooms indicated to be carpeted, unless another floor finish is indicated for such spaces.
   3. Under movable furniture and equipment, unless otherwise indicated.
D. Install carpet edge guard at every location where edge of carpet is exposed to traffic, except where another device, such as expansion joint cover system or threshold, with integral carpet binder bar, is indicated
   1. Anchor edge guards to substrate.
   2. Comply with requirements in Section 09 6516 and CBC Chapter 11B.

E. Expansion Joints: Do not bridge building expansion joints with continuous carpeting, provide for movement.

F. Piecing: Use full sizes of carpet for applications where use of smaller size would cause an extra seam.
   1. Use of small pieces in areas where larger piece could be used is not permitted.

3.04 GLUED-DOWN INSTALLATION-DIRECT TO FLOOR

A. Floor Preparation: Allow concrete slabs to age minimum of 90 days and perform moisture test prior to starting Work.
   1. Surfaces to receive carpet shall be dry, free of grease, wax and foreign matter and thoroughly cleaned with commercial vacuum cleaner.
   2. Grind ridges and high spots smooth.
   3. Fill cracks 1/16 inch and wider with latex emulsion filler compatible with adhesive.

B. Fit sections of carpet into each space prior to application of adhesive.
   1. Trim edges and butter cuts with seaming cement.

C. Apply adhesive uniformly to substrate following manufacturer's instructions.
   1. Butt carpet edges tightly together to form seams without gaps.
   2. Roll lightly to eliminate air pockets and ensure uniform bond.
   3. Remove adhesive promptly from face of carpet.

3.05 CLEANING AND PROTECTION

A. Remove debris from installation, carefully sorting pieces to be saved from scraps to be disposed of.

B. Remove adhesive from carpet surface with manufacturer's recommended cleaning agent.
   1. Replace carpet which cannot be cleaned.

C. Vacuum carpet using commercial machine with face-beater element. Remove protruding face yarn.

D. Protect carpet during remainder of construction period, so that carpet will be in undamaged and unsoiled condition at time of acceptance.
   1. Use non-staining material for protective cover.

E. Maintenance Materials: Deliver specified overrun and usable scraps of carpet to Owner's designated storage space, properly packaged (paper wrapped) and identified.
   1. Usable scraps are defined to include roll ends of less than 9 feet in length, and pieces of more than 3 sq. ft. area and more than 8 inches wide.
   2. Dispose of smaller pieces as "construction waste" in accordance with requirements of Section 01 7419
3.06 CARPET DATA

A. Carpet Designation: CPT-1
   1. Manufacturer/Quality: Centiva by Tandus US, Inc, or approved equal.
   2. Style: Plexus Colour IV 02875
   3. Face Yarn: 100% Antron Legacy Nylon, with Ensure Soil Protection.
   4. Construction: Stratatec Patterned Loop
   5. Pattern: Texture.
   6. Dye Method: 50% Solution Dyed / 50% Yarn Dyed.
   7. Color: Earth 18563
   8. Gauge: 5/64inch
   9. Stitches: 11.0 per inch
  10. Average Pile Height: 0.187 inch
  11. Primary Backing: Non-woven synthetic fiber
  12. Secondary Backing: Powerbond RS Closed-Cell Vinyl Cushion
      a. Weight: 35.5 oz/yd2
      b. Density: 18.5 lbs/cu. ft.
      c. Thickness: 0.156 inch
      d. Total Weight (RS): 85.0 oz/yd2 ±5 percent
  13. Width: 6 feet (Roll)
  15. Flame Spread: Critical radiant flux to meet Class I, 0.45 watts/sq. cm. as tested by ASTM E 648 or NFPA 253.

END OF SECTION 09 6800
CARPET
09 6800 - 8
SECTION 09 9100
PAINTING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Surface preparation and field painting of following:
      a. Exposed interior items and surfaces.
      b. Surface preparation, priming, and finish coats specified in this Section are in
         addition to shop priming and surface treatment specified in other Sections.

B. Related Sections:
   1. Section 07 9200: Joint Sealants
   2. Section 09 2900: Gypsum Board

1.02 REFERENCES

A. South Coast Air Quality Management District (SCAQMD):
   1. SCAQMD Rule 1113 – Architectural Coatings
   2. SCAQMD Rule 1168 – Adhesive and Sealant Applications

1.03 QUALITY ASSURANCE

A. Approved Equal: Provide materials or products specified by trade name as specified.
   1. Interpret references to brand names as establishing standard of quality.
      a. Such interpretation is not to be construed as limiting competition.
   2. Presume brand names, where used in specifications, to be followed by words “or
      approved equal”.
   3. Such approval will be granted only as set forth in Contract Documents and with
      certification that materials are equal or superior to brand named in specifications
      in construction, efficiency, and utility.
      a. In making submittals for approval as equal, include manufacturer’s product
         data sheet for each product indicating composition and percent by weight.

1.04 SUBMITTALS

A. Product Data: For each paint system specified; include primers.
      a. Indicate each material and cross-reference specific coating, finish system,
         and application.
      b. Identify each material by catalog number and general classification.
      c. Include manufacturer’s name, product name and number; including primers,
         thinners, and coloring agents, together with manufacturers’ catalog data fully
         describing each material as to content, recommended installation, and
         preparation methods. Identify surfaces to receive various paint materials.
   2. Manufacturer’s Information: Provide manufacturer’s technical information,
      including label analysis and instructions for handling, storing, and applying each
      coating material proposed for use.
3. Certification by manufacturer that products supplied comply with local regulations controlling use of Volatile Organic Compounds (VOC).

B. Samples for Verification: After receipt of Architect’s Color Schedule, submit following for Architect’s review for color and texture only:
   1. Stepped Samples: Defining each separate coat, including primers.
      a. Use representative colors when preparing samples for review.
      b. Resubmit until required sheen, color, and texture are achieved.
   2. Provide list of materials and applications for each coat of each sample.
      a. Label each sample for location and application.
   3. Provide minimum of four 8-1/2 by 11 inch painted samples of each color and material, with texture to simulate actual conditions.
      a. On Metal – Provide minimum of four 4 by 8 inch samples for each type of finish and color, defining prime and finish coat.
      b. Do not proceed with painting work until color samples have been accepted.

C. Field Sample: When and as directed by Architect, apply one complete coating system for each color, gloss and texture required.
   1. When approved, sample panel areas will be deemed incorporated into Work and will serve as standards by which subsequent Work of this Section will be judged.

D. Provide list of solid volume factors for each type of material if so requested by Architect.

1.05 DEFINITIONS

A. “Paint” as used in this Section means coating systems materials, including primers, emulsions, enamels, stains, sealers, and other applied materials whether used as prime, intermediate, or finish coats.

1.06 SYSTEM DESCRIPTION

A. Paint exposed surfaces except where material is obviously intended and specifically noted as surface not to be painted:
   1. Where items or surfaces are not specifically mentioned, paint item or surface same as adjacent similar materials or surfaces whether or not schedules indicate colors.
      a. When system, color, or finish is not designated, Architect will select from standard colors and finishes available.
      b. Refer to Finish Schedules and notations on Drawings.
      c. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work (unless scheduled to receive high performance coating), conduit, and metal surfaces of mechanical and electrical equipment as indicated.

B. Work Not to be Painted: In general, following items will not require finishing unless specifically specified, scheduled, or indicated:
   1. Flexible conduit connections to equipment, miscellaneous nameplates, stamping, and instruction labels and manufacturer’s data.
   2. Do not paint moving parts of operating units, including, but not limited to:
      a. Mechanical and electrical parts, such as valves and damper operators, linkages, sensing devices, motor and fan shafts.
3. Do not paint code required labels, such as Underwriters’ Laboratories and Factory Mutual, or equipment identification, performance rating, name, and nomenclature plates.
4. Concealed Surfaces: Painting is not required on wall or ceiling surfaces in concealed and inaccessible areas such as pipe spaces and duct shafts, as applicable to Project.
5. Paint exposed piping, ductwork, equipment, and other such items as designated or required.
6. Finish Hardware, except prime coated items.

C. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for metal fabrications, hollow metal work and similar items.

1.07 PROJECT CONDITIONS

A. Apply primers and paints only when temperature of surfaces to be painted and surrounding air temperatures are within range permitted by paint manufacturer’s printed instructions.

B. Do not apply paint in rain, fog, mist or to damp or wet surfaces; or when relative humidity exceeds 85 percent, unless otherwise specified by paint manufacturer.

C. Do not apply paint, interior, or exterior, when temperature is below 50 degrees F or above 90 degrees F, or when dust conditions are unfavorable for application.

D. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature ranges specified by paint manufacturer during application and drying periods.

E. Painting Work by Other Trades: Examine Drawings and Specifications, including requirements specified in other sections for painting work by other trades.
   1. Notify Architect in writing of conflicts between Work of this Section and that of other trades and sections, and errors, omissions, or impractical requirements.
   2. Paint or finish surfaces that are left unfinished by requirements of their specification as Work of this Section.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project Site in original, new, and unopened packages and containers bearing manufacturer’s name and label, and following information:
   1. Name or title of material.
   2. Product Description (Generic Classification or Binder Type).
   3. Federal Specification number, if applicable.
   4. Manufacturer’s stock number and date of manufacture.
   5. Manufacturer’s name
   6. Contents by volume, for major pigment and vehicle constituents.
   7. Thinning instructions.
   8. Application instructions.
   9. Color name and number.
   10. VOC Content
   11. Concurrently provide local representative of approved paint products with copies of invoices of purchased materials.
B. Storage and Mixing of Materials: Store and mix paint materials in single suitable place in compliance with health and fire regulations.
   1. Open and mix ingredients on premises in presence of Project Inspector.
   2. Maintain such storage spaces clean and neat.
   3. Remove oily rags, waste, and like materials from building each night and take every precaution to avoid danger of fire.

1.09 REGULATORY REQUIREMENTS

A. Codes and Standards: Conform work and materials to regulations of State Fire Marshal, Safety Color Coding in conformance with OSHA, and local or State Ordinances having jurisdiction.
   1. Conform to most stringent requirements and authorities having jurisdiction.

B. Comply with applicable codes and regulations of governmental agencies having jurisdiction including those having jurisdiction over airborne emissions and industrial waste disposal.
   1. Where those requirements conflict with this Specification, comply with more stringent provisions.
   2. Regulatory changes may affect formulation, availability, or use of specified coatings.
      a. Confirm availability of coatings to be used prior to Project bid and before start of painting on Project.
   3. Comply with current applicable regulations of California Air Resources Board (CARB), South Coast Air Quality Management District (SCAQMD), and Environmental Protection Agency (EPA), as applicable.

1.10 MAINTENANCE STOCK

A. Upon completion of Work of this Section, deliver to owner, extra stock consisting of one gallon of each color, type, and gloss of finish (topcoat) paint used in Work.
   1. Tightly seal each container and clearly label contents and location where used.

PART 2 – PRODUCTS

2.01 MATERIAL QUALITY

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

B. Furnish products of only one paint manufacturer unless otherwise specified or approved.
   1. Provide primers, thinners, coloring agents, and catalysts for each painting system as approved for use by manufacturer of paint, except for materials furnished with shop prime coat by other trades.
   2. Use approved thinners only within recommended limits.

C. Factory mix paint materials to correct color, gloss, and consistency for installation to maximum extent feasible.
D. Do not use paints in Work which have been packaged longer than six months, except when such products are known to have long package stability when unopened and only when guaranteed by manufacturer.

2.02 MANUFACTURERS

A. Manufacturer’s catalog names and numbers are used to aid in establishing kind and quality of material required and are not used as indication of color desired.

   1. Equivalent opaque finish products manufactured by one of following will be acceptable, subject to conformance with specified requirements:
      a. Pittsburgh Paints, by PPG Architectural Coatings, div. of PPG Industries
      b. Sherwin-Williams Company
      c. Vista Paint Corporation

2.03 COLORS AND FINISHES

A. Surface treatments and finishes are shown on Drawings and indicated in Schedules on Drawings. Paint colors are shown on Architect’s Color Schedule.

B. Colors required or listed by Architect are not necessarily stock colors available in one particular manufacturer’s range.
   1. Non-availability of colors selected by Architect will be sufficient reason to disqualify manufacturer not capable of providing such colors.

C. Paint Coordination: Provide finish coats which are compatible with prime paints used.
   1. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates.
   2. Upon request from other subcontractors, furnish information on characteristic of specified finish materials, to ensure that compatible prime coats are used.
   3. Provide barrier coats over incompatible primers or remove and reprime as required.

2.04 PAINTABLE CAULK

A. Acrylic latex, one-part, non-sag, mildew resistant, non-bleeding and non-staining, acrylic emulsion component compound conforming to ASTM C 834, Type OP, Grade NS, formulated to be paintable.
   1. For use as interior caulk in nonworking joints only.
   2. Must be able to accommodate joint movement of not more than 5 percent in both extension and compression for total of 10 percent.
   3. Backup and Bond Breaker: Products recommended by caulking manufacturer.
   4. Provide one of following products:
      a. AC-20: Pecora Corporation.
      c. GE RCS20: Momentive Performance Materials.
   5. VOC compliant per SCAQMD Rule 1168.
PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint.
   1. Do not begin paint application until unsatisfactory conditions have been corrected and surfaces scheduled to receive paint are thoroughly dry.

B. Starting of painting will be construed as applicator’s acceptance of surfaces and conditions within particular area.

3.02 SURFACE PREPARATION

A. Clean and prepare surfaces to be painted following paint manufacturer's written instructions and as specified, for each particular substrate condition.

B. Clean surfaces to be painted before applying paint or surface treatments.
   1. Remove oil and grease prior to mechanical cleaning.
   2. Program cleaning and painting so contaminants from cleaning process will not fall onto wet, newly painted surfaces.
   3. Cover surfaces and equipment as necessary to prevent contaminants from cleaning process from falling onto equipment.

C. Clean floors and surfaces in room being painted of loose dirt and dust before painting is started.

D. Moisture Content: Measure moisture content of surfaces using electronic moisture meter.
   1. Do not apply finishes unless moisture content of surfaces are below maximum levels specified, or as otherwise recommended by manufacturer.

E. Remove hardware, hardware accessories, switch and receptacle plates, surface-mounted lighting fixtures, escutcheons and plates, surface-mounted equipment, free-standing equipment blocking access to painted surfaces, and other items as required prior to surface preparation and painting operations.
   1. Following completion of painting of each space or area, reinstall removed items.

F. Provide barrier coats over incompatible primers or remove and reprime.

G. Gypsum Board: Remove dust, loose particles or other matter that would prevent proper paint adhesion.
   1. Check to see that joints and screw heads have been properly covered with joint compound and sanded smooth and flush with adjacent surfaces.
   2. Before finishing untextured smooth gypsum board, use damp sponge along edge of joints where nap of paper has been raised by sanding.

H. Wood: Ensure that surfaces are clean and dry.
   1. Sandpaper wood (except saw-textured wood, if specified) smooth to provide even surface and then dust off and wipe clean.
   2. Touch up knots and pitch pockets with shellac on interior wood.
   3. After priming coat has been applied, thoroughly fill nail holes, irregularities and
cracks; use plastic wood filler for stained or natural finish and putty for painted work.

I. Ferrous Metals: Clean ungalvanized ferrous metal surfaces that have not been shop coated or are not otherwise specified to receive high performance coatings.
   1. Remove oil, grease, dirt, loose mill scale, and other foreign substances.
   2. Use solvent (SSPC SP1) or mechanical cleaning methods (SSPC SP2 and SP3) that comply with The Society for Protective Coatings (SSPC) recommendations.
   3. Where rust or scale is present, wire brush and sandpaper clean.
   4. Clean field welds and abraded portions of field welded and erected ferrous metal components.

J. Galvanized Surfaces: Clean galvanized surfaces with non-petroleum-based solvents (SSPC SP1) so surface is free of oil and surface contaminants.
   1. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
   2. Spot prime field connections, welds, soldered joints, and burned and abraded portions.
   3. Factory finished surfaces indicated to be repainted shall be sanded or etched to increase adherence of finish coats.

K. Paintable Caulk Installation:
   1. Comply with general sealant installation requirements in Section 09 9200.
   2. Use only for caulking of followings joints in dry areas:
      a. Perimeter caulking of interior door frames.
   3. Joint Design: Width of joint should be approximately 12 times anticipated movement and fall within range of 1/4 inch to 3/4 inch

3.03 EXISTING PAINTED SURFACES

A. Before painting or finishing over existing paint or finishes, paint small inconspicuous locations representing each condition to test for compatibility.
   1. Where problems are encountered, do not proceed without Architect's instructions.

B. Previously Painted Surfaces to Receive New Paint Coatings: Clean, prepare and repaint existing materials as indicated.
   1. Sand rough areas and feather edge chipped paint.
   2. Spackle and sand nail holes and like defects.
   3. Wash existing painted surfaces with strong solution of biodegradable detergent and rinse with clean water.
   4. Allow surfaces to dry thoroughly before paint is applied.
   5. Clean and dust surfaces thoroughly and spot prime bare, abraded or touched-up areas.

C. Do not apply water-base paints over existing oil-based painted surfaces unless surface has been "scuff-sanded" and properly primed with paint manufacturer's recommended primer.
   1. Test original surfaces to verify where oil-based paints were used.

D. Apply coatings conforming to respective schedules listed herein, except that pretreatments, sealers, fillers and prime coats need not be provided on surfaces where existing coatings are soundly adhered and in good condition.
3.04 MATERIAL PREPARATION

A. Mix and prepare painting materials in field following manufacturer's directions.

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

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

3.05 APPLICATION

A. Apply paint following manufacturer's directions.
   1. Use applicators and techniques best suited for substrate and type of material being applied.
   2. Mix to proper consistency.
   3. On brush-applied work brush out smooth leaving minimum of brush marks, with paint uniformly flowed on.

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

C. Apply paint to clean, dry, prepared surfaces only.
   1. Apply paint material evenly, smoothly flowed on without runs, sags, or holidays.

D. Provide finish coats compatible with primers used.

E. Minimum Coating Thickness: Apply each material at not less than manufacturer's recommended spreading rate, to provide a total dry film thickness of not less than 5.0 mils for entire coating system of prime and finish coats for 3 coat work.
   1. Provide total dry film thickness of not less than 3.5 mils for entire coating system of prime and finish coat for 2 coat work.

F. Number of coats and film thickness required is same regardless of application method.
   1. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
   2. Sand between applications where sanding is required to produce even smooth surface following manufacturer's directions.

G. Apply additional coats when undercoats, stains or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance.
   1. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive dry film thickness equivalent to that of flat surfaces.
   2. Number of coats specified herein are minimum to be applied.
      a. Apply additional coats in event full coverage is not obtained or required total thickness of paint does not comply with mil thickness recommended by paint manufacturer.
H. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces.

I. Included Work: Finish tops, bottoms, and edges of doors same as balance of door.
   1. Where walls are specified to be painted, include columns, arrises, reveals, soffits, returns, and like surfaces.

J. Priming: Where shop coats and touch-up painting are specified under other sections of Work, omit prime coat.

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

3.06 CLEANING AND PROTECTION

A. Cleanup: At end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from Project Site.
   1. Remove paint, varnish and brush marks from glazing material
   2. Upon completion of painting work, wash and polish glazing material both sides.
      a. Glazing material, which is damaged, shall be removed and replaced with new material.

B. Protection: Protect work of other trades, whether to be painted or not, against damage by painting.
   1. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

C. Protect floors and adjacent surfaces from paint smears, spatters and droppings.
   1. Use dropcloths to protect floors.
   2. Cover fixtures and mask off areas where required.

D. Provide “Wet Paint” signs and barricades to protect newly painted finishes.
   1. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

E. At completion of work of other trades, touch-up and restore damaged and defaced painted surfaces.

3.07 PAINT SYSTEM SCHEDULES – GENERAL

A. Provide following paint systems for substrate indicated.
   1. Products must meet or exceed current applicable regulations of agencies listed in Regulatory Requirements Article.

3.08 SCHEDULE OF EXTERIOR PAINT SYSTEMS

A. Paint System Type 3:
   1. Type and Gloss: Aliphatic Urethane; Semi-Gloss
   2. Use: Exterior ferrous metal sheet metal flashing and trim, except where otherwise specified.
      a. Primer: Surface Tolerant Epoxy, Devoe Bar-Rust 235V
      b. 2nd and 3rd Coats:: Aliphatic Urethane, Devoe Devthane 379H
3.09 SCHEDULE OF INTERIOR PAINT SYSTEMS

A. **Paint System Type 5:**
   1. **Type and Gloss:** Water-based Acrylic Urethane; Semi-Gloss
   2. **Use:** Interior ferrous metal surfaces indicated.
      a. **Primer:** ULTRA-GRIP Interior/Exterior Flat UGPR00-1
      b. 2\textsuperscript{nd} Coat: ULTRASHIELD DTM Semi-Gloss ULDM 50
      c. 3\textsuperscript{rd} Coat: ULTRASHIELD DTM Semi-Gloss ULDM 50B.

C. **Paint System Type 20:**
   1. **Type and Gloss:** Eggshell
   2. **Use:** Gypsum Board
      a. **Primer:** W600 Ecoshield Zero-VOC Latex Primer
      b. 2\textsuperscript{nd} and 3\textsuperscript{rd} Coats: W602 Ecoshield Low Sheen or SPMA40 Suprema Low Sheen

3.09 SPECIAL TREATMENT OF SPECIFIC SURFACES

A. **Mechanical and Electrical Work:**
   1. **Paint exposed surfaces of,** but not limited to following:
      a. Interior plumbing, HVAC, and electrical, factory-primed equipment, apparatus, pipes and fittings, vents, ducts, miscellaneous supports and hangers, electrical conduit, fittings, pull boxes, outlet boxes, and other unfinished surfaces of mechanical and electrical Work, miscellaneous factory-primed metal cabinets, panels, and access doors and panels.

B. **Paint System Type 30 (FB):**
   1. **Type and Gloss:** Flat Black
   2. **Use:**
      a. Ducts visible through grilles and registers
      b. Reveals at ceiling edges
   3. **Pretreatment:** UGPROO Ultra-Grip Premium
   4. **1st Coat:** W601 Ecoshield Flat or SPMA 10 Suprema Interior Flat

END OF SECTION 09 9100
SECTION 10 1100

VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Wall mounted markerboards of size indicated.

B. Related Sections:
   1. Section 06 1053: Miscellaneous Carpentry.
   2. Section 09 9100: Painting.

1.02 REFERENCES

A. ASTM International (ASTM):
   3. ASTM F793 – Standard Classification of Wall Covering by Use Characteristics.

B. Federal Specifications (FS):
   1. FS CCC-W-408 - Wall Covering, Vinyl-Coated

1.03 QUALITY ASSURANCE

A. Manufacturer shall have been regularly engaged in business of manufacturing markerboards for at least 5 years.

B. Comply with requirements and recommendations of applicable portions of Porcelain Enamel Institute – PEI 2.

1.04 SUBMITTALS

A. Shop Drawings: Indicate gages, profiles, sections of materials, details of construction, hardware, methods of attachment and anchoring, as applicable for specified materials.

B. Samples:
   1. Minimum 3 inch x 5 inch markerboard samples.
      a. Furnish manufacturer's full range of colors.
   2. Minimum 3 inch x 5 inch tackboard samples.
      a. Furnish manufacturer's full range of colors and patterns.

C. Product Data: Manufacturer's technical data, product specifications, installation instructions, and other pertinent information as applicable for each product or material specified.
D. Test Reports: Certified laboratory test reports as applicable to indicate compliance with specified requirements.

1.05 PROJECT CONDITIONS

A. Sequencing, Scheduling:
   1. Coordinate with related Work of other sections including gypsum board and tackboards.
   2. Do not install markerboards until paint is applied to surfaces concealed behind them.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project Site with manufacturer's labels intact and legible.

B. Deliver factory-built units completely assembled in one piece without joints, whenever possible.
   1. Where dimensions exceed panel size, provide 2 or more pieces of equal length, as acceptable to Architect.
   2. When overall dimensions require delivery in separate units, prefabricate at factory, disassemble for delivery, and make final joint at Project Site.
   3. Use splines at joints to maintain surface alignment and smooth joints.

C. Provide means necessary to protect markerboards before, during, and after installation.

1.07 SPECIAL PROJECT WARRANTY

A. Furnish manufacturer's 50 year material warranty for markerboards.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Markerboards and Tackboards:
   1. A-1 Visual Systems
   2. Nelson Adams / NACO

2.02 SYSTEM PERFORMANCE

A. System shall be comprised of factory assembled markerboards, in configurations and sizes indicated or as specified.

B. Laminations of panel components shall be by face sheet manufacturer.

2.03 MATERIALS

A. Wall-Mounted Markerboards:
   1. Dry Markerboards: porcelain enamel steel manufactured to exceed performance specifications for porcelain enamel S104 of Porcelain Institute.
      a. Provide markerboards capable of supporting papers by means of magnets.
b. Writing surface to resist wear and damage from shock and abrasion and not dent, shatter or crack.
c. Provide writing surfaces that will retain original color, writing, and erasing qualities and not become glossy or shiny in normal use.
d. Gloss Variation of Surface: Not to exceed 3 units when measured by 45 degree gloss meter in accordance with Porcelain Enamel Institute Bulletin 1-18 Gloss Test for Porcelain Enamels and ASTM C 346.

2. Steel Base Metal: High quality enameling iron or steel of low metalloid and copper content, especially manufactured and processed for temperatures over 1,400 degrees F. used in coating porcelain on steel units for architectural purposes.
   a. Minimum 24 gage.

3. Facing Surfaces:
   a. Provide board surfaces consisting of following:
      1) Vitreous-porcelain writing surface coating of 0.0025 inch minimum thickness.
      2) Reverse side of steel base sheet to receive ground coat of 0.0005 inch thickness and spray coat of silicon.
      3) Provide porcelain enamel panel edges at butt joints.
      4) Fuse cover and ground coats to steel at manufacturer's standard firing temperature, but at least 1,250 degrees F.

4. Dry Markerboard Surface Steel: Factory laminated to 7/16 inch thick fiberboard core.
   a. Provide moisture blocking backing sheet.
   b. Core: 45 pound particle board.
   c. Moisture Barrier Backer Sheet: Minimum 0.015 aluminum or 28 gage galvanized steel.
      1) Provide backer sheet factory laminated to core under pressure.

5. Lamination: Bond surface facing and backing to core material by means of special flexible adhesive developed for this purpose with no unbonded area.
   a. Face and back: Not removable without rupturing core material.
   b. Panels: No delamination under normal use.

6. Joints: Where vertical joints occur, fit 14 gage continuous concealed steel spline tightly into grooves in core material.
   a. Factory rabbet to produce smooth butt joint.
   b. Do not furnish exposed trim.

B. Tackboards:
   1. Vinyl Fabric-Faced: Vinyl fabric complying with FS CCC-W-408, Type II, Class 2, laminated to 1/4 inch thick cork backing sheet.
   2. Unless otherwise indicated, make up rigid panels by factory laminating under pressure to 1/4 inch thick plywood or hardboard backing.

C. Trim and Accessories:
   1. General: Fabricate frames and trim of not less than 0.062 inch thick aluminum alloy, size and shape as indicated, to suit type of installation.
      a. Provide straight, single-length units wherever possible and keep joints to minimum.
      b. Miter corners to a neat, hairline closure.
   2. Edge Trim:
      a. Extruded aluminum, Alloy 6063-T5.
3. Accessories Tray: Furnish manufacturer’s standard continuous flat-ribbed or box-type with slanted front, aluminum accessories tray with cast aluminum end closures for each markerboard.
   a. Extend accessories tray to end of both vertical edges of board.
   b. On flat-rib tray, provide 3/4 inch radius on comers and polish at ends.

4. Map Rail: Furnish map rail at top of each unit, complete with following accessories:
   a. Display Rail: Provide continuous cork display rail two inch wide, as indicated, integral with map rail.
      1) Extend display rail to end of both vertical edges.
   b. End Stops: Provide one end stop at each end of map rail.
   c. Map Hooks: Provide 2 map hooks with flexible metal clips for each 4 feet of map rail or fraction thereof.

2.04 FABRICATION

   A. Assembly: Provide factory-assembled units unless field-assembled units are indicated.

PART 3 - EXECUTION

3.01 PREPARATION

   A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to ensure proper fitting of Work.
      1. Allow for trimming and fitting wherever taking of field measurements before fabrication might delay Work.

3.02 INSTALLATION

   A. Install boards in locations and mounting heights as shown and in accordance with manufacturer’s instructions and reviewed Shop Drawings
      1. Provide grounds, clips, backing materials, brackets and anchors, trim, and accessories required for complete installation.
      2. Fasteners for Assembly of Trim and Frame Units: Truss-head aluminum or stainless steel self-tapping screws with double cadmium-plated finish.

   B. Coordinate site-assembled units with grounds, trim, and accessories.
      1. Join parts with neat, precision fit.

   C. Install units with concealed hangers plumb and level, in accordance with manufacturer’s printed instructions.

   D. Install panels after finish painting of wall surfaces has been completed and paint is cured.
      1. Install panels level, plumb and neatly assembled.
      2. Prior to Substantial Completion, completely clean trim of dirt, finger-marks, or other foreign material.
3.03 ADJUST AND CLEAN

A. Verify that accessories required for each unit are properly installed and operating units properly functioning.

B. Clean units in accordance with manufacturer's instructions.

C. Remove and legally dispose of rubbish, debris, and waste materials off Project Site.
   1. Comply with requirements of Section 01 7419.

3.04 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 10 1100
PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Furnishing materials, labor, and equipment necessary for completion of signage as indicated on Drawings and as specified.
   2. Types of signage include, but is not limited to following:
      a. Interior and exterior room signs and directional signs
      b. Geometric restrooms signs

B. Related Requirements:
   1. Refer to Division 26 Sections for illuminated exit signs.

1.02 REFERENCES


1.03 QUALITY ASSURANCE

A. Uniformity of Manufacturer: For each separate type of sign required, obtain signs from one source from single manufacturer.

B. Accessibility:
   1. Comply with CBC, Chapter 11B.

1.04 SUBMITTALS

A. Product Data: Manufacturer’s technical data and installation instructions for each type of sign required.

B. Samples: Each sign form and material showing finishes, colors, surface textures and qualities of manufacturer and design of each sign component including graphics.
   1. Full-size sample units, if requested by Architect.
   2. Acceptable units may be installed as part of Work.

C. Shop Drawings: For fabrication and erection of signs.
   1. Include plans, elevations, and large scale details of sign wording and lettering layout.
   2. Show anchorages and accessory items.

1.05 DEFINITIONS

A. Accessible Route: Continuous unobstructed path that complies with California Building Code (CBC).
B. Characters: Letters, numbers, punctuation marks, and typographic symbols.

C. Circulation Path: Exterior or interior way of passage from one place to another for pedestrians, including, but not limited to, walks and hallways.

D. Common Use: Interior and exterior rooms, spaces, or elements made available for occupancy by students, staff, or others visiting or utilizing facilities.

E. Facility: Portions of buildings, structures, equipment, walks, passageways, or other real or property located on Project Site.

F. ISA: International Symbol of Accessibility

G. Pictogram: Pictorial symbol, which is recognized as representing activities, facilities, or concepts.

H. Sign: Architectural element composed of displayed text, symbolic, tactile or pictorial information.

I. Space: Definable area, such as room, toilet room, hall, entrance, storage room, or lobby.

J. Tactile: Object that can be perceived through sense of touch.

1.06 SYSTEM DESCRIPTION

A. Comply with most stringent requirements of CBC, Chapter 11B for following:
   1. Tactile character type and size.
   2. Finish and contrast.
   3. Raised and visual characters.
   4. Visual character and line spacing height and installation height.
   5. Braille: Use California (Contracted) Grade 2 Braille wherever Braille is required.
   6. Tactile sign installation height and location.
   7. Identify accessible building entrances with ISA per CBC Section 11B-216.6.
   8. Provide each permanent room and space identified by sign with sign installed adjacent to door it identifies, with raised characters and Braille.
      a. Provide signage at toilet rooms complying with CBC Section 11B-216.8
   9. Provide tactile exit signs as required by CBC Section 1011.4
   10. Provide signs indicating provision of special equipment for hearing impaired (i.e. TTY phone, volume control phones, and Assistive Listening Systems, where required.

PART 2 – PRODUCTS

2.01 GENERAL

A. Letter Style: Helvetica Medium, unless indicated otherwise..
   1. Uppercase Letters.
2.02 PLASTIC SIGNS

A. Basis-of-Design: Design for interior plastic room signs is based on Best Sign Systems standard HC 300 ADA System plaque signs and accessories as manufactured by Best Manufacturing Co., Montrose, CO.

B. Subject to compliance with specified requirements, provide named product or comparable product by one of following manufacturers:
1. Mohawk Sign Systems, Schenectady, NY
2. Karman, Ltd., Canoga Park, CA

C. Subject to compliance with specified requirements, comparable products may be submitted by alternate manufacturers in accordance with requirements for product substitutions specified in Section 01 6000 and following:
1. Submit items listed in "Submittals" Article and as specified in Section 01 3300, for evaluation of proposed system.
2. Complete project shop drawings for similar project may be submitted for evaluation purposes, however shop drawings specific to this Project will be required from successful bidder.
3. Copy of manufacturer's finish and material warranty.

D. Material: Plaque stock of laminated phenolic and melamine plastic (MP) for interior signs and fiberglass (FP) for exterior signs suited for graphic sandblast process.
1. Sign stock with face and core plies suited for integral raised profile of text and Braille, in finishes and color combinations indicated or, if not indicated, as selected from manufacturer's standards.
2. NEMA rated self-extinguishing.
3. Thickness: 1/4 inch.
4. Edges: Square cut.
5. Corners: As indicated on Drawings.

E. Finish and Contrast: Matte finish with color of characters and symbols contrasting with background by minimum of 70 percent, and have non-glare finish per CBC Sections 11B-703.5.1, 11B-703.6.2, and 11B-703.7.1
1. Colors as selected by Architect.

F. Raised (Tactile) and Visual Characters:
1. Provide raised characters minimum of 5/8 inch and maximum of 2 inches high, based on height of uppercase letter "I", complying with CBC Sections 11B-703.2 and 11B-703.2.5
   a. Accompanied by California Contracted Grade 2 Braille complying with CBC Section 11B-703.2.
2. Proportions: Select characters from fonts where width of uppercase letter "O" is 60 percent minimum and 110 percent maximum of height of uppercase letter "I" per CBC Sections 11 B-703.4 and 11 B-703.6
3. Format: Provide text in horizontal format per CBC Sections 11 B-703.2 and 11 B-703.5
4. Stroke Thickness: Provide stroke thickness of uppercase letter "I" of 15 percent maximum of height of character per CBC Section 11 B-703.4 and 11B-703.6
5. Raised Character and Line Spacing: Measure character spacing between two closest points of adjacent raised characters within message, excluding word spaces.
a. Where characters have rectangular cross sections, provide spacing between individual raised characters of 1/8 inch minimum and 4 times raised character stroke width maximum.
b. Where characters have other cross sections, provide spacing between individual raised characters of 1/16 inch minimum and 4 times raised character stroke width maximum at base of cross sections, and 1/8 inch minimum and 4 times raised character stroke width maximum at top of cross sections.
c. Separate characters from raised borders and decorative elements by 3/8 inch minimum.
d. Provide spacing between baselines of separate lines of raised message of 135 percent minimum and 170 percent maximum of raised character height per CBC Section 11 B-703.2

6. Visual Character and Line Spacing: Measure visual character spacing on sign between two closest points of adjacent characters, excluding word spaces.
   a. Provide spacing between individual characters of 10 percent minimum and 35 percent maximum of character height.
   b. Provide spacing between the baselines of separate lines of characters within message of 135 percent minimum and 170 percent maximum of character height per CBC Section 11B-703.5

7. Visual Character Height and Installation Height: Provide minimum character height complying with CBC Table 11 B-703.5.5

8. Measure viewing distance as horizontal distance between character and obstruction preventing further approach towards sign.

9. Base character height on uppercase letter "I".
   a. Install visual characters at 40 inches minimum above finish floor or ground except for elevator car controls, floor-level exit signs and emergency procedures information per CBC Section 11 B-703.5.

10. Visual Character Case and Style: Provide visual characters on sign of uppercase or lowercase or combination of both and conventional in form.
    a. Do not use characters that are italic, oblique, script, highly decorative, or of other unusual forms per CBC Section 11 B-703.5

11. Visual Character Stroke Thickness: Provide stroke thickness of uppercase letter "I" of 10 percent maximum of height of character per CBC Section 11 B-703.5

12. Provide pictograms, where required, complying with CBC Section 11B-703.6.

13. Provide symbol of accessibility (ISA), complying with CBC Section 11B-703.7.

G. Braille: Use California (Contracted) Grade 2 Braille wherever Braille is required, complying with CBC Sections 11B-703.3 and 11B-703.4

1. Braille Dots:
   a. Locate 0.100 inch on center in each cell with 0.300 inch space between cells, measured from second column of dots in first cell to first column of dots in second cell.
   b. Raised minimum of 0.025 inch above background.
   c. Domed or rounded per CBC Sections 11B-703.3 and 11B-703.3.1

2. Position Braille below corresponding text in horizontal format, flush left or centered.

5. Multi-lined text, Braille shall be placed below entire text.

6. Separate Braille by 3/8 inch minimum and 1/2 inch maximum from other tactile characters, and 3/8 inch minimum from raised borders and decorative elements. per CBC Section 11 B-703.3
H. Applied copy not acceptable.

I. Geometric Toilet Room Signs:
1. Comply with CBC Section 11B-703.7.2.6
2. Fabricated of 1/4 inch thick, non-glare material which shall contrast with restroom door (light to dark, or dark to light).
3. Boys/Mens Rooms: Triangular with equal sides, 12 inches in length.
5. When restroom or other sanitary facility is accessible, place ISA in center of geometric sign.
6. Non-tactile text, such as “Staff Only”, may be added to sign.
7. Install signs on door leading into restroom or other sanitary facility, centered on door, and with center of sign 60 inches from finished floor.

J. Provide Plastic Signs as indicated in schedule and details.

2.03 ACCESSIBLE PATH OF TRAVEL SIGNS

A. Accessible Path of Travel Signs:
1. Circulation paths of travel with stairs or other obstacles leading from public right of ways, public transportation, and parking lots, that are not accessible, or do not lead to accessible entrances to building.
   a. Locate accessible route signage at decision points compliant with CBC Chapter 11B directing people with disabilities to accessible routes or entrances.
   b. Locate and install signs so steps will not have to be retraced.
2. Graphics: White on dark blue background; non-glare, high contrast signs.
   a. Conform to requirements of CBC Chapter 11B
   b. ISA minimum 4-1/2 inches high.
3. Installation Location and Mounting:
   a. Mount sign on post or wall with lower edge of sign between 48 inches and 60 inches above ground or surface.

2.04 INFORMATIONAL SIGNS

A. Building Entrance Signs:
1. Provide signs at building entrances stating: “No Smoking in Building”, in accordance with California statute prohibiting smoking in public buildings.
2. When functional spaces have individual entrances from exterior of building, or from courtyard, and such entrances are accessible, one sign can be placed on each exterior elevation stating “All Rooms Have Accessible Entrances.”
   a. Include ISA on such signs, and include phrase: “No smoking in Building”.

B. Room Identification Signs:
1. For each permanent room and space identified by sign, install sign adjacent to room or space it identifies, with raised characters and Braille.
   a. Includes entrances to rooms and spaces, which are entered by exterior entrance or by door off interior corridor or courtyard, per CBC Chapter 11B.
2. Toilet Room Identification Signs: Include gender pictogram in 6 inch high field.
a. Locate Pictogram field above raised character and Braille text on tactile sign, which is to be located adjacent to latch side of door, per CBC Chapter 11B.

b. Where there is not adequate space for sign immediately adjacent to door, and door opens inward, gender pictogram, ISA, and raised characters and Braille can be included on geometric sign installed on door.

PART 3 – EXECUTION

3.01 INSTALLATION

A. General: Locate sign units and accessories where shown, scheduled, or directed by Architect.
   1. Use mounting methods shown or selected by Architect.
   2. Comply with manufacturer's instructions, and CBC Chapter 11B.

B. Install level, plumb, and at proper height with sign surfaces free from distortion or other defects in appearance.
   1. Cooperate with other trades for installation to finish surfaces.
   2. Repair or replace damaged units as directed by Architect.

C. Tactile Sign Installation Height and Location:
   1. Locate tactile characters on signs minimum 48 inches above finish floor or ground surface, measured from baseline of lowest Braille cells and 60 inches maximum above finish floor or ground surface, measured from baseline of highest line of raised characters.
   2. Locate tactile signs on approach side of door at entry or exit, and allow for reach within 0 inches of required clear floor space per CBC Section and Figure 11B-703.4.2.
      a. Where tactile sign is provided at door, locate sign on wall alongside door at latch side.
      b. When at double doors with one active leaf, locate sign on inactive leaf.
      c. When at double doors with two active leafs, locate sign to right of right hand door.
      d. Where there is no wall space at latch side of single door or at right side of double doors, locate signs on nearest adjacent wall.
      e. Locate signs containing tactile characters so that clear floor space of 18 inches minimum by 18 inches minimum, centered on tactile characters, is provided beyond arc of door swing between closed position and 45 degree open position per CBC Section 11B-703.4.

D. Plastic Signs: Mount sign with aluminum T-type bracket, finish to match adjacent surface or adhesive mount with adhesive recommended by sign manufacturer for application to substrate.
   1. Locate signs so that person may approach within 3 inches of sign without encountering protruding objects or standing within swing of door per CBC Chapter 11B.
3.02 CLEANING AND PROTECTION

A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer’s instructions.
   1. Protect units from damage until acceptance by Owner.

END OF SECTION 10 1400
SECTION 10 2114
SOLID PLASTIC TOILET COMPARTMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Solid plastic (HDPE) toilet compartments and screens as follows:
      a. Compartment Style: Floor mounted, overhead braced.

B. Related Sections:
   1. Section 10 2813: Toilet Accessories.

1.02 REFERENCES

A. California Code of Regulations, Title 24, 2013 edition, Part 2, California Building
   Code (CBC), Volumes 1 and 2.
   1. Chapter 11B – Accessibility to Public Buildings, Public Accommodations,
      Commercial Buildings, and Public Housing.
   2. Chapter 26 - Plastic

B. ASTM International (ASTM):
   1. ASTM A 167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate,
      Sheet and Strip.
   2. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of
      Building Materials.

1.03 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Company regularly engaged in manufacture of
   products specified, whose products have been in satisfactory use under similar
   service conditions for not less than 5 years.

B. Installer’s Qualifications: Company or Individual, regularly engaged in installation of
   products specified, with minimum of 5 years experience.

C. Field Measurements: Take field measurements prior to preparation of shop
   drawings and fabrication where possible, to ensure proper fitting of Work.
   1. Allow for adjustments within specified tolerances wherever taking of field
      measurements before fabrication might delay Work.

D. Coordination: Furnish inserts and anchorages that must be built into other work for
   installation of toilet partitions and related work.
   1. Coordinate delivery with other work to avoid delay.

E. Accessible Toilet Compartments:
   1. Wheelchair accessible compartments complying with CBC Section 11B-604.8.1.
   2. Toe clearance for at least one side partition of wheelchair accessible
      compartment complying with CBC Section 11B-604.8.1.4.
a. Minimum 9 inches high above finish floor and minimum 6 inches deep beyond compartment side face of partition, exclusive of partition support members.
   1) Provide smooth partition components at toe clearances without sharp edges or abrasive surfaces.
   2) Toe clearance at side partition is not required in compartment greater than 66 inches wide.
3. Provide ambulatory accessible compartment where there are six or more toilet compartments, or where combination of urinals and water closets totals six or more per CBC Section 11B-213.3.1.
   a. Provide such compartment complying with CBC Section 11B-604.8.2.
4. Provide self-closing door and door hardware for accessible compartment complying with CBC Section 11B-404, except provide clearance between door side of ambulatory accessible compartment and obstruction of 44 inches per CBC Figure 11B-604.8.2.
5. Place door pull complying with CBC Section 11B-404.2.7 on both sides of door near latch.
6. Do not allow doors to swing into clear space or clearance required for fixtures.

1.04 SUBMITTALS

A. Product Data: Manufacturer's detailed technical data for materials, fabrication, and installation, including catalog cuts of anchors, hardware, fastenings and accessories.

B. Shop Drawings: For fabrication and erection of toilet partition assemblies not fully described by product drawings, templates, and instructions for installation of anchorage devices built into other work.
   1. Locations of reinforcement and cutouts for compartment-mounted toilet accessories.

C. Samples:
   1. Minimum of four for each compartment or screen color and finish required, prepared on 6-inch square samples of same thickness and material indicated for Work.
   2. Hardware, fastenings, and accessories.
   3. Furnish color samples for Architect’s approval.

1.05 PROJECT CONDITIONS

A. Verify that field measurements are as indicated on shop drawings.

B. Coordinate Work with placement of support framing and anchors in wall.

C. Install toilet partitions and accessories after other finishing operations including painting, have been completed.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in good condition to Project Site in manufacturer’s original unopened containers that bear name and brand of manufacturer, project identification, shipping and handling instructions.
B. Store materials in clean, dry, enclosed space off ground, and protected from weather and from extremes of heat and cold.

1.07 WARRANTY

A. Manufacturer: Guarantee its plastic against breakage, corrosion, and delaminating under normal conditions for 15 years from date of Substantial Completion.
   1. Should materials be found to be defective during that period for reasons listed above, materials will be replaced free of charge.
   2. Labor is not included in manufacturer’s warranty.

B. Installer: Provide labor warranty for replacement of defective materials for same period of time.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Manufacturer: Subject to compliance with specified requirements, provide products of one of following, or approved equal:
   1. Accurate Partitions Corp.
   2. Bradley Corp'/Mills Partitions
   3. Partition Systems Incorporated of South Carolina
   4. Scranton Products
   5. Weis/Robart Partitions, Inc.

2.02 MATERIALS

A. Solid-Plastic, Polymer Resin: High-density polyethylene (HDPE) with homogenous color throughout.
   1. Provide material not less than 1 inch thick with seamless construction and eased edges in color and pattern as follows:
   2. Color and Pattern: As selected by Architect..

B. Pilaster Shoes: Stainless Steel, 3 inches high, with theft-proof stainless steel fasteners.

C. Full-Height (Continuous) Brackets: Stainless Steel of manufacturer's standard design for attaching panels and screens to walls and pilasters; predrilled by manufacturer.

D. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile in manufacturer's standard finish.

E. Heat-Sink Strip: Manufacturer's standard continuous, extruded aluminum strip in manufacturer's standard finish.

F. Stainless Steel: Conforming to ASTM A 167.

G. Zamak fittings are not acceptable.
2.03 CONSTRUCTION

A. Provide standard doors, panels, screens, and pilasters fabricated for compartment system.
   1. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories, and grab bars, as indicated.
   2. Aluminum heat sink may be fastened to bottom edges (optional).

B. Door Dimensions: Dimensions are for clear, unobstructed opening widths with door at 90 degree angle from closed position.
   2. End Opening Accessible Compartments: 32 inches wide.
   3. Side Opening Accessible Compartments: 34 inches wide.

C. Panel and Door Heights and Mounting: 55 inches high, mounted at 14 inches above finished floor.

D. Urinal Screen Height and Mounting: 42 inches high, mounted at 14 inches above finished floor.

E. Floor Anchored Overhead Braced and Compartments: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions.
   1. Make provisions for setting and securing continuous head rail at top of each pilaster.
   2. Provide shoes at pilasters to conceal supports and leveling mechanism.

F. Wall-Hung Screens: Provide units in sizes indicated of same construction and finish as compartment panels, unless otherwise indicated.

G. Brackets: Through-bolted brackets to panels and pilasters with one-way sex bolts.

2.04 HARDWARE

A. Door Hardware:
   1. Hinges: Surface mounted stainless steel gravity hinges attached to door and pilaster by theft resistant one-way stainless steel machine screws.
      a. Metal to metal connection shall withstand a direct pull over 1,000 lbs. per screw.
      b. Fasten hinge to door by through bolting.
      c. Equip outswinging doors and doors to accessible compartments with selfclosing hinges.
      d. Manufacturer's standard vault-type hinge, subject to Architect's review.
   2. Provide door strike and keeper fabricated from heavy aluminum extrusion, 6063-T6 Alloy, with clear anodized finish with wrap around flange, surface mounted and through bolted to pilaster with one-way sex bolts.
   3. Door Latch: 14 gage stainless steel latch with shock resistant nylon track sliding on one-piece 11 gage stainless steel keeper.
      a. Provide door latch housing fabricated from heavy aluminum extrusion, 6063-T6 alloy, with clear anodized finish, surface mounted and through-bolted to door with one-way sex bolts.
b. Provide sliding door latch, requiring less than 5 lb. force to operate, without pinching or twisting operation. of heavy aluminum with finish through-bolted to doors and pilasters with one-way sex bolts.
c. Center opening hardware between 30 and 44 inches above finish floor.
d. Furnish with satin stainless steel finish.

4. Coat Hook: Combination stainless steel hook and rubber-tipped bumper, sized to prevent door hitting mounted accessories.
   a. Install maximum 48 inches above finish floor.
   b. At doors to accessible compartments include door pull and wall stop.
   c. Mount hook maximum 48 inches above finish floor.

5. Provide accessible doors with second u-shaped door pull on outswinging doors mounted at 36 inches above finished floor.

B. Use stainless steel angles to attach pilasters to floor and ceiling.
   a. Attach angles to pilasters with 3/4 inch stainless steel tamper resistant torx head screws.
   b. Pilaster sleeves shall be 4 inches high, Type 316, 20 gage stainless steel, secured to pilasters with stainless steel tamper resistant torx head screw.
   c. Sleeves shall conceal angle bracket connections at floor and ceiling.

C. Use full length continuous 18 gage stainless steel wall brackets for panels to pilaster, pilasters to wall, and panel to wall connections.
   1. Through-bolt wall brackets to panels and pilasters with one-way sex bolts.
   2. Attach brackets to adjacent wall construction with No. 14 x 1-1/2 inch stainless steel Phillips head screws.
      a. Anchor directly behind vertical edge of panels and pilasters at twelve inch intervals along full length of bracket, and at each twelve inch interval alternately spaced between anchor connections.

2.05 FINISHES

A. Solid Plastic: Color as selected by Architect.

B. Stainless Steel: No. 4, Satin

2.06 PERFORMANCE REQUIREMENTS

A. Fire Resistance: Partition materials shall comply with following requirements, when tested in accordance with ASTM E 84:
   1. Smoke Developed Index: Less than 450.
   2. Flame Spread Index: Less than 75.
   3. Material Fire Ratings:
      a. Conforming to CBC Class B fire hazard classification.

PART 3 – EXECUTION

3.01 PREPARATION

A. Examine areas to receive toilet partitions and screens for correct height and spacing of anchorage/blocking and plumbing fixtures that may affect installation of partitions.
B. Take complete and accurate measurements of complete toilet compartment locations.

C. Start of Work constitutes acceptance of Project Conditions.

3.02 INSTALLATION

A. General: Install toilet partitions, in accordance with manufacturer’s installation instructions, approved shop drawings.
   1. Install toilet partitions rigid, straight, plumb, level, and aligned.
   2. Provide clearances of not more than 1/2 inch between pilasters and panels and not more than 1 inch between panels and walls.
   3. Secure units in position with manufacturer’s recommended anchoring devices.
   4. Maintain uniform clearance at vertical edge of doors from top to bottom, not exceeding 3/16 inch.
   5. Mount doors and panels at 14 inches above finished floor.
   6. Conceal evidence of drilling, cutting and fitting of wall, floor and ceiling finish.

B. Floor Anchored Overhead Braced Compartments: Secure pilasters to floor and level, plumb, and tighten.
   1. Secure continuous head rail to each pilaster with not less than 2 fasteners.
   2. Hang doors and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure.
   1. Set units level and plumb and to resist lateral impact.

3.03 ADJUSTING AND CLEANING

A. Hardware Adjustment: Adjust and lubricate hardware following manufacturer’s written instructions for proper operation.
   1. Set hinges on inswinging doors to hold open approximately 30 degrees from closed position when unlatched.
   2. Set hinges on outswinging doors and swing doors in entrance screens to return to fully closed position.

B. Perform final adjustments to pilaster leveling devices, door hardware, and other operating parts of partition assembly just prior to final inspection.

C. Clean exposed surfaces of partitions, hardware, fittings and accessories, and touch up minor scratches and other finish imperfections using materials and methods recommended by partition manufacturer.

D. Replace damaged units which cannot be satisfactorily field repaired, as directed by Architect.

END OF SECTION 10 2114
SECTION 10 2813

TOILET ACCESSORIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Toilet accessories.
   2. Warm-Air Hand Dryer
   3. Underlavatory guards.

B. Related Sections:
   1. Section 07 9200: Joint Sealants
   2. Section 09 2900: Gypsum Board
   3. Section 10 2114: Solid Plastic Toilet Compartments

C. Schedule of Toilet Accessories: Each type of toilet accessory required is specified in schedule at end of this Section.

D. Related Requirements:
   1. Refer to Division 22 Sections for related plumbing fixtures and installation.
   2. Refer to Division 26 Sections for electrical power for warm-air hand dryers.
   3. Refer to Drawings for location of Owner Furnished Contractor Installed (OFCI) accessories.

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM 153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
   2. ASTM A167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
   3. ASTM A 653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   4. ASTM A 666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
   5. ASTM A 1008 – Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
   6. ASTM B 16 – Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
   7. ASTM B 19 – Standard Specification for Cartridge Brass Sheet, Strip, Plate, Bar, and Disks
   8. ASTM B 30 – Standard Specification for Copper Alloys in Ingot Form

1.03 QUALITY ASSURANCE

A. Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specified products indicated in Toilet Accessory Schedule.
   1. Do not modify aesthetic effects, as judged solely by Architect, except with Architect's approval.
   2. Where modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.04 SUBMITTALS

A. Product Data: Include construction details, material descriptions, thicknesses, dimensions, profiles, fastening, and mounting methods, specified options, and finishes for each type of accessory specified.

B. Samples: Full-size samples of units, upon request, to Architect for review of design and operation.
   1. Acceptable samples will be returned and may be used in Work.
   2. Compliance with other requirements is exclusive responsibility of Contractor.

C. Matrix: Provide matrix indicating name of each room to receive accessories and type and quantity of each accessory to be provided in each room.

D. Setting Drawings: For cutouts required in other Work.
   1. Include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

E. Operation and Maintenance Data:
   1. Maintenance data, operating instructions and keys required for each type of equipment and lock or accessories to include in maintenance manuals specified in Division 01.
   2. Provide lists of replacement parts and service recommendations.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver items in manufacturer’s original unopened protective packaging.

B. Store materials in original protective packaging to prevent soiling, physical damage, or wetting.

C. Handle so as to prevent damage to finished surfaces.

D. Maintain protective covers on units until installation is complete.
   1. Remove covers at final clean up of installation.
1.06 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, 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 Work.

1.07 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of Contract Documents.

B. Manufacturer’s Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.
   1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Basis-of-Design: Model numbers specified for Toilet Accessories are based on products as manufactured by Bobrick Washroom Equipment Co.
   1. Unless indicated otherwise, listed products are District Standard items and substitutions are not permitted.

2.02 MATERIALS – GENERAL

A. Stainless Steel: ASTM A 666, Type 304, with No.4 finish, 22 gage minimum, unless otherwise indicated.

B. Brass: ASTM B19, leaded and unleaded, flat products, ASTM B16; Rods, shapes, forgings, and flat products with finished edges; ASTM B 30 castings.

C. Sheet Steel: ASTM A 1008 cold-rolled, commercial quality 20 gage minimum, unless otherwise indicated.
   1. Surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653, G60.

E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B 456, Type SC 2.

F. Mirror Glass: ASTM C1036, Type I, Class 1, Quality q2, 1/4 inch thick, with silver coating, electroplated-copper protective coating, and nonmetallic paint coating complying with ASTM C 1503.

H. Fasteners: Screws, bolts, and other devices of same material as accessory unit tamper and theft resistant when exposed, galvanized steel where concealed.

2.03 FABRICATION

A. General: Stamped names or labels on exposed faces of toilet accessory units are not permitted, except where otherwise indicated
   1. Unobtrusive labels on surfaces not exposed to view are acceptable.

B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled.
   1. Hang doors or access panels with continuous stainless steel piano hinge.
   2. Provide concealed anchorage wherever possible.

C. Recessed Toilet Accessories – Except where otherwise indicated, fabricate units of welded construction, without mitered corners.
   1. Hang doors or access panels with full-length stainless steel piano hinge.
   2. Provide anchorage which is fully concealed when unit is closed.

D. Mirrors: Provide mirror backing and support system which will permit rigid, tamperproof glass installation and prevent accumulation of moisture, as follows:
   1. Fabricate mirror frames with channel shapes of not less than 20 gage, with square corners carefully mitered to hairline joints and mechanically interlocked.

E. Grab Bars: Stainless steel type with wall thickness not less than 18 gage and as follows:
   1. Mounting: Concealed, manufacturer's standard flanges and anchorages.
   2. Gripping Surfaces: Smooth, satin finish, with manufacturer's standard non-slip texture on gripping surface.
   3. Heavy-Duty Size: Outside diameter of 1-1/4 inch.

F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying.
   1. Where locks are required for particular type of toilet accessory, provide keyed-alike throughout Project.
   2. Furnish two keys for each lock and minimum of six keys to Owner's representative.

PART 3 – EXECUTION

3.01 INSPECTION

A. Check wall opening for correct dimensions, plumbness of blocking or frames, and other preparation that would affect installation of accessories.

B. Check areas to receive surface mounted units for conditions that would affect quality and execution of Work.

C. Verify spacing of plumbing fixtures and toilet partitions that affect installation of accessories.

D. Do not begin installation of washroom accessories until openings and surfaces are acceptable to Contractor and Architect.
3.02 INSTALLATION

A. Install toilet accessory units following manufacturer's instructions, using fasteners appropriate to substrate and recommended by unit manufacturer.
   1. Mount toilet accessories required to be accessible in locations and at heights complying with CBC Sections 11B-602 through 11B-612.

B. Install units plumb, level, and firmly anchored in locations and at heights indicated.
   1. Use concealed fastenings wherever possible.
   2. Provide anchors, bolts and other necessary anchorages.
   3. Install concealed mounting devices and fasteners fabricated of same material as accessories, or of galvanized steel, as recommended by manufacturer.
   4. Install exposed mounting devices and fasteners finished to match accessories.
   5. Provide theft-resistant fasteners for accessory mountings.
      a. Finish of exposed fasteners to match items secured.
   6. Fit flanges of accessories snug to wall surfaces.
      a. Provide sealant in gaps between 90 degree return flanges and finish wall surface after accessories are installed.
      b. Comply with requirements of Section 07 9200 for mildew-resistant silicone sealant
         1) Do not use acrylic sealant

C. Secure mirrors to walls in concealed, tamperproof manner with special hangers or screws.
   1. Set unit plumbs, level, and square at locations indicated, following manufacturer's instructions for type of substrate indicated.

D. Grab Bars in Toilet Facilities:
   1. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.
   2. Comply with CBC Section 11B-609.
   3. Ensure grab bars and wall or other surfaces adjacent to grab bars are free of sharp or abrasive elements and have rounded edges.
   4. Clearances:
      a. 1-1/2 inch clearance between wall surface and inside face of bar.
      b. 1-1/2 inch minimum between grab bar and projecting objects below and at ends.
      c. 12 inches minimum between grab bar and projecting objects above point of grab bar.
   5. Toilet paper and feminine napkin disposals when located on grab bar side of accessible toilet room or stall are not to project more than 3 inches from finished wall surface nor be located closer than 1-1/2 inches clear of tangent point of grab bar.
      a. Do not install surface mounted accessories above grab bar where they will restrict usability.

E. Conceal evidence of drilling, cutting and fitting on adjacent finishes.

3.03 ADJUSTING AND CLEANING

A. Adjust accessories for proper operation and verify that mechanisms function smoothly.
   1. Replace damaged or defective items.
B. Clean and polish exposed surfaces following manufacturer's recommendations after removing temporary labels and protective coatings.

3.04 CLOSE OUT

A. Deliver accessories schedule, keys, and parts manual as part of Project Closeout Documents.

B. For Owner's permanent records, provide two sets of following items of manufacturer's literature:
   1. Technical data sheets of each item installed on Project.
   2. Service and parts manuals.
   3. Name and local representative to be contacted in event of need for field service or consultation.

3.05 SCHEDULE OF TOILET ACCESSORIES

A. Unless noted otherwise, provide toilet accessories equal to Bobrick Model Numbers listed below
   1. Stainless Steel Framed Mirror: B-290 series with 1/4 inch select float plate glass mirror with 15 year silver spoilage warranty.
      a. Frame: 3/4 inch welded seamless stainless steel beveled to glass.
      b. Size as indicated.
      a. Surface-mounted at each non-accessible stall.
   3. Dual Roll, Recessed Toilet Tissue Dispenser: B-3888 with theft-resistant spindles, stainless steel, at each accessible stall in toilet rooms.
   11. Warm-Air Hand Dryer, automatic no-touch operation, surface mounted, maximum 4 inch projection: Model No. 0199 by American Specialties, Inc. ASI)
   13. Underlavatory guards, molded vinyl covering for supply and drain piping with flip tops at valve to allow service access without removing coverings: Truebro Lav Guard or approved equal.

END OF SECTION 10 2813
SECTION 10 4400

FIRE PROTECTION SPECIALTIES

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Fire extinguishers.

1.02 REFERENCES

A. California Code of Regulations:
   1. Title 19 – Public Safety
   2. Title 24, 2013 edition:
         1) Chapter 11B – Accessibility to Public Buildings, Public
            Accommodations, Commercial Buildings, and Public Housing.
      b. Part 9 – California Fire Code (CFC).

B. National Fire Protection Association (NFPA):

1.03 QUALITY ASSURANCE

A. Provide portable fire extinguishers by one manufacturer, unless otherwise
   acceptable to Architect.

B. UL-Listed Products: Provide new portable fire extinguishers which are UL Listed and
   bear UL "Listing Mark" for type, rating, and classification of extinguisher indicated.

C. Provide fire extinguishers as required by CCR, Title 19 and NFPA 10.

1.04 SUBMITTALS

A. Product Data: Manufacturer's technical data and installation instructions for portable
   fire extinguishers required.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with specified requirements, provide products of one of
   following:
   1. JL Industries.
   2. Larsen's Mfg. Co. (Basis-of-Design)
   3. Potter-Roemer Inc.
   4. Standard Fire-West
2.02 FIRE EXTINGUISHERS (FE)

A. General: Provide fire extinguishers for each location indicated complying with requirements of governing authorities.

B. Multi-Purpose Dry Chemical Type: UL-rated 2-A:10-B:C, 5 lb. nominal capacity, in enameled steel container, for Class A, Class B and Class C fires.

2.03 MOUNTING BRACKETS

A. Provide manufacturer’s standard bracket designed to prevent accidental dislodgement of extinguisher.
   1. Of proper size for type and capacity of extinguisher indicated.
   2. In manufacturer's standard finish.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged units.

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

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for installing fire extinguishers

B. Install in locations and at mounting heights indicated.
   1. When not indicated, at heights complying with applicable regulations of governing authorities.
   2. Mount fire extinguishers with handles 48 inches above finished floor.
   3. Where exact location of bracket mounted fire extinguisher is not indicated, locate as directed by Architect.

3.03 IDENTIFICATION

A. Identify bracket-mounted extinguishers with red letter decals spelling "FIRE EXTINGUISHER" applied to wall surface.
   1. Letter size, style, and location as selected by Architect.

END OF SECTION 10 4400
SECTION 11 5223

AUDIO-VISUAL EQUIPMENT SUPPORTS

PART 1 – GENERAL

1.01 SECTION INCLUDES

A. Video projector ceiling mounting system
B. Flat screen TV mounting system

1.02 RELATED SECTIONS

A. Section 09 5100: Acoustical Ceilings.
B. Division 26 sections for electrical requirements

1.02 SUBMITTALS

A. Product Data: Manufacturer's specifications and installation instructions for specified equipment.
B. Electrical power requirements and cabling requirements

PART 2 - PRODUCTS

2.01 VIDEO PROJECTOR MOUNTING SYSTEM

A. Projector Mount:
   1. Manufacturer: Peerless-AV, or approved equal.
   2. Model: PRGS-UNV
   3. Extension Column: Model AEC006009-AB
   4. Escutcheon Ring: Model ACC640-W
   5. Ceiling Plate: Model CMJ500R1
   6. Mounting Method: Ceiling mounted
   7. Finish: To match ceiling

2.02 FLAT SCREEN TV MOUNTING SYSTEM

A. TV Screen Mount:
   1. Manufacturer: Peerless-AV, or approved equal.
   2. Model: ST660 Tilt Wall Mount
   3. Finish: To match wall

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install equipment in locations shown, complying with manufacturer's recommendations.
B. Anchor units to other construction as indicated, using manufacturer's recommended methods, for type of installation shown.

C. Clean exposed surfaces and touch-up marred finishes or replace item as necessary to eliminate evidence of damage or deterioration.

END OF SECTION 11 5223
SECTION 12 2113
HORIZONTAL LOUVER BLINDS

PART 1  GENERAL

1.01  SUMMARY

A. Horizontal aluminum window blinds

B. Related Sections:
   1. Section 06 1053: Miscellaneous Carpentry; blocking for support of window blind brackets.

1.02  REFERENCES

A. California Code of Regulations (CCR):
   1. Title 19 – Public Safety

B. ASTM International (ASTM):

C. National Fire Protection Association (NFPA):

1.03  QUALITY ASSURANCE

A. Provide materials in colors and patterns as indicated.
   1. When not indicated, as selected by Architect.

B. Supplier: Manufacturer, subsidiary, or licensed agent approved to supply products specified, and to honor claims against products presented in accordance with warranty.

C. Installer Qualifications: Installer or agent qualified to install specified products by prior experience, demonstrated performance, and acceptance of requirements of manufacturer, subsidiary, or licensed agent.
   1. Responsibility for acceptable installation rests with installer.

1.04  SUBMITTALS

A. Product Data: Manufacturer’s specifications and installation instructions for each type of louver blind unit required.
   1. Include methods of installation for each type of opening and supporting structure.
B. Shop Drawings: For special components and application conditions of louver blind units which are not fully dimensioned or detailed in manufacturer's product data show relationship to adjoining Work.
   1. Include typical elevation layout indicating proposed division between blind units and meeting edges at corners.
   2. Provide sections and details at head and sill between blind units and corners.

C. Samples:
   1. For each component, material and finish which will be exposed to view, for each type of louver blind required.
   2. Prepare samples from same materials to be used for Work.
      a. Upon Architect's Request: Submit one complete small size operating unit of horizontal louver blind required.

1.05 PROJECT CONDITIONS

A. Prior to installation, ensure building is enclosed.
   1. Roof must be tight.

B. Maintain interior temperature between 60 degrees F and 90 degrees F during and after installation.
   1. Relative humidity not to exceed 80 percent.

C. Ensure that wet work, including gypsum board and taping, and painting is complete and dry.

D. Ensure that ceilings and mechanical work above blind installation is complete.

E. Make electrical power (110 volt AC) available for installer's tools within 500 feet of blind installation areas.

1.06 DELEIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project Site in Manufacturer's original unopened packaging with labels intact.

B. Store materials in clean area, free of corrosive fumes, dust, and away from construction activities.

C. Stack materials horizontally using plastic or wood shims to provide drainage and ventilation so that water cannot accumulate in, about or upon containers.

1.07 WARRANTY

A. Limited Lifetime Warranty: Provide manufacturer's limited warranty to repair or replace part or parts found to be defective in workmanship or material, provided blind remains in its original installed location, for life of blind, at manufacturer's option, without charge.

1.08 MAINTENANCE STOCK:

A. Deliver maintenance stock of material to Owner.
1. Furnish maintenance material matching products installed, packaged with protective covering for storage and identified with appropriate labels.
2. Typical Horizontal Louver Blind Units: Furnish quantity of typical louver blind units equal to 5 percent of amount installed.

PART 2 PRODUCTS

2.01 HORIZONTAL LOUVER BLINDS

A. Manufacturer: Subject to compliance with specified requirements, provide products of one of following, or approved equal:
   2. Levelor Contract.

B. Headrail: Manufacturer's standard headrail consisting of channel-shaped section fabricated from minimum 0.025 inch thick sheet steel with rolled edges at top.
   1. Increase metal thickness as recommended by manufacturer for large blind units.
   2. Furnish complete with tilting mechanism, top and end braces, top cradles, cord lock, and accessory items required for type of blind and installation indicated.

C. Bottom Rail: Manufacturer's standard tubular steel bottom rail, designed to withstand twisting or sagging.
   1. Contour top surface to match slat curvature
   2. Provide underside of bottom rail flat with no outside clips, tape holders, end caps or other fittings which create light gaps at sill.
   3. Close ends with manufacturer's standard metal or plastic end caps, of same color as rail.
      a. Finish rail in same color as slats, unless otherwise indicated.

D. Slats: Manufacturer's standard, spring-tempered aluminum slats, 0.008 inches thick, (louver blades), with rounded corners and forming burrs removed, as follows:
   1. Slat Width: 1 inch narrow slats, with other components sized to suit.
   2. Provide slats designed and spaced to achieve maximum overlap and closure for optimum light exclusion.
   3. Notch rear of blade at ladders and offset rout holes at lift cords to enable blades to touch one another when closed.

E. Ladders: Manufacturer's standard ladder construction designed to support and maintain slats at proper spacing and alignment in open and closed positions, as follows:
   1. Braided polyester cord design consisting of vertical components of not less than 0.045 inches nor more than 0.066 inches in diameter and integrally braided ladder rungs of not less than 4 threads; space ladders not further than 21 inches apart and 7 inches from ends of slats.

F. Tilting Mechanism: Manufacturer's standard assembly including disengaging worm and gear mechanism to eliminate overdrive, low friction gear tilter, drum and cradle at each ladder, tilt rod, tape clips, and grommet guides to prevent wear on ladder and cords.
   1. Designed to hold slats at any angle and prevent movement of slats due to vibration, operated as follows:
a. Wand Operation: Manufacturer's standard, detachable clear plastic wand, of proper length to suit blind installation and to provide convenient operation.

G. Lifting Mechanism: Manufacturer’s standard including crash-proof cord locks with cord separators and braid polyester or nylon lift cords with tassels at ends.
   1. Size cord to suit blind type.
   2. Include cord equalizers of self-aligning type designed to maintain horizontal blind position.

H. Installation Brackets: Manufacturer’s standard brackets designed to facilitate removal of head channels.
   1. Provide intermediate brackets at spacing recommended by blind manufacturer.
   2. Include hardware necessary for secure attachment of brackets to adjoining construction and to head rails.
   3. Design brackets to support safely weight of blind assemblies plus forces applied to operate blinds.

I. Finish: Provide finishes indicated below.
   1. Finish exposed accessories and hardware to match rail color, except as indicated otherwise.
      a. Provide manufacturer’s standard corrosion resistant finish to concealed items of hardware.
   2. Steel Components: Galvanize and either phosphate coat or prime exposed steel surfaces, followed by manufacturer’s standard baked-on synthetic resin enamel finish.
   3. Aluminum Slats: Provide manufacturer’s standard factory-applied finish system consisting of chemical conversion coating followed by baked-on synthetic resin enamel finish coat.

2.02 FABRICATION AND OPERATION

A. Prior to fabrication, verify actual opening dimensions by accurate site measurements.
   1. Adjust dimensions for proper fit at openings.
   2. Cooperate with other trades for securing tracks to substrates and other finished surfaces.

B. Fabricate window treatment components from corrosive-resistant, non-staining, non-fading materials which are completely compatible with each other, and which do not require lubrication during normal expected life.

C. Fabricate blind units to completely fill openings as shown, from head-to-sill and jamb-to-jamb.

D. Space supporting ladders to comply with manufacturer's standards, unless otherwise indicated.

E. Space slats to provide overlap for light exclusion when in fully closed position.

F. Equip horizontal blind units, unless otherwise indicated for following operation:
   1. Full-tilting operation with slats rotating approximately 180 degrees.
2. Place tilt operating controls on left-hand side of blind units, unless otherwise indicated.
3. Full-height raising, to manufacturer's minimum stacking dimension, with lifting cord locks for stopping blind at any point of ascending or descending travel.
4. Place pull cord on right-hand side of blind units, unless otherwise indicated.

2.03 SOURCE QUALITY CONTROL

A. Provide 1 inch mini horizontal aluminum blinds which are complete assemblies of only one manufacturer for entire project for each type required.
   1. Including hardware, accessory items, mounting brackets, and fastenings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install louver blind units in manner indicated to comply with manufacturer's instructions.
   1. Position units level, plumb, secure, at proper height and location relative to adjoining window units and other related Work.
   2. Securely anchor units with proper clips, brackets, anchorages, suited to type of mounting indicated.

B. Provide adequate clearance between sash and blinds to permit unencumbered operation of sash hardware.

C. Divisions between blinds are permitted only at mullions by continuous windows or openings where more than one blind for one opening occurs, unless otherwise indicated.

D. Isolate metal parts from concrete and mortar to prevent galvanic action.
   1. Use tape or thick coating or other means approved by Architect to effect separation.

3.02 PROTECTION

A. Protect installed units to ensure their being in perfect operating conditions, without damage, blemishes, or indication of use at completion of Project.
   1. Repair or replace damaged units as directed by Architect.

END OF SECTION 12 2113
SECTION 22 0500
COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 22.

B. This Division is an integrated whole comprising interrelated and interdependent Section and shall be considered in its entirety in determining requirements of the Work.

C. Refer to other sections of this Division for additional requirements or information regarding the subjects of this Section.

1.02 SECTION INCLUDES

A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
   1. Submittals.
   2. Coordination drawings.
   3. Record documents.
   5. Rough-ins.
   6. Plumbing installations.
   7. Cutting and patching.

1.03 DESCRIPTION

A. Provide a complete and operable installation, including all labor, supervision, materials, equipment, tools, apparatus, transportation, warehousing, rigging, scaffolding and other equipment and services necessary to accomplish the work in accordance with the intent and meaning of these drawings and specifications.

1.04 DEFINITIONS

A. "Provide" means furnish, install and connect unless otherwise described in specific instances.

B. "Piping" means pipes, fittings, valves and all like pipe accessories connected thereto.

C. "Ductwork" means ducts, plenums, compartments, or casings including the building structure, which are used to convey or contain air.

D. "Extend", "Submit", "Repair" and similar words mean that the Contractor (or his designated subcontractor) shall accomplish the action described.
E. "Codes" or "Code" means all codes, laws, statutes, rules, regulations, ordinances, orders, decrees, and other requirements of all legally constituted authorities and public utility franchise holders having jurisdiction.

F. "Products", "Materials" and "Equipment" are used interchangeably and mean materials, fixtures, equipment, accessories, etc.

G. "Utility Areas" are defined as mechanical, electrical, janitorial, and similar rooms or spaces which are normally used or occupied only by custodial or maintenance personnel. "Public Areas" are defined as the rooms or spaces, which are not included in the utility areas definition.

H. "Building Boundary" includes concrete walkways immediately adjacent to the building structure.

I. "Below Grade" means buried in the ground.

J. "Substantial Mechanical Completion" means all components of all systems are functioning but lacking in final adjustment.

K. Pressure rating specified (such as for valves and the like) means design working pressure for and with references to the fluid, which the device will serve.

1.05 RELATED WORK

A. Coordination: Refer to Architectural and Electrical Drawings for the construction details and coordinate the work of this Division with that of other Divisions. Order the work of this Division so that progress will harmonize with that of other Divisions and all work will proceed expeditiously. The work of this Division shall include direct responsibility for the correct placing and connection of mechanical work in relation to the work of other Divisions.

B. Examine other Divisions for work related to the Work of this Division, especially Electrical.

1.06 EXISTING CONDITIONS

A. Visit the site prior to bidding and investigate the existing conditions, which affect or will be affected by the work of this Division. Become thoroughly familiar with the working conditions and take into account any special or unusual features peculiar to this job. By the act of submitting a Bid, the Contractor will be deemed to have complied with the foregoing, to have accepted such conditions, and to have made allowance therefore in preparing his Bid.

B. The locations of existing concealed utility lines are shown in accordance with reference data received by the Architect. The Architect does not guarantee the accuracy of such data. The points of connection are therefore approximate and the Bidder shall include adequate funds in his Bid to cover costs of connection regardless of their exact location.

C. Exercise extreme caution during trenching operations. Repair the damage caused by such operations to existing utility lines at no cost to the Owner, whether the lines are shown on drawings or not.
1.07 DRAWINGS AND SPECIFICATIONS

A. These drawings and specifications do not include necessary components for construction safety.

B. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option".

C. Except where dimensioned, the drawings relating to this division are a diagrammatic presentation of the design concept, which indicates the general area where piping and ductwork is to be run. The drawings do not necessarily indicate any and all offsets and configurations required for coordination with other trades. The contractor is responsible for the correct placing of his work, and the proper location and connection of his work in relation to the work of other trades.

1.08 PERMITS AND INSPECTIONS

A. Obtain, schedule and pay for permits, licenses, approvals, tests, and inspections required by legally constituted authorities and public utility franchise holders having jurisdiction over the work.

B. Afford the Architect's representative every facility for evaluating the skill and competence of the mechanics and to examine the materials. Concealed work shall be reopened when so directed during his periodic visits.

1.09 CODES AND REGULATIONS

A. By submitting a Bid, Contractor is deemed to represent himself as competent to accomplish the work of this Division in conformance with applicable Codes. In case of conflict between the Contract Documents and Code requirements, the Codes shall take precedence. Should such conflicts appear, cease work on the parts of the contract affected and immediately notify the Architect in writing. It shall be the Contractor's responsibility to correct, at no cost to the Owner, any work he executes in violation of Code requirements. Specific references to codes elsewhere in this Division are either to aid the Contractor in locating applicable information or to deny him permission to use options, which are permitted by Codes.

B. Applicable Codes: (Current editions unless otherwise noted)
   1. All local codes; city and/or county as applicable.
   2. OSHA requirements
   3. California Code of Regulations (CCR) Titles (as applicable)
   4. Fire Marshal Regulations
   5. State, County, City Health Department Ordinances and Regulations
   6. Regulations of all other authorities having jurisdiction.

C. Where conflict or variation exists amongst Codes, the most stringent shall govern.

1.10 SUBMITTALS

A. General: Follow the procedures specified in Division 01.
B. Mechanical Submittals: Increase the number of mechanical related shop drawings, product data, and samples submitted to allow for required distribution by one additional copy, which will be retained by the Mechanical Consulting Engineer.

C. Product Data: Assemble "product data" into tabbed brochures according to main areas of work i.e. Plumbing; H.V.A.C.; Temperature Control; Testing, Adjusting, and Balancing.
   1. Assemble each brochure with tabbed separators for each Specification Section where products are noted to be submitted, with separate tabs for each product listed.
   2. Temperature "control shop drawings" may be submitted separately after preparations for review.
   3. For items such as valves, hangers and accessories, indicate specific items and where they are to be used.
   4. Contractor need only to submit for review those items specified to be submitted, unless requested by the Architect for special review.

D. Submit for review, only the specific items required in this Section or other Sections of Division 22.

E. Additional submittals shall include, but not limited:
   1. Air balance reports and equipment data record drawings.
   2. Certification of completion of testing.
   3. Certification of completion of operation instructions.
   4. Operating instruction brochure.
   5. Maintenance instruction brochures.
   7. 1/4" = 1'-0" or larger scale layouts of "Equivalent" equipment or "Or Approved Equal" equipment.
   8. Coordination Drawings, where requested or required.

F. Submittal materials will be reviewed for substantial conformity with the intent of the contract plans and specifications only. Such review does not indicate approval of dimensions, quantities, coordination with other trades, or work methods of the contractor, which are indicated thereon.

G. Additional copies may be required by individual sections of these specifications.

1.11 COORDINATION

A. The Contractor shall be responsible for coordinating the layout of all building elements to avoid conflict of the work of the structural, mechanical, electrical systems, and architectural features of the building.

B. The cost of any extra work of any kind caused by a conflict due to this lack of coordination shall be borne by the Contractor.

C. Contractor shall designate an individual competent and versed in the mechanical trades to coordinate the mechanical work with the work of other trades.
1.12 COORDINATION OF DRAWINGS

A. Prepare coordination drawings in accordance with Division 01 to a scale of 1/4" = 1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of the installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:

1. Indicate the proposed locations of piping, ductwork, equipment, and materials.
   Include the following:
   a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   b. Equipment for connections and support details.

2. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

B. Submittal of "Or Approved Equal" substitutions of equipment will not be reviewed unless accompanied by coordination drawings.

1.13 RECORD AND DOCUMENTATION

A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Record as specified in Division 01 the locations and invert elevations of underground installations.

2. Accumulate the following and deliver to the Owner's representative prior to final acceptance of the work.

3. Record (As-Built) Drawings:
   a. Maintain in good order in the field office a complete set of prints for all work being done under Division 15. Update the drawings daily with neat and legible annotations in red ink showing the work as actually installed.
   b. The actual size, location and elevation of all buried lines, valve boxes, manholes, monuments, and stub-outs shall be accurately located and dimensioned from building walls or other permanent landmarks.
   c. Furnish the originals.

4. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated mechanical systems and equipment. Seven copies of the manual, bond in hardback binders or an approved equivalent shall be provided to the Architect.

5. Furnish one complete manual prior to the time that system or equipment tests are performed.

6. Furnish the remaining manuals before the contract is completed.

7. The following identification shall be inscribed on the cover:

   OPERATION AND MAINTENANCE MANUAL

   PROJECT TITLE . . . . . . . .

   CONTRACTOR
8. Provide a table of contents. Insert tab sheets to identify discrete subjects. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in. The manual shall be complete in all respects for all materials, piping, valves, devices and equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:
   a. Updated approved materials lists, shop drawings and catalog information of all items of mechanical system equipment.
   b. System layout showing piping, valves and controls.
   c. Wiring and control diagrams with data to explain detailed operation and control of each component.
   d. A control sequence describing start-up, operation and shutdown.
   e. Detailed description of the function of each principal component of the system.
   f. Procedure for starting.
   g. Procedure for operating.
   h. Shut-down instructions.
   i. Installation instructions.
   j. Adjustments, maintenance and overhaul instructions.
   k. Lubrication schedule including type, grade, temperature range and frequency.
   l. Safety precautions, diagrams and illustrations.
   m. Test procedures.
   n. Performance data.
   o. Parts list, with manufacturer's names and catalog numbers.
   p. Preventive maintenance schedule.
   q. Service organization with name, address and telephone number.
   r. Valve identification chart and schedule.
   s. ASME certificates.
   t. Air balance report.

B. Standards Compliance: Where equipment or materials are specified to conform with requirements of standards of recognized technical or industrial organizations such as American National Standards Institute (ANSI) American Society for Mechanical Engineers (ASME) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), American Society for Testing and Materials (ASTM), Underwriters Laboratories (UL), American Gas Association (AGA), American Refrigeration Institute (ARI), or National Electrical Manufacturer's Association (NEMA), that use a label or published listing as a method of indicating compliance, proof of such conformance shall be submitted and approved. The label or listing of the specified organization will be acceptable evidence.

C. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements.

D. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

E. Factory Tests: Factory tests are tests, which are required to be performed on the actual materials or equipment, proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.
F. Permits and Certificates of Inspection: Furnish the originals.

G. Testing procedures and test results required in this and other sections. Furnish 2 copies.

H. Other data required by other sections of this Division. Furnish 2 copies.

1.14 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01.

1.15 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.16 EQUIVALENT EQUIPMENT

A. These specifications and/or drawings names and specifies certain equipment in detail. It also names equivalent equipment by manufacturer, which is not considered to be a "substitution".

B. Submit equivalent equipment to the Architect for review per the requirements of Division 01, and Section "Basic Mechanical Requirements."

C. Equipment of Manufacturers named in Division 22 will be considered equivalent to that specified in detail and/or named on the drawings if:
   1. The proposed equipment is of equivalent quality, capacity.
   2. Equipment is as fully equipped, fits the space allotted, and has physical configuration and weight similar to the equipment specified in detail.

D. A complete lay out of an equipment room or area must be submitted for equivalent equipment. Notice space limitations. Layouts to include plans and section views at a scale of not less than 1/4" = 1 ft.

E. The Architect shall determine the acceptability of "Equivalent Equipment."

1.17 CONSTRUCTION COST BREAK DOWN

A. Prepare and submit for review a construction cost breakdown for the major subdivisions of the mechanical work in accordance with General and Supplemental Conditions and Division 01.

B. Subdivide each item on the breakdown into two headings: labor and materials. Include overhead and profit in each entry.

C. Submit one copy of the breakdown directly to the Engineer and the remaining copies sent through regular channels.
1.18 TOOLS

A. Provide all special tools needed for proper operation and routine adjustment and maintenance of systems and equipment. Deliver tools to Owner's representative and request a receipt for same.

1.19 WARRANTIES

A. Refer to Division 01 Section for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Where periods more than one year are specified in the specifications, such longer periods shall govern. However, when any component fails at any time during this period, the warranty period for such component and all other components, which are inactive because of, said failure shall be suspended. The warranty period for such components shall resume running for the remaining portion of the warranty period when failed component is completely repaired and in operation; however, in no case shall the resumed portion of the warranty period be less than 3 months in duration.

C. Neither payment for work, nor total or partial occupancy of work by the Owner, within or prior to the warranty period specified, shall be construed as acceptance of faulty work or shall condone any negligence or omission of Contractor in doing the work.

D. Compile and assemble the warranties specified in Division 22, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

E. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names and addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.20 SEISMIC RESTRAINT

A. Provide seismic restraint for mechanical equipment, piping, and ductwork.

B. Contractor shall submit certification of suitability of seismic restraint methods signed by Structural Engineer registered in State of California.

C. Contractor may refer to details applicable in the SMACNA, "GUIDELINES FOR SEISMIC RESTRAINT OF MECHANICAL SYSTEMS", using the 'g' forces for "other buildings" classification CCR Title 24. Deliver a copy of these Guidelines to the Owner's Resident Inspector.

1.21 SYSTEM OPERATIONAL TEST

A. The Contractor shall inform the Owner one week prior to starting this testing in order that the Owner's representative may be present.

B. After balancing and prior to final inspection, the contractor shall operate all systems continuously trouble free and stable for a minimum period of fourteen (14) consecutive days including Saturday and Sunday. Each day shall be a minimum of an 8-hour day.
Should a problem arise, the fourteen (14) day period shall be restarted and repeated until successfully operated for full 14 days. A written report certified by the Owner's representative shall indicate the successful completion of a stable and trouble free 14-day period.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standard Products: Materials and equipment shall be essentially the standard cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be their latest standard designs that comply with the specification requirements.

B. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening, unless more stringent requirements are specified. Where two or more units of the same type of equipment are required, these units shall be products of a single manufacturer. The components thereof, however, are not required to be exclusively of the same manufacturer.

C. Each major component of equipment shall have manufacturer's name, address, model, and serial number on a nameplate securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

D. Whenever on the plans, or in these specifications, products are identified by the name of one manufacturer, it is intended that equivalent products of other manufacturers are acceptable, unless otherwise indicated, if accepted as a substitution by the Architect.

E. Where three or more manufacturers are listed as "acceptable manufacturers" however, then the products furnished shall be the product of one of the manufacturers listed. Manufacturers listed as "acceptable manufacturers" shall be considered "Equivalents" and shall meet quality and performance of a particular one specified by both name and catalog number.

2.02 PRODUCT LISTING

A. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work, except as otherwise indicated.

2.03 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model name, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.
2.04 SUBSTITUTIONS
   A. General: Submittals of "Substitutions" shall be in accordance with requirements of Division 01.
   B. By proposing a substitution, it is deemed that the Contractor shall bear the cost of any changes (whether architectural, structural, electrical or mechanical) necessary to accommodate the substitution, if said substitution is accepted.
   C. Specific: Refer to other sections of this Division for additional requirements.

2.05 SUBMITTALS
   A. General: Make submittals in accordance with requirements of Division 01.
   B. Specific: Refer to other sections of this Division for additional requirements.

PART 3 - EXECUTION

3.01 WORKMANSHIP AND INSTALLATION METHODS
   A. Workmanship shall be in the best standard practice of the trade.
   B. Install equipment in accordance with the manufacturer's instructions and recommendations unless otherwise noted or specified.

3.02 TEST
   A. General:
      1. Demonstrate that all components of the work of this Division have been provided and that they operate in accordance with the Contract Documents.
      2. Provide instruments and personnel for tests and demonstrations. Submit signed test results.
   B. Specific: Refer to the other sections of this Division for test requirements.

3.03 ROUGH-IN
   A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
   B. Refer to equipment specifications in Divisions 02 through 23 for rough-in requirements.

3.04 MECHANICAL INSTALLATIONS
   A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
      1. Coordinate mechanical systems, equipment, and materials installation with other building components.
      2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.

4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.

6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.

7. Coordinate connection of mechanical system with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.

9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.

10. All mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components in full compliance with the equipment manufacturer's recommendations. If the drawings or the manufacturer does not provide a specific space requirement for servicing equipment, provide as a minimum, horizontal distance of 36" from face of equipment to opposite vertical surface.

11. Install access panels or doors where units are concealed behind finished surfaces.

12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

13. Any equipment located above a ceiling that has any component, which is serviceable shall be installed within 12" of the top of the ceiling.

3.05 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01. In addition to the requirements specified in Division 01, the following requirements apply:
   1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
   1. Uncover Work to provide for installation of ill-timed Work.
   2. Remove and replace defective work.
   3. Remove and replace Work not conforming to requirements of the Contract Documents.
   4. Remove samples of installed Work as specified for testing.
   5. Install equipment and materials in existing structures.
   6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

F. Patch existing finished surfaces and building components using experienced installers and new materials matching existing materials. For installer’s qualifications refer to the materials and methods required for the surface and building components being patched.

3.06 DELIVERY, HANDLING, STORAGE OF MATERIALS AND PROTECTION OF WORK

A. Protect materials against dirt, water, chemical and mechanical damage both while in storage and during construction.

B. Cover materials in such a manner that no finished surfaces will be damaged, marred or splattered with plaster or paint, and all moving parts will be kept clean and dry.

C. Replace or refinish any damaged materials including fronts of control panels, ductwork fittings, and shop-fabricated ductwork.

D. Keep cabinets and other openings closed to prevent entry of foreign matter.

E. Specific: Refer to other sections of this Division for additional requirements.

3.07 PROJECT CONDITIONS

A. Check and coordinate for clearance, accessibility and placement of equipment either by going through openings provided or by placing equipment during construction. Ordering of equipment to be shipped disassembled, or disassembly of equipment at Project Site and reassembly of equipment to accomplish this requirement shall be executed without additional cost. Where provided openings are inadequate to accommodate equipment, provide new openings and restoration of same, all at no additional cost. Obtain written approval for new openings before proceeding.

B. Verify location of all plumbing fixtures and equipment within finished spaces with the Architectural Drawings. In the event that Mechanical Drawings do not indicate exact locations, or are in conflict with the Architectural Drawings, obtain information regarding proper locations. Installation of work without proper instruction under such circumstances will result in relocation of work, when directed, without additional cost.

3.08 INSTRUCTION TO OWNER PERSONNEL

A. When specified in other sections, the Contractor shall furnish, without additional expense to the Owner, the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified.
Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance of work. Instruction shall be given at the Owner's convenience. The number of man-days (eight-hours) of instruction furnished shall be as specified in other sections. When more than four man-days of instruction are specified, approximately half of the time shall be used for classroom instruction. All other time shall be used for instruction with the equipment or system. When significant changes or modifications are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

B. Contractor shall videotape, both visual and audio, instruction to Owner's personnel on the maintenance and operation of the mechanical systems.

C. Submit certification, signed by Owner's agent that instructions have been completed and the videotape has been reviewed and delivered to the Owner.

D. Printed operating instructions and a copy of wiring diagrams are to be mounted in all equipment areas, framed and behind glass or encased in plastic. Printed operating instructions shall include steps for starting up and securing equipment. As a precedent to final acceptance four (4) copies of instructions are to be submitted to the Architect for review. Contractor shall turn over to Owner in a neat brochure form, equipment guarantee and maintenance instructions.

3.09 CLEANING

A. Cleaning shall be done as the work proceeds. Periodically remove waste and debris to keep the site as clean as is practical.

B. Refer the Division 01 Section: for general requirements for final cleaning.

C. Leave exposed parts of the mechanical work in a neat, clean and usable condition, with painted surfaces unblemished and plated metal surfaces polished.

D. Thoroughly clean all materials, equipment and appliances. Clean and prepare all surfaces to be painted. Clean the entire premises of unused materials, debris, spots and marks to the satisfaction of the Architect.

E. Remove, thoroughly clean and replace all strainers and automatic valves after the system has been put in operation until system is clear of all foreign matter and repeat this operation after ten (10) days and again after the system has been in operation thirty (30) days. Submit certification that this operation has been completed.

3.10 SAFETY REQUIREMENTS

A. Enclose and guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts in accordance with OSHA requirements. Insulate, guard, and cover any high-temperature equipment and piping so located as to endanger personnel or create a fire hazard.

END OF SECTION 22 0500
SECTION 22 0503
EARTHWORK FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES
A. This Section includes limited scope instructions for methods and materials applicable to excavation for underground utilities and services, including underground piping under the building and from building to utility connection, tanks, basins, and equipment.

1.02 SUBMITTALS
A. Submit schedules in accordance with Conditions of Contract and Divisions 01 and 22 specification sections.
   1. Indicate proposed methods and schedule of operations prior to commencement of work.
   2. Include coordination for shut off of utility services where required.
   3. Maintain services to areas outside construction limits, where such service exists.
   4. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01.

1.03 DEFINITIONS
A. Excavation consists of removal of material encountered to sub-grade elevations indicated and subsequent disposal of materials removed.

B. Unauthorized excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction of Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be at Contractor's expense.

C. Sub-grade: The undisturbed earth or the compacted soil layer immediately below granular sub-base drainage fill, or topsoil materials.

D. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.

1.04 CODES AND ORDINANCES
A. Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.

1.05 PROJECT CONDITIONS
A. Conditions Affecting Excavations: The following project conditions apply:
   1. Maintain and protect existing building services which transit the area affected by selective demolition.
2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.

B. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.

C. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations. Remove existing underground utilities indicated to be removed.

D. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.

E. Use of Explosives: Use of explosives is not permitted.

1.06 SEQUENCE AND SCHEDULING

A. Coordinate the shut off and disconnection of utility services with Owner and utility company.

B. Provide minimum of 48-hour notice to Architect prior to utility interruption.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Select Bedding Sand: Dry river bed sand free of any debris or organic matter.

B. Mastic Coatings: "Henry's" oil base roof mastic or approved equal.

C. Polyethylene sheeting not less than 8 mils thick.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where earthwork is to occur. Determine extent of work and effect on existing conditions to remain. Advise Architect of any conditions that might create extensive alteration beyond indicated scope.

B. Clearances: Take special notice and maintain the required horizontal and vertical depth clearances from structural footings for utility trenches running parallel to footings. Do not violate the area of the footing bearing prism.
In the event of conflict (i.e., the utility cannot be relocated or its depth changed), proceed as directed by the Architect. Lower structural footings to maintain proper clearances for underground utilities trenching without additional cost to Owner.

3.02 EXCAVATION

A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.

B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
   1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

C. Install sediment and erosion control measures in accordance with local codes and ordinances.

3.03 DEWATERING

A. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
   1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
   2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

3.04 MATERIAL STORAGE

A. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
   1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
   2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

3.05 TRENCHING

A. Do all necessary trenching, excavation, shoring and backfilling required for the proper laying of the pipe lines.

B. Pipe Trench Dimensions: The following requirements are considered minimal unless otherwise indicated, in order to provide adequate pipe clearances and bedding. Provide trenches wider than the specified minimum where required to properly install the particular type of piping. In the event utility company regulations, code requirements, or the pipe manufacturer’s recommendations differ from these provisions, the most restrictive requirements shall take precedence:
1. Pipe Burial Depths:
   - Sewer & Drainage: 24"(a) + pipe O.D.(b) + 3" bed of sand
   - Gas: 30" + pipe O.D. + 4" bed of sand
   - Water (Domestic)
     - PVC: 30" + pipe O.D. + 4" bed of sand
     - All other: 24" (30" at planters) + pipe O.D. + 4" bed of sand
   - Pre-insulated Piping: 24" + jacket O.D. + 4" bed
   - Condenser Water (PVC): 30" + pipe O.D. + 4" bed

Notes:
   a. Finish grade to top of pipe, typical.
   b. O.D.: Outside dimension.

2. Trench Widths:
   - Sewer & Drainage: 12" + pipe O.D. for 4" to 18" diameter pipe
   - Gas: 8" + pipe O.D.
   - Water (Domestic): 8" + pipe O.D.
   - Water (Fire):
     - Pre-insulated Pipe: 8" + jacket O.D.
     - Condenser Water: 8" + pipe O.D.

C. Where rock is encountered, carry excavation below required elevation and backfill with a layer of select bedding sand prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.

D. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.

E. Do not install copper piping or metal gas piping in a common trench with other dissimilar metal piping or conduit; separate a minimum of 4 feet when running parallel to such piping or conduit.

F. Separate multiple parallel lines of piping in a common trench a minimum of 12 inches, both horizontally and vertically, between individual pipes.

G. Install domestic water piping, running parallel in a common trench with sewer or drainage lines, on a solid shelf 12 inches above the sewer or drainage piping.

H. Do not run electrical power and communications conduit in a common trench with sewer, drainage, water or gas piping.

I. Provide and install a bare 14 gauge copper "tracer" wire, continuous for entire length, for all underground non-metallic piping. Secure to piping at alternate joints, at each fitting and at each valve. Locate "Tracer" wire along side pipe, but not under pipe.
J. Install thrust blocks in all pressurized lines. Install thrust blocks in accordance with pipe manufacturer’s recommendations.

3.06 EXCAVATION FOR UNDERGROUND CLARIFIERS AND STRUCTURES

A. Excavation for Underground Tanks, Basins, and Mechanical Structures: conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
   1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter larger with emulsified asphalt tree paint.
   2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

3.07 BACKFILLING AND FILLING

A. Backfilling and Filling: Place soil materials in layers to required sub-grade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

B. Bedding: Lay and bed pipe in compacted select dry river-bed bedding sand, thickness as specified herein and backfill with the same sand material to a height of one foot above the top of pipe.
   1. Sewer drain lines except as hereinafter specified may be bedded in the native soil provided it is rock free and sandy. Dig out under bell portions of the piping for uniform bearing.
   2. Under walks and pavements, use a combination of sub-base materials and excavated or borrowed materials.
   3. Under building slabs, set piping on a 6-inch bed of dry river-bed sand and backfilled to 12” of finish grade with dry river-bed sand. Remainder of backfill to be approved backfill material.
   4. Under piping and equipment, use sub-base materials where required over rock bearing surface and for correction of unauthorized excavation.
   5. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of piping, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway sub-base.
   6. Other areas use excavated or borrowed materials.

C. Backfill excavations as promptly as work permits, but not until completion of the following:
   1. Do not backfill until installation has been approved and as-built drawings are up to date.
   2. Inspection, testing, approval, and locations of underground utilities have been recorded.
   4. Removal of shoring and bracing, and backfilling of voids.
   5. Removal of trash and debris.
D. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

E. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage as specified in Division 02. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

F. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

G. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 deg. F.

H. Unauthorized excavation:
   1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Architect.
   2. In locations other than those above, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Architect.

3.08 SUBSIDENCE

A. Subsidence: Where subsidence occurs at mechanical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.09 CORROSION PROTECTION

A. All below ground metallic fittings, valves, flanges, bolts, pipes (which are not factory coated with a bituminous material) shall be protected against corrosion as follows:
   1. All metallic components as described above shall receive a heavy coating of "Henry's" oil base roof mastic.
   2. After mastic coating is completed and inspected, wrap entire metallic component with a minimum of 8 mil polyethylene wrap overlapped 50% of the circumference and extended beyond ends of component as required for polyethylene to be secured to piping. The overlap seam shall be located to avoid backfill material from entering the encapsulated area. The ends and seam of the polyethylene material shall be secured to the piping and sealed with 3M Scotch/Wrap N. 50, 10 mil., 2" wide, printed, pipe wrap sealing tape.
   3. The mastic coating shall be inspected and approved prior to the finish application of the polyethylene material, which shall also be inspected.

END OF SECTION 22 0503
SECTION 22 0514

SELECTIVE PLUMBING DEMOLITION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes limited scope of selective plumbing demolition work as follows:
   1. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
   2. Dismantling plumbing materials and equipment made obsolete by these installations.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 and Division 22 Specification Sections.

B. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
   1. Coordinate sequencing and Owner occupancy specified in Division 01.
   2. Coordinate other selective demolition work as outlined in Division 01.

1.03 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:
   1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
   2. Locate, identify, and protect plumbing services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas. Provide minimum of 72-hour notice to Owner prior to utility interruption.

1.04 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of utility services with the Owner and the utility company.

B. Notify the Architect at least 7 days prior to commencing demolition operations.

C. Perform demolition in phases as indicated.

PART 2 - PRODUCTS (Not Applicable)
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where selective demolition is to occur. Determine extent of work and affect on existing conditions to remain. Advise Architect of any conditions that might create extensive alterations beyond indicated scope.

3.02 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned plumbing materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing plumbing materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

1. Protect all removed and salvaged equipment from being damaged during the demolition work.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. Plumbing Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete piping, fittings and specialties, equipment, air distribution ductwork and all associated accessories, controls, fixtures, and insulation.
   a. Obtain written approval form Architect and owner for piping and ducts embedded in floors, walls, and ceilings which may remain if such materials do not interfere with new installations.
   1) Drain and cap piping and ducts allowed to remain.
   b. Remove materials above accessible ceilings.

2. Perform cutting and patching required for demolition.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED SECTIONS

A. Division 22 Section "Identification For Plumbing Piping And Equipment" for valve tags and charts.

1.02 SECTION INCLUDES

A. This Section includes general duty valves common to most mechanical piping systems.
   1. Special purpose valves are specified in individual piping system specifications.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract, Division 01 Specification Sections, and Section 22 0500 "Common Work Results for Plumbing."
   1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.
   2. Provide valve schedule showing manufacturer's figure numbers and sizes.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Comply with the requirements specified in Division 01 Section "Materials and Equipment," under "Source Limitations."

B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

C. Manufacturer’s Standardization Society of the Valve and Fittings Industry (MSS) Compliance): Comply with the various MSS Standard Practices referenced.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves for shipping as follows:
   1. Ensure valves are dry and internally protected against rust and corrosion.
   2. Protect valve ends against damage to threads, flange faces, and weld-end preps.
   3. Set valves in best position for handling. Set globe and gate valves closed to prevent rattling; set ball and plug valves open to minimize exposure of functional surfaces; and block swing check valves in either closed or open position.

B. Storage: Use the following precautions during storage:
   1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
   2. Protect valves from weather. Store valves indoor. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

2.02 VALVE FEATURES, GENERAL

B. Valve Design: Rising stem or rising outside screw and yoke stems.
   1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.

C. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.

D. Sizes: Same size as upstream pipe, unless otherwise indicated.

E. Operators: Provide the following special operator features:
   1. Hand wheels, fastened to valve stem, for valves other than quarter turn.
   2. Lever handles, on quarter-turn valves 6-inches and smaller, except for plug valves. Provide plug valves with square heads; provide one wrench for every 10 plug valves.
   3. Chain-wheel operators, for valves 2-1/2 inch and larger, install 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
      a. Provide gear drive operators, on quarter-turn valves 8-inch and larger.

F. Extended Stems: Where insulation is indicated or specified provide extended stems arranged to receive insulation.

G. End Connections: As indicated in the valve specifications.
      a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg. F for gate, globe, and check valves; below 421 deg. F for ball valves.

2.03 GATE VALVES

A. Gate Valves, 2-Inch and Smaller: MSS SP-80; Class 150, body and union bonnet of ASTM B62 cast bronze; with threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron hand wheel. Do not use solder end valves for hot water heating or steam piping applications.
### MANUFACTURER | THREADED NRS | THREADED RS | SOLDER NRS | SOLDER RS
--- | --- | --- | --- | ---
Crane | X | 431UB | X | X
Grinnell | | 3050 | 3060 | X | X
Milwaukee | 1141 | 1151 | X | 1169
Nibco | T-136 | T-135 | S-136 | X
KITZ | X | 42 | X | 43

*X* means not available. Provide 'lead-free' valves where applicable.

**B. Gate Valves, 2-1/2 Inch and Larger:** MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A126 class B; with flanged ends, "Teflon" impregnated packing, and two-piece backing gland assembly.

### MANUFACTURER | OS & Y RS | NRS
--- | --- | ---
Crane | 465-1/2 | 461
Grinnell | 6020A | 6060A
Nibco | 617-O | F-619
Milwaukee | F-2885 | F-2882
KITZ | 72 | 75

Provide 'lead-free' valves where applicable.

#### 2.04 BALL VALVES

**A. Ball Valves, 2 Inches and Smaller:** Rated for 150 psi saturated stem pressure, 400 psi WOG pressure; two- or three-piece construction; with bronze body conforming to ASTM B 62, full port only, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, and vinyl covered steel handle. Provide solder ends for condenser water, chilled water, and domestic hot and cold water service; threaded ends for heating hot water and low-pressure steam.
Ball Valves - 1 Inch and Smaller:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>THREADED ENDS</th>
<th>SOLDER ENDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>9302</td>
<td>9322</td>
</tr>
<tr>
<td>Nibco</td>
<td>T-580-70</td>
<td>S-580-70</td>
</tr>
<tr>
<td>Stockham</td>
<td>S-216 BR-R-T</td>
<td>S-216-BR-R-S</td>
</tr>
<tr>
<td>Watts</td>
<td>B-6000</td>
<td>B-6001</td>
</tr>
<tr>
<td>Milwaukee</td>
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<td>BA-150</td>
</tr>
<tr>
<td>KITZ</td>
<td>58</td>
<td>59</td>
</tr>
</tbody>
</table>

"X" means not available. Provide 'lead-free' valves where applicable.

Ball Valves - 1-1/4 Inch to 2 Inch:

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>THREADED ENDS</th>
<th>SOLDER ENDS</th>
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</thead>
<tbody>
<tr>
<td>Conbraco (Apollo)</td>
<td>82-100</td>
<td>82-200</td>
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<tr>
<td>Nibco</td>
<td>T-590-Y</td>
<td>S-590-Y</td>
</tr>
<tr>
<td>Stockham</td>
<td>S-216 BR-R-T</td>
<td>S-216-BR-R-S</td>
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<tr>
<td>Watts</td>
<td>B-6800</td>
<td>B-6801</td>
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<tr>
<td>KITZ</td>
<td>62</td>
<td>63</td>
</tr>
</tbody>
</table>

"X" means not available. Provide 'lead-free' valves where applicable.

B. For grooved end connections, use Victaulic Style 721.

2.05  PLUG VALVES

A. Plug Valves, 2-Inch and Smaller: Rated at 150 psi WOG; bronze body, with straightaway pattern, square head, and threaded ends.
   1. Lunkenheimer: 454 or equal.
   2. Homestead: 611 (Semi Steel Body) or equal.

B. Plug Valves, 2-1/2 Inch and Larger: MSS SP-78; rated at 175 psi WOG; lubricated plug type, with semi steel body, single gland, wrench operated and flanged ends.
   1. Powell: 2201 or equal.
   2. Homestead: 605 or equal.
### 2.06 GLOBE VALVES

A. Globe Valves, 2-Inch and Smaller: MSS SP-80; Class 125; body and screwed bonnet of ASTM B 62 cast bronze; with threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron hand wheel. Provide Class 150 valves meeting the above where system pressure requires.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>CLASS 125 THREADED</th>
<th>CLASS 150 SOLDER</th>
<th>THREADED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>1</td>
<td>1310</td>
<td>17TF</td>
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<td>Milwaukee</td>
<td>502</td>
<td>1502</td>
<td>590</td>
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<td>Nibco</td>
<td>T-211-B</td>
<td>S-211-B</td>
<td>T-235-Y</td>
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<td>T-211-Y</td>
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</tr>
<tr>
<td>KITZ</td>
<td>11</td>
<td>12</td>
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</tr>
</tbody>
</table>

B. Globe Valves, 2-1/2-Inch and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; with outside screw and yoke, bronze mounted, flanged ends, and "Teflon" impregnated packing, and two-piece backing gland assembly.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>STRAIGHT BODY</th>
<th>ANGLE BODY</th>
</tr>
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<tbody>
<tr>
<td>Crane</td>
<td>351</td>
<td>353</td>
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<tr>
<td>Milwaukee</td>
<td>F2981</td>
<td>F2986</td>
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<tr>
<td>Nibco</td>
<td>F-718-B</td>
<td>F-818-B</td>
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<tr>
<td>KITZ</td>
<td>76</td>
<td>X</td>
</tr>
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</table>

"X" means not available.

### 2.07 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 125, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and bronze disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150 valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.
GENERAL DUTY VALVES FOR PLUMBING PIPING

22 0523-6

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>CLASS 125 THREADED ENDS</th>
<th>CLASS 125 SOLDER ENDS</th>
<th>CLASS 125 THREADED ENDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>37</td>
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<td>Milwaukee</td>
<td>509</td>
<td>1509</td>
<td>510</td>
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<tr>
<td>Nibco</td>
<td>T-413</td>
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<td>T-433</td>
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<tr>
<td>KITZ</td>
<td>22</td>
<td>23</td>
<td>29</td>
</tr>
</tbody>
</table>

For grooved connections, use Victaulic Series 712.

B. Swing Check Valves, 2-1/2 Inch and Larger: MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), cast iron body and bolted cap conforming to ASTM A 126, Class B; horizontal wing, and bronze disc or cast-iron disc with bronze disc ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>CLASS 125</th>
<th>CLASS 175</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crane</td>
<td>373</td>
<td>X</td>
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<tr>
<td>Milwaukee</td>
<td>F2974</td>
<td>X</td>
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<tr>
<td>Nibco</td>
<td>F-918</td>
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<tr>
<td>KITZ</td>
<td>78</td>
<td>X</td>
</tr>
</tbody>
</table>

For grooved connections, use Victaulic Series 712.

“X” means not available.

C. Lift Check Valves, 2-Inch and Smaller: Class 125; cast-bronze body and cap conforming to ASTM B 62; horizontal or angle pattern, lift-type valve, with stainless steel spring, bronze disc holder with renewable "Teflon" disc, and threaded ends. Provide valves capable of being refitted and ground while the valve remains in the line.

<table>
<thead>
<tr>
<th>MANUFACTURER</th>
<th>HORIZONTAL</th>
<th>ANGLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jenkins</td>
<td>655-A</td>
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<tr>
<td>Lunkenheimer</td>
<td>233</td>
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</tbody>
</table>

“X” means not available.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.

B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

C. Examine threads on both the valve and the mating pipe for form (i.e., out-of-round or local indentation) and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

3.02 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:
   1. Copper Tube Size, 2-Inch and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
   2. Steel Pipe Sizes, 2-Inch and Smaller: threaded or grooved end.
   3. Steel Pipe Sizes 2-1/2 Inch and Larger: grooved end or flanged.

3.03 VALVE INSTALLATIONS

A. General Application: Refer to piping system specification sections for specific valve applications and arrangements. Use gate, ball, and butterfly valves for shut-off duty. Use globe, plug, and ball valves for throttling duty.

B. Locate valves for easy access and provide separate support where necessary. Where concealed, install behind access panel with valve located for complete accessibility for servicing.

C. Install valves and unions for each fixture and item of equipment. Arrange valves to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.

E. Install valves in horizontal piping with stem at or above the center of the pipe.

F. Install valves in a position to allow full stem movement.
G. Installation of Check Valves: Install for proper direction of flow as follows:
   1. Swing Check Valves: Horizontal position with hinge pin level.
   2. Lift Check Valve: With stem upright and plumb.

H. Where shut-off valves are installed in a confined space such as in a wall or furring, install ball valves with operating handle parallel with face of wall.

I. Where valves are located in walls, do not install more than 6'-0" from finished floor. Where valves are located above ceiling, install valve centered on access point and not greater than 24" above access point.

3.04 SOLDER CONNECTIONS

A. Cut tube square and to exact lengths.

B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket in same manner.

C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.

D. Open gate and glove valves to full open position.

E. Remove the cap and disc holder of swing check valves having composition discs.

F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.

G. Apply heat evenly to outside of valve around joint until solder will melt upon contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

H. Use 95-5 tin/antimony 'lead-free' solder for all solder joints unless indicated otherwise.

3.05 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.06 FLANGED CONNECTIONS

A. Align flange surfaces parallel.
B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.07  FIELD QUALITY CONTROL

A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.08  ADJUSTING AND CLEANING

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.09  VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

A. Below schedules are for standard installation conditions. Variations or special valves and/or conditions set forth in other Division 22 Sections shall take precedence.

<table>
<thead>
<tr>
<th>VALVES, 2-INCH AND SMALLER</th>
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<tbody>
<tr>
<td>SERVICE</td>
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<tr>
<td>Condenser Water</td>
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<tr>
<td>Chilled Water</td>
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<tr>
<td>Domestic Hot and Cold Water</td>
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<tr>
<td>Heating Hot Water</td>
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<table>
<thead>
<tr>
<th>VALVES, 2-1/2 INCH AND LARGER</th>
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<tr>
<td>SERVICE</td>
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<td>Heating Hot Water</td>
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END OF SECTION 22 0523
SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of supports and anchors required by this section is indicated on drawings or in other Division 22 Sections and include the following:
   1. Horizontal-Piping Hangers and Supports;
   2. Vertical-Piping Clamps;
   3. Hanger-Rod Attachments;
   4. Building Attachments;
   5. Saddles and Shields;
   6. Miscellaneous Materials;
   7. Anchors;
   8. Equipment Supports.

1.02 RELATED SECTIONS

A. This section is part of each Division 22 Section making reference to or requiring supports and anchors specified herein.

B. Supports and anchors furnished as part of factory-fabricated equipment are specified as part of equipment assembly in other Division 22 Sections.

C. Section: Cast-in-Place Concrete.

1.03 QUALITY ASSURANCE

A. Codes and Standards:
   1. Code Compliance: Comply with 2013 CBC and ASCE 7-10, and applicable plumbing codes pertaining to product materials and installation of supports and anchors.
   2. UL and FM Compliance: Provide products which are UL-listed and FM approved.
   3. MSS Standard Compliance:
      a. Provide pipe hangers and supports of which materials, design, and manufacturer comply with MSS SP-58.
      b. Select and apply pipe hangers and supports, complying with MSS SP-69.
      c. Fabricate and install pipe hangers and supports, complying with MSS SP-89.
      d. Terminology used in this section is defined in MSS SP-90.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.
PART 2 - PRODUCTS

2.01 MANUFACTURED UNITS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.
   1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
   2. Pipe attachments shall have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with a sheet metal shield. Insert and shield shall cover entire circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

2.02 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. General: Except as otherwise indicated, provide factory fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.
   1. Adjustable Steel Clevis Hangers
   2. Adjustable Swivel Pipe Rings

2.03 VERTICAL-PIPING CLAMPS

A. General: Except as otherwise indicated, provide factory fabricated vertical-piping clamps complying with MSS SP-58, of one of the following types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.
   1. Two-Bolt Riser Clamps

2.04 HANGER-ROD AND BUILDING ATTACHMENTS

A. General Hanger Rod Attachment: Refer to structural drawings for requirements of hanger rod and building attachments. If a specific attachment that is required is not detailed on the structural drawings, one of the following attachments may be submitted for review by the structural engineer prior to installation. Except as otherwise indicated, provide factory fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachment to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
B. General Building Attachment: Except as otherwise indicated, provide factory fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer’s published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.
1. Concrete Inserts
2. Center Beam Clamps
3. Steel Beam Clamps W/Eye Nut
4. Linked Steel Clamps W/Eye Nut
5. Malleable Beam Clamps
6. Steel Brackets: One of the following for indicated loading
7. Light Duty

2.05 SADDLES AND SHIELDS

A. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

B. Protection Shields: MSS Type 40; provide high density insert of same thickness of insulation.

2.06 MANUFACTURERS OF HANGERS AND SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide hangers and supports of one of the following:
1. B-Line Systems, Inc.
2. Tolco, Inc.
3. Elcen Metal Products Co.
5. ITT Grinnel Corp.

2.07 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes and Bars: ASTM A36.

B. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

C. Pipe Alignment Guides: Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

D. Pipe Roll Stand: Factory fabricated cast iron stand, size as required, with insulation installed on piping.
2.08 ISOLATORS
   A. Isolators: Provide factory-fabricated isolators of size required.

PART 3 - EXECUTION

3.01 INSPECTION
   A. Examine substrates and conditions under which supports and anchors are to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION
   A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachment.
   B. Prior to installation of hangers, supports, anchors and associated work, installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Architect/Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.03 INSTALLATION OF BUILDING ATTACHMENTS
   A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.04 INSTALLATION OF HANGERS AND SUPPORTS
   A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and type as installed for adjacent similar piping.

C. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

D. Provisions of Movement: Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors.

E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

F. Pipe Slopes: Install hangers and supports to provide required pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.

G. Bare Piping: Install isolators for all bare domestic water piping.

H. Insulated Piping: Comply with the following installation requirements.
   1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
   2. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. Provide rigid insulation reinforcement at shields.

I. Hangers and supports to be capable to resist the minimum seismic forces indicated in drawings.

3.05 EQUIPMENT SUPPORTS

A. Furnish to Contractor, scaled layouts of all required bases, with dimensions of bases, and location to column center lines. Furnish templates, anchor bolts, and accessories, necessary for base construction.

3.06 ADJUSTING AND CLEANING

A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.

B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.

C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces.
   1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
E. For galvanized surfaces clean welds bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A-780.

END OF SECTION 22 0529
SECTION 22 0553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of mechanical identification work required by this section is indicated on drawings or specified in other Division 22 Sections, and includes the following:
   1. Painted Identification Materials
   2. Plastic Pipe Markers
   3. Plastic Tape
   4. Underground-Type Plastic Line Marker
   5. Plastic Duct Markers
   6. Valve Tags
   7. Diagram and Schedule Frames
   8. Engraved Plastic-Laminate Signs
   9. Plastic Equipment Markers
   10. Plasticized Tags
   11. Equipment Marker

1.02 RELATED SECTIONS

A. This section makes reference to identification devices specified herein.

B. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division 22 Sections.

C. Refer to Division 26 Sections for identification requirements of electrical work; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules and Diagrams:
   1. Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule.
   2. Submit temperature control diagrams and Sequence of Operation on bond paper suitable for framing.
D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 01 and Division 22, Section 22 0500.

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
   2. No adhesive type identification markers will be accepted. All markers and tags shall be permanently attached to pipe, etc.
   3. All identification markers installed exterior of buildings shall be ultra-violet resistant.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
   1. Allen Systems, Inc.
   3. Industrial Safety Supply Co., Inc.
   4. Seton Name Plate Corp.

2.02 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 Sections. Where more than a single type is specified for application, selection is Installer's option, but provide a single selection for each product category.

2.03 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on un-insulated pipes subject to fluid temperatures of 125°F (52°C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

C. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   2. Laminated or bonded application of pipe marker to pipe (or insulation).
   3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

D. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, taped lapped 3".
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

E. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.
   1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

2.04 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.05 UNDERGROUND-TYPE PLASTIC LINE MARKER

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.
   1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.06 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamped-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high and with 5/32" hole for fastener.
   1. Provide 1-1/2" diameter tags, except as otherwise indicated.
   2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Access panel markers: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

D. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.
2.07 DIAGRAM AND SCHEDULE FRAMES

A. General: For each page of schedule and/or diagrams, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.08 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver’s standard letter style of the sizes and wording indicated, white with black core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16” for units up to 20 sq. in. or 8” length; 1/8” for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.09 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

2.10 EQUIPMENT MARKERS

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
   a. Manufacturer, product name, model number, and serial number.
   b. Capacity, operating and power characteristics, and essential data.
   c. Labels of tested compliances.

2. Location: Accessible and visible.

3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.

2. Data.

3. Name and plan number.
   a. Equipment service.
   b. Design capacity.
   c. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

4. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine sub-core, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
   1. Data: Instructions for operation of equipment and for safety procedures.
   2. Engraving: Manufacturer’s standard letter style, of sizes and with terms to match equipment identification.
   3. Retain and edit subparagraph above or first subparagraph below.
   4. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
   5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
   1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.11 PLASTIC DUCT MARKERS

A. Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finishes, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
   1. Plastic pipe markers, with application system as indicated under “Materials” in this section. Install on pipe insulation segment where required for hot-non-insulated pipes.

B. Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
   1. Near each valve and control device.
   2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
   3. Near locations where pipes pass through walls, floors ceilings, or enter non-accessible enclosures.
4. At access doors, manholes similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50’ along each piping run, except reduce spacing to 25’ in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.03 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping systems, except sanitary sewer and storm drainage install continuous underground-type plastic line marker, located directly over buried line at 6” to 8” below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16”, install single line marker.

3.04 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve on valve schedule for each piping system.

B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

3.05 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
   1. Fuel-burning units including boilers, furnaces, heaters.
   2. Pumps, compressors, chillers, condensers and similar motor-driven units.
   3. Fans and blowers.
   4. Packaged HVAC central-station or zone-type units.
   5. Split air conditioner indoor and outdoor units.
   6. Single Duct terminal units and all equipment in ceiling space. (In addition to the equipment tag, install an identification tag for VAV units in locations approved by architect to indicate where each unit is installed above the ceiling. Coordinate the Installation location, type, size and color of this tag with the architect.).

B. Lettering Size: Minimum 1/4” high lettering for name of unit where viewing distance is less than 2'-0", 1/2” high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

C. Test of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
3.06 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 22 0553
SECTION 22 0700
PLUMBING INSULATION

PART 1 - GENERAL

1.01  SECTION INCLUDES

A. Extent of plumbing insulation required by this section is indicated on drawings and schedules, and by requirements of this section, and includes the following:

1. Piping Systems Insulation:
   a. Fiberglass.
   b. Calcium Silicate.
   c. Flexible Unicellular.

2. Equipment Insulation:
   a. Fiberglass
   b. Calcium Silicate
   c. Flexible Unicellular.

1.02  RELATED SECTIONS

A. Refer to Division 22 Section "Identification For Plumbing Piping And Equipment" for installation of identification devices for piping and equipment; not work of this section.

1.03  SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of plumbing insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each plumbing system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of plumbing insulation. Include this data and product data in maintenance manual.

1.04  QUALITY ASSURANCE

A. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

B. As a minimum, insulation shall meet installed conductance as set forth in Title 24 California Code of Regulations (CCR) 2013 Building Energy Efficiency Standards or as indicated in contract documents, whichever is greater.

1.05  DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.
PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corp.
   3. Knauf Fiber Glass GmbH.
   4. Manville Products Corp.
   5. Owens-Corning Fiberglas Corp.

2.02 PIPING INSULATION MATERIALS


B. Calcium Silicate Piping Insulation: ASTM C533, Type I. Owens-Corning Fiberglass Corp. "Kaylo Asbestos Free" or equivalent.

C. Flexible Unicellular Piping Insulation: ASTM C534, Type I. Armstrong World Industries, Inc. meeting ASTM E-84 25/50 index.

D. Jackets for Piping Insulation: ASTM C921, Type I (Vapor Barrier) for piping with temperatures below ambient. (Type II (Water Vapor Permeable) for piping with temperatures above ambient. Type I may be used for all piping at Installer's option.
   1. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations. Zeston PVC Insulated fitting covers or equivalent.
   2. Encase exterior piping insulation with aluminum jacket with weather-proof construction.

E. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

F. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

G. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.03 EQUIPMENT INSULATION MATERIALS

A. Flexible Fiberglass Equipment Insulation: ASTM C553, Type II, Class F-1, Owens-Corning Fiberglass, Inc., Type 701 1.5 lbs/Ft3.

B. Calcium Silicate Equipment Insulation: ASTM C533, Type I, Block; Owens/Corning Fiberglass, Inc., Kaylo Asbestos Free, U-Grooved block insulation.

C. Jacketing Material for Equipment Insulation: Provide canvas jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.
D. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

E. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape corner angles, anchors and stud piping as recommended by insulation manufacturer for applications indicated.

F. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which plumbing insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 EQUIPMENT INSULATION

A. Cold Equipment (Below Ambient Temperature):

1. Application requirements: Insulate the following cold equipment:
   a. Refrigeration equipment, including chillers, tanks and pumps.
   b. Drip pans under chilled equipment.
   c. Cold and chilled water pumps.
   d. Pneumatic water tanks.

2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
   a. Fiberglass: 2” thick for cold surfaces above 35°F and 3” thick for surfaces 35°F and lower.

B. Hot Equipment (Above Ambient Temperature):

1. Application Requirements: Insulate the following hot equipment:
   a. Boilers (not pre-insulated at factory).
   b. Water heaters.
   c. Hot water expansion tanks.
   d. Hot water pumps.

2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation.
   a. Fiberglass: 2” thick, except 3” thick for low-pressure boilers and steam-jacketed heat exchangers.

3.03 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer’s written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.
C. Install insulation materials with smooth and even surfaces. Insulated each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

H. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

3.04 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Do not apply insulation to equipment, breechings, or stacks while hot.

E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

F. Coat insulated surfaces with layer of insulating cement, trowel in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

H. Do not insulate boiler manholes, hand-holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

J. Equipment exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by the manufacturer.
3.05 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 0700
SECTION 22 1000

PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. The following sections contain requirements that relate to this section:
   1. Division 22 Section 22 0500 applies to the work of this Section.
   2. Piping materials and installation methods peculiar to individual systems are specified within their respective system specification sections of Division 02 and 22.
   3. Valves are specified in a separate section and in individual piping system sections of Division 22.
   4. Expansion Compensation is specified within the respective system specification section of Division 22.
   5. Division 22 0529 "Hangers And Supports For Plumbing Piping And Equipment".
   6. Division 22 0553 "Plumbing Identification".

1.02 SECTION INCLUDES

A. This Section specifies piping materials and installation methods common to more than one section of Division 22 and includes joining materials, fire stop sealants, and basic piping installation instructions.

1.03 SUBMITTALS

A. Refer to Division 01 and Section 22 0500 for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on fire stop sealants.

1.04 QUALITY ASSURANCE


B. Soldering and brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Mechanical Refrigeration.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, and clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.
C. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.

B. Weld-O-Lets: Welding Weld-O-Lets may be used in lieu of tees where branch connection pipe size is two or more pipe sizes smaller than main header size.

2.02 JOINING MATERIALS

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.

D. Soldering materials shall not contain lead.

E. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.03 SLEEVES AND SEALS

A. Sleeves:
   1. Sheet-Metal Sleeves: 5" and Smaller, 20 gage galvanized sheet metal; 6" and Larger, 10 gage, galvanized sheet metal, round tube closed with welded longitudinal joint.
   2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.
   3. Galvanized steel telescoping type: Galvanized sheet metal per manufacturer's standards.
   4. Polyethylene Sleeves: Manufacturer's standard product.

B. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
2.04 FIRESTOP SEALANT

A. Fire stopping material shall be asbestos-free and capable of maintaining an effective barrier against flame and gases in compliance with the following requirements:
   1. Flame Spread: 25 or less, ASTM E 84.
   2. Smoke Development: 50 or less, ASTM E 84.

B. Material when installed shall have the same fire rating as the assembly in which it is being installed.

2.05 PIPING ISOLATION

A. Manufacturer's standard product for providing sound and electrolysis isolation.

PART 3 - EXECUTION

3.01 PREPARATION

A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.02 INSTALLATIONS

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.

C. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

E. Install piping tight to slabs, beams, joists, columns, walls and other permanent elements of the building. Provide space to permit insulation applications, with 1” clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
G. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals.

I. Coordinate to provide curb, minimum 4" above finish floor, for all pipe shafts or floor openings for multiple pipes.

J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, or floors, the fire rated integrity shall be maintained.

3.03 PIPE SUPPORTS AND HANGERS

A. Horizontal Pipes: Hangers and supports shall be hung from solid rods, and lengths of which shall be adjustable. Strap hangers will not be permitted. In lieu of individual hangers, trapeze hangers may be used for parallel pipes, details of which shall be submitted to the Architect for approval. Hanger rods for both single and trapeze hangers shall be hung from suitable clips, beam clamps or inserts, as necessary. For concrete construction, inserts shall be set in forms before concrete is poured. Explosive type fasteners or studs will not be permitted. "Phillips" type shield may be used when authorized by the Architect. No piping shall be supported by any wire, rope, wood or other makeshift device.

B. Provide hangers size and spacing per SMACNA "Guidelines for Seismic Restraint of Mechanical Systems".

C. Where building construction does not permit the above-specified spacing of hangers, the Contractor shall provide adequate additional steel supports. Location and details shall be submitted to the Architect for approval. In all cases, pipe supports shall be spaced to provide adequate support for the pipes, the medium in the pipes, insulation, valves and fittings.

D. All vertical pipelines shall be supported, not hung, at each floor. Malleable iron or steel pipe clamps of ample size, bolted around the pipes, shall be used for these pipe supports. All vertical water piping shall have vibration isolators between support clamp and structure.

E. Pipe hangers shall be of the positive restraint type or be provided with approved restraint clips to prevent lateral movement of attachment.

F. Pipe hangers shall be of the positive restraint type or be provided with approved restraint clips to prevent lateral movement of attachment.

G. Contractor may refer to details applicable in the SMACNA "Guidelines for Seismic Restraint of Mechanical Systems".

3.04 FITTINGS AND SPECIALTIES

A. Use fittings for all changes in direction and all branch connections.

B. Remake leaking joints using new materials.
C. Install Y-type strainers with blow-down valves on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.

D. Install unions adjacent to each valve and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.

E. Install Flanges in piping 2-1/2” and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.

F. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air).

G. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

3.05 JOINTS

A. Steel Pipe Joints:
   1. Pipe 2” and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten to leave not more then 3 threads exposed.
   2. Pipe Larger than 2”:
      a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
      b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
      c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.1.0 Code for Pressure Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

B. Non-ferrous Pipe Joints:
   1. Brazed and Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.1.0 -Standard Code for Pressure Piping, Power Piping and ANSI B9.1 - Standard Safety Code for Mechanical Refrigeration. Thoroughly clean tube surface and inside surface of the cup of the fittings, using every fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
   2. Mechanical Joints: Flared compression fittings may be used for refrigerant lines 3/4" and smaller.

C. Joints for other piping materials are specified within the respective piping systems sections.
3.06 INSTALLATION OF SLEEVES

A. Provide pipe sleeves for pipes to pass through walls, floor and roofs. Diameter of sleeve to be 1-inch larger than the outside diameter of pipe or pipe and covering of insulated pipe. Galvanized steel telescoping type sleeves or polyethylene may be used. Where seepage may occur, use steel pipe sleeves.

B. All pipe sleeves through floors other than floors on grade shall extend 2-inches above finished floor and shall be caulked with mineral wool. Provide collar where polyethylene sleeve is used.

C. Where required in existing construction, or where sleeves have been omitted, openings for pipe may be core drilled in floors and/or walls or partitions, providing prior acceptance of such core drilling is obtained from the Architect. Holes core drilled through floors above grade shall be provided with sleeves extending 2-inches above finish floor as hereinbefore specified.

D. Seal with resilient sealant: Dow Corning "Fire Stop" or approved equal.

3.07 INSTALLATION OF FIRE STOP SEALANT

A. Fire-stopping shall be provided at, but not limited to, duct, and piping penetrations through floor slabs and through time rated partitions or firewalls.

B. Install fire-stopping materials in accordance with the manufacturer's instructions and the following requirements.

C. Filling: Fire-stopping materials shall completely fill the void spaces.

D. Coordination: Coordinate the work with other trades. Fire-stopping materials at penetrations of insulated pipes and ducts shall be applied prior to insulation, unless the insulation meets the requirements specified for fire-stopping.

E. Surface Preparation: Surfaces to be in contact with fire-stopping materials shall be free of dirt, grease, oil, loose material, rust, or other substances that may affect proper fitting or the required fire resistance.

3.08 INSTALLATION OF PIPE ISOLATION

A. Provide sound and electrolysis isolation on all un-insulated, pipes, Semco "Trisolators" or Potter-Roemer "Prisolators".

3.09 INSTALLATION OF PIPE FLASHING

A. Pipe flashing assemblies, "Semco" Fig. 1100-4, as required, seal the joint between flashing and pipe with waterproofing compound. Install counter-flashing sleeve to cover a minimum of 3/4-inch to top of lead flashing, making the top joint permanently watertight.
3.10 TESTING OF PIPING

A. Provide notification of test at least three working days prior to tests on all or part of any piping system. Do not allow or cause any piping system to be insulated, covered, concealed or enclosed until such systems have been tested and reviewed.

B. Provide all necessary materials (including temporary isolation valves or caps), pumps, testing media and labor for testing. Temporarily remove any device in piping system, which will not withstand test pressure specified, and reinstall same after successful testing. Test time begins to accrue after full test pressure is achieved.

C. Testing and inspection of all piping systems and associated equipment for leaks shall be accomplished after installation and cleaning and prior to placing into service. Flanges, threaded joints and all welds shall be left unpainted and un-insulated until the piping systems have been approved.

D. A rigid visual inspection of each specific piping system shall be made prior to conducting tightness tests, to ascertain that all appurtenances and equipment are provided, properly connected and supported, and in all respects ready for testing.

E. Equipment such as pumps, chillers, tanks, heat exchangers, flexible hose, safety valves and similar equipment shall not be subjected to the piping system test pressure. Equipment shall either be disconnected from the piping or be isolated by valves or blanks during testing and reinstalled after acceptance by the Owner.

F. Indicating pressure gauges mounted locally may be tested with the lines provided the test pressure does not exceed the scale range.

G. Orifice plates, rotometers, displacement meters and other line inserts shall either not be installed until completion of all testing, or shall be removed prior to any tests and reinstalled after test has been accepted by the Owner.

H. The application of pressure to a system shall be under control at all times, so that in no case shall the test pressure be exceeded by more than 6 percent.

I. Gauges used for testing shall be tested for accuracy as directed or approved by the Owner, and then installed as close as possible to the low point of the piping system.

J. Do not apply test pressure until the piping system and its contents approach the same temperature.

K. While piping is under test, exercise care, that excessive pressure does not occur due to increase in ambient temperature.

L. Control Valves:
   1. Control valves which are installed with block and by-pass valve shall have the block valve closed, the by-pass valve opened, and a temporary pipe piece inserted in place of the control valve (or a test blank may be installed on each side of the control valve) until all flushing and testing of all lines of that system is completed and accepted by the Owner, after which they shall be reinstalled.
2. Control valves installed without block or by-pass valves shall be replaced by a pipe piece during flushing and testing of the system. After acceptance of the flushing they shall be reinstalled.

M. Minimum piping test pressures shall be as noted in tabulation; or they shall be 150 percent of design pressure for the specific system being tested, whichever is higher.

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>TEST MEDIUM</th>
<th>TESTING PRESSURE (PSIG)</th>
<th>DURATION (HOURS)</th>
<th>ACCEPTABLE TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil, Water Vent, &amp; Storm Water</td>
<td>Water</td>
<td>Top of highest vent</td>
<td>4</td>
<td>No joint sweat</td>
</tr>
<tr>
<td>Water</td>
<td>Water</td>
<td>150</td>
<td>4</td>
<td>None. Except Temperature change.</td>
</tr>
<tr>
<td>Fuel Gas</td>
<td>Air</td>
<td>60</td>
<td>4</td>
<td>None. Except Temperature change.</td>
</tr>
</tbody>
</table>

N. Conduct hydrostatic tests with water at a temperature below 100 degrees F.
   1. Fill the system slowly with water and vent at highest points to expel the air before pressurizing.
   2. Carefully examine all joints for leaks or defects.
   3. Provide connections as required to accomplish the above.

O. Keep accurate test records of each line or system tested and provide copies of same to Owner after acceptance. Each test shall include:
   1. Identification of piping system and test number.
   2. Testing medium.
   3. Test pressure.
   4. Date of test acceptance.

3.11 ADJUSTMENTS

A. At the completion of the Work, completely adjust all valves and equipment for their proper use and rating.

END OF SECTION 22 1000
SECTION 22 1019
PLUMBING PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED SECTIONS

A. This section applies to all piping systems specified in Division 22.
B. Valves are specified in a separate section and in individual piping system sections of Division 22.
C. Fire Barrier Penetration Seals are specified in Section 22 1000.

1.02 SECTION INCLUDES

A. This Section specifies piping specialties and installation methods common to more than one section of Division 22.

1.03 SUBMITTALS

A. Refer to Division 01 and Basic Mechanical Requirements for administrative and procedural requirements for submittals.
B. Product Data: Submit product data on the following items:
   1. Escutcheons
   2. Dielectric Unions and Fittings
   3. Mechanical Sleeve Seals
   4. Strainers

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or, by packaging with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer Uniformity: Conform to the requirements specified in Basic Mechanical Requirements, under "Product Options."
B. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:
   1. Pipe Escutcheons:
      a. BrassCraft
      b. McGuire
      c. Pasco
2. Dielectric Waterway Fittings:
   a. Epco Sales, Inc.
   b. Victaulic Company of America

3. Dielectric Unions:
   a. Eclipse, Inc.
   b. Perfection Corp.
   c. Watts Regulator Co.

4. Strainers:
   a. Armstrong Machine Works
   b. Hoffman Specialty ITT; Fluid Handling Div.
   c. Metraflex Co.
   d. R-P&C Valve; Div. White Consolidated Industries, Inc.
   e. Spirax Sarco
   f. Trane Co.
   g. Victaulic Co. of America. (low pressure applications only).
   h. Watts Regulator Co.

5. Mechanical Sleeve Seals:
   a. Thunderline Corp.

2.02 PIPE AND FITTINGS

A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.

2.03 JOINING MATERIALS

A. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

B. Brazing Materials: Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

C. Soldering Materials: Refer to individual piping system specifications for solder appropriate for each respective system.

D. Gaskets for Flanged Joints: Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.04 PIPING SPECIALTIES

A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
B. Unions: Malleable-iron, Class 150 for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.

C. Dielectric Unions: Provide dielectric unions with appropriate end connections for the pipe materials in which installed (screwed, soldered, or flanged), which effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.

E. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64" perforations at 233 per square inch.
   1. Provide strainers with 125 psi working pressure rating for low-pressure applications, and 250 psi pressure rating for high-pressure application.
   2. Threaded Ends, 2" and Smaller: Cast-iron body, screwed screen retainer with centered blow-down fitted with pipe plug.
   3. Threaded Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blow-down fitted with pipe plug.
   4. Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blow-down fitted with pipe plug.
   5. Butt Welded Ends, 2-1/2" and Larger for Low Pressure Application: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blow-down fitted with pipe plug.
   7. Grooved Ends, 2-1/2" and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

F. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 ESCUTCHEONS

A. Install escutcheons at all exposed penetrations of piping through walls, ceilings, and floors in rooms with finish surfaces.

3.02 FITTINGS AND SPECIALTIES

A. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, and elsewhere as indicated.

B. Install unions adjacent to each valve and at the final connection to each piece of equipment and plumbing fixture having 2" and smaller connections, and elsewhere as indicated.
C. Install Flanges in piping 2-1/2” and larger, where indicated, adjacent to each valve, and at the final connection to each piece of equipment.

D. Install dielectric unions to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum).

E. Install dielectric fittings to connect piping materials of dissimilar metals in wet piping systems (water, steam).

END OF SECTION 22 1019
SECTION 22 1100
FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes potable cold water, hot water, and circulation hot water piping, fittings, and specialties within the building to a point of 5 feet outside the building.

1.02 RELATED SECTIONS

A. The following sections contain requirements that relate to this section.
   1. Division 22 Section "Water Distribution System" for water service piping (which connects the "Water Distribution Piping" to wells and public utilities).
   2. Division 7 Section "Joint Sealers" for materials and methods for sealing pipe penetrations through basement walls and fire and smoke barriers.
   3. Division 22 Section "General Duty Valves."
   4. Division 22 Section "Plumbing Identification" for labeling and identification of piping systems.
   5. Division 22 Section "Common Work Result for Plumbing."

B. Separate sections of Division 22 specify Basic Piping Materials and Methods, Hangers, and Supports, Expansion Compensation, piping system identification, materials and requirements, general duty valves, pipe insulation, fire protection piping, and plumbing equipment.

1.03 DEFINITIONS

A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.

B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distributing system of the building served.

C. Pipe sizes used in this Specification are nominal pipe size (NPS).

1.04 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specifications Sections.
   1. Product data for each piping specialty and valve specified.
   2. Test reports specified in Part 3 of this Section.
   3. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 01 and Division 22 Section "Common Work Results for Plumbing."

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following codes:
1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
2. Comply with applicable portions of Codes and Regulations in use by Authorities having jurisdiction. See Division 22 Section "Common Work Results for Plumbing".

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide factory-applied plastic end-caps on each length of pipe and tube, except for concrete, corrugated metal, hub-and-spigot, and clay pipe. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings and specialties, from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

D. Store CPVC, and PVC pipe and fittings where protected from direct sunlight.

E. Store pipe in a manner to prevent sagging and bending.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of concrete equipment pads. Cast anchor-bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate the installation of pipe sleeves for foundation wall penetrations.

1.08 EXTRA MATERIALS

A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bibb, fixture supply, or faucet installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer Uniformity: Conform to the requirements specified in Division 22 Section "Common Work Results for Plumbing."

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Strainers:
      a. Josam Co.
      b. Metraflex Co.
      d. Spirax Sarco, Inc.
2. Balance Cocks:
   a. Hammond Valve Corp.
   b. Milwaukee Valve Co., Inc.
   c. Walworth
   d. Stockham Valves & Fittings, Inc.

3. Hose Bibbs:
   a. Lee Brass Co.
   b. Nibco, Inc.
   c. Watts Regulator Co.
   d. Woodford Mfg. Co.

4. Wall Hydrants:
   a. Josam Co.
   c. Wade Div., Tyler Pipe
   d. Woodford Mfg. Co.
   e. Zurn Industries Inc., Hydromechanics Div.

5. Backflow Preventers:
   a. Cla-Val Co.
   b. Febco
   c. Hersey Products, Inc.
   d. Watts Regulator Co.
   e. Zurn Industries Inc. Wilkins Regulators Div.

6. Mechanical Couplings and Fittings for Grooved-End Steel Pipe:
   a. Grinnell Corp.
   b. Gustin-Bacon Div., Tyler Pipe
   c. Stockham Valves & Fittings, Inc.
   d. Victaulic Co. of America

7. Mechanical Couplings and Fittings for Grooved-End Copper Tube:
   a. Victaulic Co. of America

8. Compression Fittings for PB Plastic Pipe:
   a. Brass-Craft Sub. of Masco Corp.

9. Vacuum Breakers for Hose Connections:
   b. Conbraco Industries, Inc.
   c. Watts Regulator Co.

10. Mechanical Sleeve Seals:
    a. Thunderline Corp.

11. Pipe Escutcheons:
    a. BrassCraft
    b. McGuire
    c. Pasco
12. Dielectric Waterway Fittings:
   a. Epco Sales, Inc.
   b. Victaulic Company of America

13. Dielectric Unions:
   a. Eclipse, Inc.
   b. Perfection Corp.
   c. Watts Regulator Co.

2.02 PIPE AND TUBE MATERIALS, GENERAL

A. Pipe and Tube: Refer to Part 3, Article "Application, General," for identification of systems where the below materials are used.

B. Copper Tube: (Within Building) ASTM B88, Type ‘L’ Water Tube, drawn temper. Piping shall be of domestic manufacture.

C. Copper Tube: (Underground) ASTM B88, Type ‘K’ Water Tube, annealed temper. Piping shall be of domestic manufacture.

2.03 FITTINGS

A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern. Fittings shall be of domestic manufacture.

B. Wrought Copper and Bronze Grooved-End Fittings: ASTM B75 Tube and ASTM B584 Bronze Castings. Fittings shall be of domestic manufacture.


D. Dielectric Unions: Threaded, solder, or grooved-end connections as required to suit application; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion. Domestic manufacture.

E. Dielectric Unions: Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze wire reinforced protective jacket; minimum 150 psig working pressure, maximum 250 degree F operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be 12" long and capable of 3/4-inch misalignment. Sweat ends are not acceptable. Domestic manufacture.

2.04 JOINING MATERIALS

A. Solder Filler Metal: ASTM B32, 95-5 Tin-Antimony 'lead free'.

B. Brazing Filler Metals: AWS A5.8, BCUP Series.

C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressure.
2.05 GENERAL-DUTY VALVES

A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "Valves." Special duty valves are specified below by their generic name; refer to Part 3 Article "Valve Application" for specific uses and applications for each valve specified.

B. Shut-off valves in PVC Pipe: Ball type valve with union ends rated for 150 PSI W.P. and suitable for distilled water service.

2.06 SPECIAL DUTY VALVES

A. Balance Cocks: 400 PSI WOG, 2 piece, ball valve, handle, memory stop, with threaded-end connections conforming to ASME B1.20.1.

B. Balance Cocks: 400 PSI WOG, 2 piece bronze, ball valve, handle, memory stop, with solder-end connections.

2.07 PIPING SPECIALTIES

A. Basket Strainers: Cast-iron body, 125 psi flanges, bolted-type or yoke-type cover with removable non-corrosive perforated strainer basket having 1/8-inch perforations and lift-out handle.

B. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens shall be Type 304 stainless steel, with 3/64" perforations at 233 per square inch. Strainers in copper lined to have bronze bodies. Domestic manufacture.
   1. Provide strainers with 125 psi working pressure rating for low pressure applications, and 250 psi pressure rating for high pressure application.
   2. Threaded ends, 2" and Smaller: Cast-iron body, or bronze body, screwed screen retainer with centered blow-down fitted with pipe plug.
   3. Threaded Ends, 2-1/2" and Larger: Cast-iron body or bronze body bolted screen retainer with off-center blow-down fitted with pipe plug.
   4. Flanged Ends, 2-1/2" and Larger: Cast-iron body or bronze body, bolted screen retainer with off-center blow-down fitted with pipe plug.

C. Hose connections: Hose connections shall have garden hose threaded outlets conforming to ASME B1.20.7.

D. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 3/4- inch solder inlet, hose outlet.

E. Recessed Wall Hydrants: Cast-bronze box and door, with chrome-plated face, tee handle key, vacuum breaker, hinged locking cover, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.

F. Vacuum Breakers: Hose connection vacuum breakers shall conform to ASSE Standard 1011, with finish to match hose connection.
G. Backflow Preventers: Reduced-pressure-principle assembly consisting of shutoff valves on inlet and outlet and strainer on inlet. Assemblies shall include test cocks and pressure-differential relief valve located between 2 positive seating check valves and comply with requirements of ASSE Standard 1013. Assemblies shall have approval of Health Department having jurisdiction.

H. Pressure-Regulating Valves: Single-seated, direct-operated type, having bronze body with integral strainer and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and inlet and outlet pressures indicated.

I. Relief Valves: Sizes for relief valves shall be in accordance with ASME Boiler and Pressure Vessel Codes for indicated capacity of the appliance for which installed.
1. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Temperature relief valves shall be factory set at 210 degree F, and pressure relief at 150 psi.

J. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation.

K. Sleeves:
1. Sheet-Metal Sleeves: 10 gage, galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A53, Grade A.

L. Mechanical Sleeve Seals: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine rough-in requirements for plumbing fixtures and other equipment with water connections to verify actual locations of piping connections prior to installation.

3.02 PREPARATION
A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.03 PIPE APPLICATIONS
A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 4 inches and smaller, above ground, within building.
B. Install Type K, annealed temper copper tube for pipe sizes 2 inches and smaller, with minimum number of joints, below ground.
C. Water piping in sizes 2-1/2 to 6 inches may be Type L drawn copper tube with roll-grooved ends and mechanical couplings, above ground within building.

3.04 PIPING INSTALLATION

A. General Locations and Arrangements; Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Contractor shall provide protection for all metallic piping below grade as outlined in the installation standards for protectively coated pipe (IAPMO IS 13-91) due to soil's high rate of corrosivity.

C. Use fittings for all changes in direction and branch connections.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted unless expressly indicated.

E. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

F. Conceal all piping installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

G. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

H. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

I. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

J. Pipe sleeves smaller than 6 inches shall be galvanized steel pipe; pipe sleeves 6 inches and larger shall be galvanized steel sheet metal.

K. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls with sleeves and mechanical sleeve seals.

L. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 07 for special sealers and materials.

3.05 HANGERS AND SUPPORTS

A. General: Hanger, support, and anchor devices conforming to MSS SP-69 are specified in Division 22 Section, "Hangers and Supports." Conform to the table below for maximum spacing of supports:
B. Pipe Attachments: Install the following:
   1. Adjustable steel clevis hangers, MSS Type 1, for individual horizontal runs less than 20 feet in length.
   2. Adjustable roller hangers, MSS Type 43, and spring hangers, MSS Type 41 with Type 49, for individual horizontal runs 20 feet and longer.
   3. Pipe roll, complete MSS Type 44 for multiple horizontal runs, 20 feet or longer, support on a trapeze.
   4. Spring hangers to support vertical runs.

C. Support vertical steel pipe and copper tube at each floor.

3.06 PIPE AND TUBE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
   1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
   2. Fill the tubing and fittings during soldering and brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
   3. Heat joints to proper and uniform temperature.

C. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threaded for field-cut threads. Join pipe fittings and valves as follows:
   1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   2. Align threads at point of assembly.
   3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
   4. Assembly joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
      a. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

E. Grooved-End Joints: Prepare pipe and tubing and install in accordance with manufacturer’s installation instructions.

3.07 SERVICE ENTRANCE

A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building. Water service piping is specified in separate section of Division 02 and Division 22.

B. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.
C. Install shutoff valve at service entrance inside building; complete with strainer, pressure gage, and test tee with valve.

3.08 VALVE APPLICATIONS

A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
   2. Throttling duty: Use globe and ball valves.

3.09 INSTALLATION OF VALVES

A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use gate valves; for sectional valves 2-1/2 inches and larger, use gate or butterfly valves.

B. Shutoff Valves: Install shutoff valves at inlet and outlet of each plumbing equipment item and elsewhere as indicated.
   1. At plumbing equipment: 2” and smaller use gate or ball valves.
   2. At plumbing equipment: 2-1/2” and large use gate or butterfly valves.
   3. For plumbing fixtures see fixture trim.
   4. All other locations use gate valves.

C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves use 3/4” hose end drain valve.

D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.

E. Balance Cocks: Install in each hot water re-circulating loop, discharge side of each pump, and elsewhere as indicated.

F. Hose Bibbs: Install on exposed piping where indicated. Provide vacuum breaker.

G. Wall Hydrants: Install where indicated. Provide vacuum breaker.

3.10 INSTALLATION PIPING SPECIALTIES

A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Install air cap fitting and pipe relief outlet drain without valves to nearest floor drain. Identify all piping downstream of backflow preventers as “industrial water”.

B. Install pressure-regulating valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gage on valve outlet.

3.11 INSTALLATION OF PIPING WATER HAMMER ARRESTORS

A. Provide an air chamber at each valve water outlet or fixture supply for fixtures with manual closing valves.
Air chamber shall be 18 inches long and one pipe size larger than supply to outlet. For a battery of fixtures, one air chamber 30 inches long and the full size of the header, but not less than 1 inch may be installed in lieu of individual air chambers. Precision Plumbing Products, JMJ "System Rated" arrestors are acceptable in lieu of air chambers.

B. Install water hammer arrestors on supply line to fixtures with self-closing, automatic or flushometer valves. Arrestors shall be as close as possible to individual fixtures and on the end of the header for a battery of fixtures. Arrestors shall be installed in the wall or furring, whenever possible, behind an access plate large enough to permit removal of the arrestor. Sizes as shown on the drawings or as specified hereinafter. Sizes and model numbers are J. R. Smith; equivalent arrestors by Josam or Zurn are acceptable.

3.12 EQUIPMENT CONNECTIONS

A. Piping Run-outs to Fixtures: Provide hot and cold water piping Run-outs to fixtures of sizes indicated, but in no case smaller than required by plumbing code.

B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. For connections 2-1/2 inches and larger, use flanges instead of unions.

3.13 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution piping as follows:
   1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
   2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
      a. Rough-In Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
      b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
   3. Re-inspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for re-inspection by the plumbing official.
   4. Reports: Prepare inspection reports signed by the plumbing official.

B. Test water distribution piping as follows:
   1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
   2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.

4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.

5. Prepare reports for all tests and required corrective action.

### 3.14 ADJUSTING AND CLEANING

**A.** Clean and disinfect water distribution piping as follows:

1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.

2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
   
   a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.

   b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.

   c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.

   d. Following the allowed standing time, flush the system with clean, potable water until chlorine does not remain in the water coming from the system.

   e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

**B.** Prepare reports for all purging and disinfecting activities.

### 3.15 COMMISSIONING

**A.** Fill the system. Check compression tanks, where used, to determine that they are not air bound and that the system is completely full of water.

**B.** Before operating the system, perform these steps:

1. Close drain valve, hydrants, and hose bibbs.

2. Open valves to full open position.

3. Remove and clean strainers.


5. Lubricate pump motors and bearings.

END OF SECTION 22 1100
Facility Water Distribution
22 1100-12
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes building sanitary and storm drainage and vent piping systems, including drains and drainage specialties.

1.02 RELATED SECTIONS

A. The following sections contain requirements that relate to this section:
   1. Division 02 Section "Structural Excavation and Backfill", for trenching and backfilling materials and methods for underground piping installations.
   2. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.

1.03 DEFINITIONS

A. Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.

B. Building Sewer: That part of the piping within public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal.

C. Drainage System: Includes all the piping within public or private premises which conveys sewage, rain water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and backpressure.

1.04 SUBMITTALS

A. Product data for the following products:
   1. Drainage piping specialties

1.05 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following:

1.06 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof drains, flashing, and roof penetrations.
B. Coordinate flashing materials installation of roofing, waterproofing, and adjoining substrate work.

C. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.

D. Coordinate with installation of sanitary and storm sewer system as necessary to interface building drains with drainage piping system.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide drainage and vent systems from one of the following:
   1. Drainage Piping Specialties, including backwater valves, expansion joints, drains, trap primers, and vandal-proof vent caps:
      c. Tyler Pipe; Subs. of Tyler Corp.
      d. Zurn Industries Inc; Hydromechanics Div.

2.02 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

A. General: Select from the following options:
   1. Pipe Sizes Larger than 2": Cast-iron soil pipe. Conform to ASTM A74, for service weight, hub-and-spigot soil pipe and fittings, with clamps and compression gasket joints conforming to ASTM C564. Piping shall bear the CISPI stamp.
   2. Pipe Sizes Larger than 2": Hub-less cast-iron soil pipe. Conform to CISPI Standard 301, Service weight, cast-iron soil pipe and fittings, with neoprene gaskets conforming to CISPI Standard 310. Piping shall bear the CISPI stamp.
   3. Type "DWV" hard drawn copper waste, vents and end fittings. ASTM B32 for pipe, and cast bronze drainage pattern fittings with soldered joints.

B. All waste and vent piping occurring in demountable or minimum thickness partitions shall be type DWV copper from finish floor through roof.

2.03 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

A. Pipe and fittings shall have heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces.

B. General: For pipe and fittings below grade and/or below finish floor of floors on grade select from the following options:
   1. Pipe Sizes 15" and Smaller: Cast-iron soil pipe. Conform to ASTM A74, for standard weight hub and spigot soil pipe and fittings, with clamps and neoprene gasket, conforming to ASTM C564. Piping shall bear the CISPI stamp.
   2. Pipe Sizes 16" and Smaller: Hub-less cast iron soil pipe, conform to CISPI Standard 301, service weight; with "Best" or "MG" cast iron joint connection couplings. Coupling body shall conform to ASTM A-48 or ASTM A-74 with neoprene gasket conforming to ASTM C-564. Piping shall bear the CISPI stamp.
2.04 DRAINAGE PIPE SPECIALTIES

A. Trap Primers: Bronze body valve with automatic vacuum breaker, with 1/2 inch connections matching piping system. Complying with ASSE 1018.

B. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.

C. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.

2.05 CLEANOUTS

A. Cleanouts on cast iron soil pipe, iron body with ABS plugs screwed into caulking ferrules. Cleanouts on steel pipe, ABS plugs. Cleanouts on vitrified clay pipe, vitrified clay pipe. Where cleanouts occur in finished interior surfaces, smooth polished chromium plated. Exposed parts of floor cleanouts in finished rooms, non-slip polished nickel bronze. Floor cleanouts adjustable type. Where cleanouts occur in carpeted floor areas, the cover shall be elevated so as to be flush with finished carpeted areas.

B. Floor Cleanouts: Cast-iron body and frame, with cleanout plug and adjustable round top as follows:
   1. Floor level type in rooms with concrete floor: Smith #4021, Josam 58330-2, or Zurn Z1420-25 with cast iron top.

C. Wall Cleanouts: Cast-iron body adaptable to pipe with ABS plastic plug; stainless steel cover including screws.
   1. Wall type for cast iron pipes: Smith #4532, Josam 58790-4, or Zurn Z-1445-1.
   2. Wall type for steel pipes: Smith #4472, Josam 58890-4, or Zurn 1460-8.

D. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide under-deck clamp and sleeve length as required.

E. Vent Flashing Sleeves: Cast-iron caulking type roof coupling for cast-iron stacks, cast-iron threaded type roof coupling for steel stacks, and cast-bronze stack flashing sleeve for copper tubing.

F. Vandal-Proof Vent Caps: Cast-iron body full size of vent pipe, with caulked base connection for cast-iron pipes, threaded base for steel pipes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify all dimensions by field dimensions. Verify that all drainage and vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Verify existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
C. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

D. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

E. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION FOUNDATION FOR UNDERGROUND BUILDING DRAINS

A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.

B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated invert elevation.

C. Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

3.03 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

A. General: Select from following options:
   1. Install Copper tube with cast bronze fittings for 3 inch and smaller, drainage and vent pipe.
   2. Install hub-and-spigot, service weight, cast-iron soil pipe with compression gasket joints for larger than 2 inches drainage and vent pipe. Piping shall bear the CISPI stamp.
   3. Install Hub-less, service weight, cast-iron soil pipe and fittings for larger than 2 inch drainage and vent pipe. Piping shall bear the CISPI stamp.

3.04 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

A. General: Select from the following options:
   1. Install hub-and-spigot, service heavy weight, cast-iron, soil pipe and fittings with gasket joints for 15 inch and smaller drainage pipe. Piping shall bear the CISPI stamp.
   2. Install hub-less, service weight, cast-iron, soil pipe and "Best" or "MG" cast iron couplings with neoprene gaskets. Stainless steel couplings not acceptable below grade. Piping shall bear the CISPI stamp.

3.05 PIPE AND TUBE JOINT CONSTRUCTION

A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."

B. Cast-Iron Soil Pipe: Make lead and oakum caulked joints, compression joints, and hub-less joints in accordance with the recommendations in the CISPI Cast Iron Soil Pipe and Fittings Handbook, Chapter IV.

C. Install couplings per manufacturer's recommendations.
3.06 INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and all branch connections.

C. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals. Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inches and larger shall be sheet metal.

H. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity.

I. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, half-wyes, or long sweep quarter, sixth, eight, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

J. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer’s recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

K. Install building drain pitched down at minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger.
L. Extend building drain to connect to sewer piping, of size and in location indicated for service entrance to building. Sewer piping is specified in a separate section of Division 22.

M. Install sleeve and mechanical sleeve through foundation wall for watertight installation.

3.07 INSTALLATION OF PIPE SPECIALTIES

A. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.

B. Install expansion joints on vertical risers as indicated, and as required by the plumbing code.

C. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:
   1. As required by plumbing code.
   2. At each horizontal change in direction of piping greater than 135 degrees.
   3. At maximum intervals of 50' for piping 3" and smaller and 100' for larger piping.
   4. At base of each vertical soil or waste stack.

D. Cleanouts Covers: Install floor and wall cleanout covers for concealed piping.

E. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

3.08 INSTALLATION OF TRAP PRIMERS

A. Install trap primers with piping pitched towards drain trap, minimum of 1/8 inch per foot (1 percent). Adjust trap primer for proper flow. Provide trap primer for all floor drains and floor sinks. Multiple outlet primers are acceptable.

3.09 CONNECTIONS

A. Piping Run-outs to Fixtures: Provide drainage and vent piping run-outs to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.

B. Locate piping run-outs as close as possible to bottom of floor slab supporting fixtures or drains.

3.10 FIELD QUALITY CONTROL

A. Inspections:
   1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
   2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
a. Rough-In Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.

b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.

3. Re-inspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for re-inspected by the plumbing official.

4. Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test: Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, which has been covered or concealed before it has been tested and approved.

3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.

4. Finished Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it leaves the building, and introduce air into the system equal to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.

5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

6. Prepare reports for all tests and required corrective action.

3.11 ADJUSTING AND CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.
3.12 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

END OF SECTION 22 1300
SECTION 22 4200
COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section specifies plumbing fixtures and trim. The types of fixtures specified include the following:
   1. Water Closets
   2. Urinals
   3. Lavatories (including wheelchair type)
   4. Faucets
   5. Flush Valves
   6. Fixture Supports (including wheelchair type)
   7. Toilet Seats
   8. Fittings, Trim, and Accessories

1.02 RELATED SECTIONS

A. Separate grab bars and toilet accessories not in integral part of plumbing fixtures and are specified in Division 10.

B. Electrical Requirements for, Water Heaters, water conditioners, and other plumbing equipment are specified in other Sections of Division 22 and Division 26.

1.03 SUBMITTALS

A. Product Data: Submit Product Data and installation instructions for each fixture, faucet, specialties, accessories, and trim specified; clearly indicate rated capacities of selected models of water coolers, and water heaters.


C. Wiring Diagrams: Submit manufacturer's electrical requirements and wiring diagrams for power supply to units. Clearly differentiate between portions of wiring that are factory installed and field installed portions.

D. Maintenance Data: Include data in Maintenance Manual specified in Division 01 and Section 220500.

E. Quality Control Submittals:
   1. Submit certification of compliance with specified ANSI, UL, and ASHRAE Standards.
   2. Submit certification of compliance with performance verification requirements specified in this Section.
1.04 QUALITY ASSURANCE

A. Codes and Standards:
   2. ARI Standard 1010: "Drinking-Fountains and Self-Contained Mechanically-Refrigerated Drinking-Water Coolers."
      a. Accessible plumbing fixtures for adults; dimensions shall comply with the requirements of CCR, T-24, Section 1115. B.
      b. Heights and location of fixtures shall be according to CCR, T-24, Chapter 11-B and Table 1115B-1.
      c. Fixture Controls shall comply with CCR, T-24 section 1118 B.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store fixtures where environmental conditions are uniformly maintained within the manufacturer's recommended temperatures to prevent damage.
B. Store fixtures and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim.

1.06 SEQUENCE AND SCHEDULING

A. Schedule rough-in installations with the installation of other building components.

1.07 MAINTENANCE

A. Extra Stock: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt in a quantity of one device for each 10 fixtures.
B. Repair Kits: Furnish faucet repair kits complete with all necessary washers, springs, pins, retainer packings, O-rings, sleeves, and seats in a quantity of 1 kit for each 40 faucets.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer uniformity shall be as specified in Section 220500: "Common Work Results For Plumbing".
B. The following specification mentions manufacturers to establish a standard quality. The following fixtures and accessories are acceptable, if used throughout:
   1. Water Closets, Urinals, Lavatories, Service Sinks:
      a. American Standard
      b. Kohler Co.
   2. Stainless Steel Sinks:
   3. Faucets:
      a. Chicago Faucet Co.
b. American Standard
   c. T & S Brass
   d. Speakman
4. Flush Valves:
   a. Sloan Valve Co.
   b. Zurn
5. Water Closet Seats:
   a. Olsonite
   b. Beneke Corp
   c. Church Products
6. Fixture Supports:
   c. Zurn Industries, Inc.; Hydromechanics Div.
7. Drains:
   c. Zurn

2.02 FIXTURES

A. Plumbing fixture trim and exposed supplies and wastes are to be brass with polished chromium plated finish unless otherwise specified. Provide individual lose key or screwdriver stops for all fixture supplies. Separately trap all wastes. Furnish chrome plated wall escutcheons for all exposed supplies and trap arms. Locate stops below fixtures or countertops. All fixtures for use by the disabled shall have exposed hot water pipe and tailpiece and trap insulated with 1/2" rubber foam insulation.

B. All plumbing fixture faucets submitted for review shall have identification label or certification showing compliance with California Title 24, Part 5, Article 1, "Energy Conservation Standards"; Article 1, T20-1406; Article 2, T20-1525 and Article 4, 1604, and 1606.

C. Provide fixtures as scheduled on plumbing drawings and requirements of this Section.

2.03 FIXTURE SUPPORTS

A. Lavatory Supports: Adjustable cast iron, with thin concealed arms and sleeves, and complete with escutcheons and mounting fasteners.

B. Water Closet Supports: Adjustable, factory painted, cast iron face plate, support base, and appropriate type waste fitting having face plate gasket; zinc plated steel fixture studs and fasteners; coated and threaded adjustable wall coupling with neoprene closet outlet gasket; and chrome plated fixture cap nuts and fiber fixture washers. Provide an appropriate model to suit deep or shallow rough-in, siphon jet or blow-out water closet, and type of sanitary piping system to which it is connected.

C. Wheelchair Water Closet Supports: Adjustable, factory painted, cast iron face plate, support base, and appropriate type waste fitting having face plate gasket; zinc plated steel fixture studs and fasteners; coated and threaded adjustable wall coupling with neoprene closet outlet gasket; and chrome plated fixture cap nuts and fiber fixture washers. Units shall have elevated mounting heights of wheelchair fixtures, siphon jet or blow-out water closet, and type of sanitary piping system to which it is connected.
2.04 ESCUTCHEONS

A. Select one of the two options below:
   1. Chrome-plated cast brass with set screw.
   2. Chrome-plated sheet steel with friction clips.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.

C. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

D. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION OF FIXTURES

A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.

B. Comply with the installation requirements of California Building Code “CBC” Section 115B and Section 1118B for accessible plumbing fixtures.

C. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.

D. Securely attach wall hung fixtures to a 3/8 inch x 6 inch wide steel plate. Steel plate to extend at least one stud beyond first and last mounting point. Drill and tap plate at time of installation of fixture or fixture hanger. Support fixture hanger with 1/2" diameter threaded studs, jamb nuts, C.P. Acorn nuts and completely free of wall by means of a second set of jamb nuts. Weld plate to each metal stud crossed by means of a continuous vertical fillet weld and same size as stud thickness. Secure plate to each wood stud crossed by securely bolting to each stud crossed with two 1/2-inch steel bolts, 4-inch center with 1/8-inch maximum x 1-1/2 inch steel back up plates. Notch studs to set plate flush with surface.

E. Set mop basins in a leveling bed of cement grout.

F. Install a stop valve in an accessible location in the water connection to each fixture.

G. Install chrome plated brass escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and with cabinets and millwork.

H. Seal fixtures to walls and floors using silicone sealant as specified in Section 070900. Match sealant color to fixture color.

I. Provide abrasive washers under all single drilling deck mounted trim.
3.03 INSTALLATION OF FLOOR DRAINS

A. Install floor drains in accordance with manufacturer's written instructions and in locations indicated.
B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.
C. Set drain elevation depressed below finished slab elevation as listed below to provide proper slope to drain:

<table>
<thead>
<tr>
<th>Depression (Inch)</th>
<th>Radius Of Area Drained (Feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>5</td>
</tr>
<tr>
<td>3/4</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>1-1/4</td>
<td>20</td>
</tr>
<tr>
<td>1-1/2</td>
<td>25</td>
</tr>
</tbody>
</table>

D. Trap all drains connected to the sanitary sewer.
E. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
F. Position drains so that they are accessible and easy to maintain.

3.04 INSTALLATION OF TRAP PRIMERS

A. Install trap primers with piping pitched towards drain trap, minimum of 1/8 inch per foot (1 percent). Adjust trap primer for proper flow.

3.05 INSTALLATION OF ROOF DRAINS

A. Install roof drains at low points of roof areas, in accordance with the roof membrane manufacturer's installation instructions.
B. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.
C. Position roof drains so that they are accessible and easy to maintain.

3.06 FIELD QUALITY CONTROL

A. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
B. Inspect each installed unit for damage. Replace damaged fixtures.

3.07 ADJUSTING

A. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow and stream.
B. Replace washers or leaking or dripping faucets and stops.
3.08 CLEANING

A. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.09 PROTECTION

A. Provide protective covering for installed fixtures, water coolers, and trim.
B. Do not allow use of fixtures for temporary facilities unless expressly approved in writing by Owner.

3.10 ROUGH-IN SCHEDULE

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Hot Water</th>
<th>Cold Water</th>
<th>Waste</th>
<th>Vent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavatory or Sink</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>1-1/2&quot;</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>Water Closet with FV</td>
<td>NA</td>
<td>1&quot;</td>
<td>4&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>Urinals</td>
<td>NA</td>
<td>3/4&quot;</td>
<td>2&quot;</td>
<td>1-1/2&quot;</td>
</tr>
<tr>
<td>Service Sinks</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>3&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>Mop Basins</td>
<td>1/2&quot;</td>
<td>1/2&quot;</td>
<td>3&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>Drinking Fountains</td>
<td>NA</td>
<td>1/2&quot;</td>
<td>1-1/4&quot;</td>
<td>1-1/4&quot;</td>
</tr>
</tbody>
</table>

3.11 MOUNTING HEIGHTS SCHEDULE

<table>
<thead>
<tr>
<th>Fixture</th>
<th>Mounting Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lavatory or Sink</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Wheelchair Lavatories</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Water Closet</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Accessible Water Closet</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Standard Urinals</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Accessible Urinals</td>
<td>See Architectural Drawings</td>
</tr>
<tr>
<td>Wheelchair Water Cooler</td>
<td>See Architectural Drawings</td>
</tr>
</tbody>
</table>

3.12 ROUGH-IN FOR FIXTURES

A. Rough-in for all fixtures and/or equipment shown on any drawings, including the architectural drawings, which forms a part of the contract documents. This shall include all fixtures and equipment shown and/or noted as N.I.C. (not in contract) or as U.O.S. (furnished under another section of the specification). Stub out all piping to the exact location of the fixtures and set symmetrical with the fixture. Stub out for fixture supply pipes with drop ear fittings secured to stud or backing plate. Stub out two pipe diameter and terminate with pipe cap. When liens are indicated as capped or plugged at floor level, plug flush with the finished floor.

END OF SECTION 22 4200
SECTION 23 0500
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and the other sections of Division 22.

B. This Division is an integrated whole comprising interrelated and interdependent Section and shall be considered in its entirety in determining requirements of the Work.

C. Refer to other sections of this Division for additional requirements or information regarding the subjects of this Section.

1.02 SECTION INCLUDES

A. This Section includes general administrative and procedural requirements for mechanical installations. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:
   1. Submittals.
   2. Coordination drawings.
   3. Record documents.
   5. Rough-ins.
   6. Plumbing installations.
   7. Cutting and patching.

1.03 DESCRIPTION

A. Provide a complete and operable installation, including all labor, supervision, materials, equipment, tools, apparatus, transportation, warehousing, rigging, scaffolding and other equipment and services necessary to accomplish the work in accordance with the intent and meaning of these drawings and specifications.

1.04 DEFINITIONS

A. "Provide" means furnish, install and connect unless otherwise described in specific instances.

B. "Piping" means pipes, fittings, valves and all like pipe accessories connected thereto.

C. "Ductwork" means ducts, plenums, compartments, or casings including the building structure, which are used to convey or contain air.

D. "Extend", "Submit", "Repair" and similar words mean that the Contractor (or his designated subcontractor) shall accomplish the action described.
E. "Codes" or "Code" means all codes, laws, statutes, rules, regulations, ordinances, orders, decrees, and other requirements of all legally constituted authorities and public utility franchise holders having jurisdiction.

F. "Products", "Materials" and "Equipment" are used interchangeably and mean materials, fixtures, equipment, accessories, etc.

G. "Utility Areas" are defined as mechanical, electrical, janitorial, and similar rooms or spaces which are normally used or occupied only by custodial or maintenance personnel. "Public Areas" are defined as the rooms or spaces, which are not included in the utility areas definition.

H. "Building Boundary" includes concrete walkways immediately adjacent to the building structure.

I. "Below Grade" means buried in the ground.

J. "Substantial Mechanical Completion" means all components of all systems are functioning but lacking in final adjustment.

K. Pressure rating specified (such as for valves and the like) means design working pressure for and with references to the fluid, which the device will serve.

1.05 RELATED WORK

A. Coordination: Refer to Architectural, Civil, Structural, and Electrical Drawings for the construction details and coordinate the work of this Division with that of other Divisions. Order the work of this Division so that progress will harmonize with that of other Divisions and all work will proceed expeditiously. The work of this Division shall include direct responsibility for the correct placing and connection of mechanical work in relation to the work of other Divisions.

B. Examine other Divisions for work related to the Work of this Division, especially Electrical.

1.06 EXISTING CONDITIONS

A. Visit the site prior to bidding and investigate the existing conditions, which affect or will be affected by the work of this Division. Become thoroughly familiar with the working conditions and take into account any special or unusual features peculiar to this job. By the act of submitting a Bid, the Contractor will be deemed to have complied with the foregoing, to have accepted such conditions, and to have made allowance therefore in preparing his Bid.

B. The locations of existing concealed utility lines are shown in accordance with reference data received by the Architect. The Architect does not guarantee the accuracy of such data. The points of connection are therefore approximate and the Bidder shall include adequate funds in his Bid to cover costs of connection regardless of their exact location.

C. Exercise extreme caution during trenching operations. Repair the damage caused by such operations to existing utility lines at no cost to the Owner, whether the lines are shown on drawings or not.
1.07 DRAWINGS AND SPECIFICATIONS

A. These drawings and specifications do not include necessary components for construction safety.

B. All provisions shall be deemed mandatory except as expressly indicated as optional by the word "may" or "option".

C. Except where dimensioned, the drawings relating to this division are a diagrammatic presentation of the design concept, which indicates the general area where piping and ductwork is to be run. The drawings do not necessarily indicate any and all offsets and configurations required for coordination with other trades. The contractor is responsible for the correct placing of his work, and the proper location and connection of his work in relation to the work of other trades.

1.08 PERMITS AND INSPECTIONS

A. Obtain, schedule and pay for permits, licenses, approvals, tests, and inspections required by legally constituted authorities and public utility franchise holders having jurisdiction over the work.

B. Afford the Architect's representative every facility for evaluating the skill and competence of the mechanics and to examine the materials. Concealed work shall be reopened when so directed during his periodic visits.

1.09 CODES AND REGULATIONS

A. By submitting a Bid, Contractor is deemed to represent himself as competent to accomplish the work of this Division in conformance with applicable Codes. In case of conflict between the Contract Documents and Code requirements, the Codes shall take precedence. Should such conflicts appear, cease work on the parts of the contract affected and immediately notify the Architect in writing. It shall be the Contractor's responsibility to correct, at no cost to the Owner, any work he executes in violation of Code requirements. Specific references to codes elsewhere in this Division are either to aid the Contractor in locating applicable information or to deny him permission to use options, which are permitted by Codes.

B. Applicable Codes: (Current editions unless otherwise noted)
   1. All local codes; city and/or county as applicable.
   2. OSHA requirements
   3. California Code of Regulations (CCR) Titles (as applicable)
   4. Fire Marshal Regulations
   5. State, County, City Health Department Ordinances and Regulations
   6. Regulations of all other authorities having jurisdiction.

C. Where conflict or variation exists amongst Codes, the most stringent shall govern.

1.10 SUBMITTALS

A. General: Follow the procedures specified in Division 01.
B. Mechanical Submittals: Increase the number of mechanical related shop drawings, product data, and samples submitted to allow for required distribution by one additional copy, which will be retained by the Mechanical Consulting Engineer.

C. Product Data: Assemble "product data" into tabbed brochures according to main areas of work i.e. Fire Protection; Plumbing; H.V.A.C.; Temperature Control; Testing, Adjusting, and Balancing.
   1. Assemble each brochure with tabbed separators for each Specification Section where products are noted to be submitted, with separate tabs for each product listed.
   2. Temperature "control shop drawings" may be submitted separately after preparations for review.
   3. For items such as valves, hangers and accessories, indicate specific items and where they are to be used.
   4. Contractor need only to submit for review those items specified to be submitted, unless requested by the Architect for special review.

D. Submit for review, only the specific items required in this Section or other Sections of Division 22.

E. Additional submittals shall include, but not limited:
   1. Air balance reports and equipment data record drawings.
   2. Certification of completion of testing.
   3. Certification of completion of operation instructions.
   4. Operating instruction brochure.
   5. Maintenance instruction brochures.
   7. 1/4" = 1'-0" or larger scale layouts of "Equivalent" equipment or "Or Approved Equal" equipment.
   8. Coordination Drawings, where requested or required.

F. Submittal materials will be reviewed for substantial conformity with the intent of the contract plans and specifications only. Such review does not indicate approval of dimensions, quantities, coordination with other trades, or work methods of the contractor, which are indicated thereon.

G. Additional copies may be required by individual sections of these specifications.

1.11 COORDINATION

A. The Contractor shall be responsible for coordinating the layout of all building elements to avoid conflict of the work of the structural, mechanical, electrical systems, and architectural features of the building.

B. The cost of any extra work of any kind caused by a conflict due to this lack of coordination shall be borne by the Contractor.

C. Contractor shall designate an individual competent and versed in the mechanical trades to coordinate the mechanical work with the work of other trades.
1.12 COORDINATION OF DRAWINGS

A. Prepare coordination drawings in accordance with Division 01 to a scale of 1/4" = 1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of the installations are of importance to the efficient flow of the Work, including but not necessarily limited to the following:

1. Indicate the proposed locations of piping, ductwork, equipment, and materials.
   Include the following:
   a. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   b. Equipment for connections and support details.

2. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

B. Submittal of "Or Approved Equal" substitutions of equipment will not be reviewed unless accompanied by coordination drawings.

1.13 RECORD AND DOCUMENTATION

A. Prepare record documents in accordance with the requirements in Division 01. In addition to the requirements specified in Division 01, indicate the following installed conditions:

1. Record as specified in Division 01 the locations and invert elevations of underground installations.

2. Accumulate the following and deliver to the Owner's representative prior to final acceptance of the work.

3. Record (As-Built) Drawings:
   a. Maintain in good order in the field office a complete set of prints for all work being done under Division 23. Update the drawings daily with neat and legible annotations in red ink showing the work as actually installed.
   b. The actual size, location and elevation of all buried lines, valve boxes, manholes, monuments, and stub-outs shall be accurately located and dimensioned from building walls or other permanent landmarks.
   c. Furnish the originals.

4. Operation and Maintenance Manual: Furnish an operation and maintenance manual covering the stipulated mechanical systems and equipment. Seven copies of the manual, bond in hardback binders or an approved equivalent shall be provided to the Architect.

5. Furnish one complete manual prior to the time that system or equipment tests are performed.

6. Furnish the remaining manuals before the contract is completed.

7. The following identification shall be inscribed on the cover:

   OPERATION AND MAINTENANCE MANUAL

   PROJECT TITLE . . . . . . .

   CONTRACTOR
8. Provide a table of contents. Insert tab sheets to identify discrete subjects. Instruction sheets shall be legible and easily understood, with large sheets of drawings folded in. The manual shall be complete in all respects for all materials, piping, valves, devices and equipment, controls, accessories and appurtenances stipulated. Include as a minimum the following:
   a. Updated approved materials lists, shop drawings and catalog information of all items of mechanical system equipment.
   b. System layout showing piping, valves and controls.
   c. Wiring and control diagrams with data to explain detailed operation and control of each component.
   d. A control sequence describing start-up, operation and shutdown.
   e. Detailed description of the function of each principal component of the system.
   f. Procedure for starting.
   g. Procedure for operating.
   h. Shut-down instructions.
   i. Installation instructions.
   j. Adjustments, maintenance and overhaul instructions.
   k. Lubrication schedule including type, grade, temperature range and frequency.
   l. Safety precautions, diagrams and illustrations.
   m. Test procedures.
   n. Performance data.
   o. Parts list, with manufacturer's names and catalog numbers.
   p. Preventive maintenance schedule.
   q. Service organization with name, address and telephone number.
   r. Valve identification chart and schedule.
   s. ASME certificates.
   t. Air balance report.

B. Standards Compliance: Where equipment or materials are specified to conform with requirements of standards of recognized technical or industrial organizations such as American National Standards Institute (ANSI) American Society for Mechanical Engineers (ASME) American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), American Society for Testing and Materials (ASTM), Underwriters Laboratories (UL), American Gas Association (AGA), American Refrigeration Institute (ARI), or National Electrical Manufacturer's Association (NEMA), that use a label or published listing as a method of indicating compliance, proof of such conformance shall be submitted and approved. The label or listing of the specified organization will be acceptable evidence.

C. Certificates of Conformance or Compliance: Submit original and not pre-printed certifications. Do not make statements in the certifications that could be interpreted to imply that the product does not meet all requirements.

D. Certified Test Reports: Certified Test Reports are reports of tests conducted on previously manufactured materials or equipment identical to that proposed for use. Before delivery of materials and equipment, submit certified copies of test reports specified in the individual sections.

E. Factory Tests: Factory tests are tests, which are required to be performed on the actual materials or equipment, proposed for use. Submit results of the tests in accordance with the requirements for laboratory test results of this Contract.
F. Permits and Certificates of Inspection: Furnish the originals.

G. Testing procedures and test results required in this and other sections. Furnish 2 copies.

H. Other data required by other sections of this Division. Furnish 2 copies.

1.14 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01.

1.15 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

1.16 EQUIVALENT EQUIPMENT

A. These specifications and/or drawings names and specifies certain equipment in detail. It also names equivalent equipment by manufacturer, which is not considered to be a "substitution".

B. Submit equivalent equipment to the Architect for review per the requirements of Division 01, and Section "Basic Mechanical Requirements."

C. Equipment of Manufacturers named in Division 22 will be considered equivalent to that specified in detail and/or named on the drawings if:
   1. The proposed equipment is of equivalent quality, capacity.
   2. Equipment is as fully equipped, fits the space allotted, and has physical configuration and weight similar to the equipment specified in detail.

D. A complete lay out of an equipment room or area must be submitted for equivalent equipment. Notice space limitations. Layouts to include plans and section views at a scale of not less than 1/4" = 1 ft.

E. The Architect shall determine the acceptability of "Equivalent Equipment."

1.17 CONSTRUCTION COST BREAK DOWN

A. Prepare and submit for review a construction cost breakdown for the major subdivisions of the mechanical work in accordance with General and Supplemental Conditions and Division 01.

B. Subdivide each item on the breakdown into two headings: labor and materials. Include overhead and profit in each entry.

C. Submit one copy of the breakdown directly to the Engineer and the remaining copies sent through regular channels.
1.18 TOOLS

A. Provide all special tools needed for proper operation and routine adjustment and maintenance of systems and equipment. Deliver tools to Owner’s representative and request a receipt for same.

1.19 WARRANTIES

A. Refer to Division 01 Section for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements.

B. Where periods more than one year are specified in the specifications, such longer periods shall govern. However, when any component fails at any time during this period, the warranty period for such component and all other components, which are inactive because of said failure shall be suspended. The warranty period for such components shall resume running for the remaining portion of the warranty period when failed component is completely repaired and in operation; however, in no case shall the resumed portion of the warranty period be less than 3 months in duration.

C. Neither payment for work, nor total or partial occupancy of work by the Owner, within or prior to the warranty period specified, shall be construed as acceptance of faulty work or shall condone any negligence or omission of Contractor in doing the work.

D. Compile and assemble the warranties specified in Division 23, into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

E. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names and addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

1.20 SEISMIC RESTRAINT

A. Provide seismic restraint for mechanical equipment, piping, and ductwork.

B. Contractor shall submit certification of suitability of seismic restraint methods signed by Structural Engineer registered in State of California.

C. Contractor may refer to details applicable in the SMACNA, "GUIDELINES FOR SEISMIC RESTRAINT OF MECHANICAL SYSTEMS", using the 'g' forces for "other buildings" classification CCR Title 24. Deliver a copy of these Guidelines to the Owner’s Resident Inspector.

1.21 SYSTEM OPERATIONAL TEST

A. The Contractor shall inform the Owner one week prior to starting this testing in order that the Owner’s representative may be present.

B. After balancing and prior to final inspection, the contractor shall operate all systems continuously trouble free and stable for a minimum period of fourteen (14) consecutive days including Saturday and Sunday.
Each day shall be a minimum of an 8-hour day. Should a problem arise, the fourteen (14) day period shall be restarted and repeated until successfully operated for full 14 days. A written report certified by the Owner's representative shall indicate the successful completion of a stable and trouble free 14-day period.

PART 2 - PRODUCTS

2.01 MATERIALS AND EQUIPMENT

A. Standard Products: Materials and equipment shall be essentially the standard cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be their latest standard designs that comply with the specification requirements.

B. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening, unless more stringent requirements are specified. Where two or more units of the same type of equipment are required, these units shall be products of a single manufacturer. The components thereof, however, are not required to be exclusively of the same manufacturer.

C. Each major component of equipment shall have manufacturer's name, address, model, and serial number on a nameplate securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

D. Whenever on the plans, or in these specifications, products are identified by the name of one manufacturer, it is intended that equivalent products of other manufacturers are acceptable, unless otherwise indicated, if accepted as a substitution by the Architect.

E. Where three or more manufacturers are listed as "acceptable manufacturers" however, then the products furnished shall be the product of one of the manufacturers listed. Manufacturers listed as "acceptable manufacturers" shall be considered "Equivalents" and shall meet quality and performance of a particular one specified by both name and catalog number.

2.02 PRODUCT LISTING

A. When two or more items of same material or equipment are required (plumbing fixtures, pumps, valves, air conditioning units, etc.) they shall be of the same manufacturer. Product manufacturer uniformity does not apply to raw materials, bulk materials, pipe, tube, fittings (except flanged and grooved types), sheet metal, wire, steel bar stock, welding rods, solder, fasteners, motors for dissimilar equipment units, and similar items used in Work, except as otherwise indicated.

2.03 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated mechanical equipment, indicating manufacturer, product name, model name, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.
2.04 SUBSTITUTIONS

A. General: Submittals of "Substitutions" shall be in accordance with requirements of Division 01.

B. By proposing a substitution, it is deemed that the Contractor shall bear the cost of any changes (whether architectural, structural, electrical or mechanical) necessary to accommodate the substitution, if said substitution is accepted.

C. Specific: Refer to other sections of this Division for additional requirements.

2.05 SUBMITTALS

A. General: Make submittals in accordance with requirements of Division 01.

B. Specific: Refer to other sections of this Division for additional requirements.

PART 3 - EXECUTION

3.01 WORKMANSHIP AND INSTALLATION METHODS

A. Workmanship shall be in the best standard practice of the trade.

B. Install equipment in accordance with the manufacturer's instructions and recommendations unless otherwise noted or specified.

3.02 TEST

A. General:
   1. Demonstrate that all components of the work of this Division have been provided and that they operate in accordance with the Contract Documents.
   2. Provide instruments and personnel for tests and demonstrations. Submit signed test results.

B. Specific: Refer to the other sections of this Division for test requirements.

3.03 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 02 through 23 for rough-in requirements.

3.04 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:
   1. Coordinate mechanical systems, equipment, and materials installation with other building components.
   2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical system with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. All mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components in full compliance with the equipment manufacturer’s recommendations. If the drawings or the manufacturer does not provide a specific space requirement for servicing equipment, provide as a minimum, horizontal distance of 36” from face of equipment to opposite vertical surface.
11. Install access panels or doors where units are concealed behind finished surfaces.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Any equipment located above a ceiling that has any component, which is serviceable shall be installed within 12” of the top of the ceiling.

3.05 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01. In addition to the requirements specified in Division 01, the following requirements apply:
1. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:
1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Architect, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.
C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, heating units, plumbing fixtures and trim, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

F. Patch existing finished surfaces and building components using experienced installers and new materials matching existing materials. For installer’s qualifications refer to the materials and methods required for the surface and building components being patched.

3.06 DELIVERY, HANDLING, STORAGE OF MATERIALS AND PROTECTION OF WORK

A. Protect materials against dirt, water, chemical and mechanical damage both while in storage and during construction.

B. Cover materials in such a manner that no finished surfaces will be damaged, marred or splattered with plaster or paint, and all moving parts will be kept clean and dry.

C. Replace or refinish any damaged materials including fronts of control panels, ductwork fittings, and shop-fabricated ductwork.

D. Keep cabinets and other openings closed to prevent entry of foreign matter.

E. Specific: Refer to other sections of this Division for additional requirements.

3.07 PROJECT CONDITIONS

A. Check and coordinate for clearance, accessibility and placement of equipment either by going through openings provided or by placing equipment during construction. Ordering of equipment to be shipped disassembled, or disassembly of equipment at Project Site and reassembly of equipment to accomplish this requirement shall be executed without additional cost. Where provided openings are inadequate to accommodate equipment, provide new openings and restoration of same, all at no additional cost. Obtain written approval for new openings before proceeding.

B. Verify location of all plumbing fixtures and equipment within finished spaces with the Architectural Drawings. In the event that Mechanical Drawings do not indicate exact locations, or are in conflict with the Architectural Drawings, obtain information regarding proper locations. Installation of work without proper instruction under such circumstances will result in relocation of work, when directed, without additional cost.

3.08 INSTRUCTION TO OWNER PERSONNEL

A. When specified in other sections, the Contractor shall furnish, without additional expense to the Owner, the services of competent instructors who will give full instruction to the designated personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the equipment or system specified.
Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance of work. Instruction shall be given at the Owner's convenience. The number of man-days (eight-hours) of instruction furnished shall be as specified in other sections. When more than four man-days of instruction are specified, approximately half of the time shall be used for classroom instruction. All other time shall be used for instruction with the equipment or system. When significant changes or modifications are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

B. Contractor shall videotape, both visual and audio, instruction to Owner's personnel on the maintenance and operation of the mechanical systems.

C. Submit certification, signed by Owner's agent that instructions have been completed and the videotape has been reviewed and delivered to the Owner.

D. Printed operating instructions and a copy of wiring diagrams are to be mounted in all equipment areas, framed and behind glass or encased in plastic. Printed operating instructions shall include steps for starting up and securing equipment. As a precedent to final acceptance four (4) copies of instructions are to be submitted to the Architect for review. Contractor shall turn over to Owner in a neat brochure form, equipment guarantee and maintenance instructions.

3.09 CLEANING

A. Cleaning shall be done as the work proceeds. Periodically remove waste and debris to keep the site as clean as is practical.

B. Refer the Division 01 Section: for general requirements for final cleaning.

C. Leave exposed parts of the mechanical work in a neat, clean and usable condition, with painted surfaces unblemished and plated metal surfaces polished.

D. Thoroughly clean all materials, equipment and appliances. Clean and prepare all surfaces to be painted. Clean the entire premises of unused materials, debris, spots and marks to the satisfaction of the Architect.

E. Remove, thoroughly clean and replace all strainers and automatic valves after the system has been put in operation until system is clear of all foreign matter and repeat this operation after ten (10) days and again after the system has been in operation thirty (30) days. Submit certification that this operation has been completed.

3.10 SAFETY REQUIREMENTS

A. Enclose and guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts in accordance with OSHA requirements. Insulate, guard, and cover any high-temperature equipment and piping so located as to endanger personnel or create a fire hazard.

END OF SECTION 23 0500
SECTION 23 0513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section specifies the basic requirements for electrical components, which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory-installed motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on Drawings.

C. All motors, power driven equipment and automatic control equipment, except motor starters as hereinafter set forth required and connected with the work of this section of the specifications are to be furnished and installed under Division 23.

D. Control low (24V) and control line (120V) voltage wiring, conduit and related switches and relays required for the automatic control and/or interlock of motors and equipment includes final connection, are to be furnished and installed under Division 23. Materials and installation to conform to Class 1 or 2, CAC Title 24, Article E725, and as restricted under Division 26 of these specifications.

E. Power wiring, conduit, outlets disconnect switches, motor starters and motor-rated contactors, and making of final connections, except as hereinafter specified, are to be furnished and installed under the Division 26 of these Specification.

F. All power supply wiring for providing a control power source to control dampers, control valves, VAV boxes control, control transformers, etc., shall be furnished and installed under Division 26.

G. Identify circuits and equipment as outlined in the Electrical Sections of these Specifications.

H. Coordinate requirements for underground conduit only between buildings for control interlocks shown on the drawings. This conduit to be furnished and installed under Division 26 of these Specifications.

I. Space provisions have been made on electrical panels for control power source.

1.02 RELATED SECTIONS

A. Separate electrical components and materials required for field installation and electrical connections are specified in Division 26.

B. This section applies to all Division 23 sections specifying packaged mechanical equipment.
1.03 REFERENCES

A. NEMA Standards MG 1: Motors and Generators
B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies
C. NEMA Standard 250: Enclosures for Electrical Equipment
D. NEMA Standard KS 1: Enclosed Switches
E. Comply with California Electrical Code.

1.04 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections.

1.05 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

PART 2 - PRODUCTS

2.01 MOTOR

A. Provide all motors necessary for equipment under the Mechanical Work. See Electrical Drawings for voltage and phase of electrical services.

B. The following are basis requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment specifications.
   1. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
   2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
   3. 2-speed motors shall have 2 separate windings on poly-phase motors.
   4. Temperature Rating: As a minimum motors shall be rated for 40 degree C environment with maximum 50 degree C temperature rise for continuous duty at full load (Class A Insulation).
   5. Starting capability: Frequency of starts as indicated by automatic control system and not less than 5 evenly time spaced starts per hour for manually controlled motors.
      a. Frames: NEMA Standard No. 48 or 54; use driven equipment manufacturer's standards to suit specific application.
      b. Bearings:
         1) Ball or roller bearings with inner and outer shaft seals.
         2) Re-greaseable bearings, except permanently sealed where motor is normally inaccessible for regular maintenance.
3) Bearings designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
4) Bearings for fractional horsepower, light duty motors, and sleeve-type bearings are permitted.

c. Enclosure Type:
1) Open drip-proof motors for indoor use where satisfactorily housed or remotely located during operation.
2) Guarded drip-proof motors where exposed to contact by employees or building occupants.
3) Weather protected Type I for outdoor use, Type II where not housed (Epoxy encapsulated or TEFC).

d. Overload protection: Poly-phase built-in thermal overload protection and, where indicated, internal sensing device suitable for signaling and stopping motor at starter. Single phase, provide thermal overload protection.

e. Noise rating: "Quiet".

f. Efficiencies shall be guaranteed minimum values in accordance with the following tabulation. Efficiencies shall be established in accordance with NEMA Test Standards MG1-12.53A using IEEE Test Procedure 112, Method B:

<table>
<thead>
<tr>
<th>HP</th>
<th>EFFICIENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 2</td>
<td>81.5</td>
</tr>
<tr>
<td>3 - 5</td>
<td>86.5</td>
</tr>
<tr>
<td>7-1/2 - 10</td>
<td>90.6</td>
</tr>
<tr>
<td>15</td>
<td>92.0</td>
</tr>
</tbody>
</table>

g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

h. Provide all motors with junction boxes or terminals boxes and provide adjustable slide rails for all motors with belt drives.

i. Motors rated 1 HP and larger shall have shaft, bearings and etc. capable of operating with multiple grooved sheaves and two or more belts.

j. V Type Belt Drives: Drives requiring not more than 2 belts; variable pitch type; size for mid-point of operating range. Drives requiring 3 or more belts; nonadjustable constant speed type. Provide belts in matched sets.

2.02 MOTOR STARTERS

A. Unless provided as part of packaged mechanical equipment or otherwise indicated, starters for motors will be provided under Division 26. Provide to Division 26 the data necessary for motor starter heater sizing for all motors.

B. Starters for factory packaged mechanical equipment specified under Division 23 shall be provided as part of the package.

C. Motor Starter Characteristics:
1. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs, or units in hazardous locations, which shall have CEC proper class and division.
2. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

D. Manual switches shall have:
   1. Pilot lights and extra positions for multi-speed motors.
   2. Overload protection: melting alloy type thermal overload relays.

E. Magnetic Starters:
   1. Maintained contact push buttons and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
   2. Trip-free thermal overload relays, each phase.
   3. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls section.
   4. Built-in control circuit transformer, fused from line side, where service exceeds 240 volts.
   5. Externally operated manual reset.
   6. Under-voltage release or protection.

F. Motor Connections:
   1. Flexible conduit, except where plug-in electrical cords are specifically indicated.

2.03 DISCONNECT SWITCHES

A. When applied as part of factory furnished and mounted equipment, disconnects shall meet the requirements for disconnect switches set forth in Division 26.

PART 3 - EXECUTION

3.01 SEISMIC RESTRAINT

A. All electrical devices to be seismically restrained.
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes limited scope of selective HVAC demolition work as follows:
   1. Nondestructive removal of materials and equipment for reuse or salvage as indicated.
   2. Dismantling HVAC materials and equipment made obsolete by these installations.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 and Division 23 Specification Sections.

B. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
   1. Coordinate sequencing and Owner occupancy specified in Division 01.
   2. Coordinate other selective demolition work as outlined in Division 01.

1.03 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:
   1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
   2. Locate, identify, and protect HVAC services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas. Provide minimum of 72-hour notice to Owner prior to utility interruption.

1.04 SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of utility services with the Owner and the utility company.

B. Notify the Architect at least 7 days prior to commencing demolition operations.

C. Perform demolition in phases as indicated.

PART 2 - PRODUCTS (Not Applicable)
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas where selective demolition is to occur. Determine extent of work and affect on existing conditions to remain. Advise Architect of any conditions that might create extensive alterations beyond indicated scope.

3.02 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned HVAC materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing HVAC materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.

1. Protect all removed and salvaged equipment from being damaged during the demolition work.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. HVAC Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete piping, fittings and specialties, equipment, air distribution ductwork and all associated accessories, controls, fixtures, and insulation.
   a. Obtain written approval form Architect and owner for piping and ducts embedded in floors, walls, and ceilings which may remain if such materials do not interfere with new installations.
      1) Drain and cap piping and ducts allowed to remain.
   b. Remove materials above accessible ceilings.

2. Perform cutting and patching required for demolition.

END OF SECTION
PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of vibration control work required by this section is indicated on drawings and schedules, and/or specified in other Division 23 Sections.

B. Types of vibration control products specified in this section include the following:
   1. Fiberglass Pads and Shapes;
   2. Neoprene Pads;
   3. Vibration Isolation Springs;
   4. Pad-Type Isolators;
   5. Plate-Type Isolators;
   6. Double-Plate-Type Isolators;
   7. Threaded Double-Plate-Type Isolators;
   8. All-Directional Anchors;
   9. Neoprene Mountings;
   10. Spring Isolators, Free-Standing;
   11. Spring Isolators, Housed;
   12. Spring Isolators, Vertically-Restrained;
   13. Spring Isolators, Earthquake-Restrained;
   14. Seismic Snubbers;
   15. Thrust Restraints;
   16. Equipment Rails;
   17. Fabricated Equipment Bases;
   18. Inertia Base Frames;
   19. Roof-Curb Isolators;
   20. Isolation Hangers;
   21. Riser Isolators;
   22. Flexible Pipe Connectors.

1.02 RELATED SECTIONS

A. This section is part of each Division 23 Section making reference to vibration control products specified herein.

B. Vibration control products furnished as integral part of factory-fabricated equipment are specified as part of equipment assembly in other Division 23 Sections.

C. Refer to other Division 23 Sections for equipment foundations, hangers, sealants, gaskets, and other work related to vibration control work.

D. Refer to other Division 23 Sections for requirements of electrical connections to equipment isolated on vibration control products.
E. Refer to other Division 23 Sections for requirements of duct connections to air handling equipment isolated on vibration control products.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.
   1. Catalog cuts and data sheets on specific vibration isolators to be utilized, showing compliance with the specification.
   2. An itemized list showing the items of equipment, piping, etc., to be isolated, the isolator type and model number selected, isolator loading and deflection, and reference to specific drawing showing frame construction where applicable.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weights, required clearances, and method of assembly of components. Detail bases and show location of equipment anchoring points, coordinated with equipment manufacturer's shop drawings.
   1. Drawings showing equipment frame construction for each item of equipment, including dimensions, structural member sizes, support point locations, etc.
   2. Written approval of the frame design to be used, obtained from the manufacturer.
   3. Drawings showing methods for suspension, support, guides, etc., for piping and ductwork, etc.
   4. Drawings showing methods for isolation of pipes, etc., piercing walls, slabs, beams, etc.

C. Maintenance Data: Submit maintenance data for each type of vibration control product. Include this data, product data, and shop drawings in maintenance manual in accordance with requirements of Division 01.

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of vibration control products, of type, size, and capacity required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Except as otherwise indicated, obtain vibration control products from single manufacturer.

C. Engage manufacturer to provide technical supervision of installation of vibration control products.

D. Vibration isolation manufacturer shall have the following responsibilities:
   1. Determine vibration isolation sizes and locations.
   2. Provide piping and equipment isolation system as scheduled or specified.
   4. Provide installation instruction and drawings.
1.05 **SEISMIC RESTRAINT**

A. Provide seismic restraint for mechanical equipment, in accordance with provisions of the 2013 CBC and ASCE 7-10. Piping and ductwork restraint shall be per OSHPD pre-approval OPM#s.

**PART 2 - PRODUCTS**

**2.01 ACCEPTABLE MANUFACTURERS**

A. Manufacturer: Subject to compliance with requirements, provide vibration control products of one of the following:
   1. Mason Industries, Inc.
   2. Consolidated Kinetics, Inc.
   3. Or approved equal.

B. Except as otherwise indicated mechanical equipment shown on drawings shall be isolated from the structure by means of resilient vibration and noise isolators supplied by a single manufacturer to the Contractor.

**2.02 VIBRATION ISOLATION AND SEISMIC RESTRAINTS**

A. Type and Description:
   1. Type PN is a molded pad. The area of pad shall be chosen to match the load in order to achieve the required static deflection.
   2. Type MN is a molded neoprene in shear element equipped with leveling bolts and base-plate with bolt holes to permit attachment to the building structure where required.
   3. Type HN is a suspension hanger with a steel box frame and a molded neoprene in shear element. A neoprene grommet shall be provided at the location where the hanger rod passes through the hanger box so that no metal-to-metal contact occurs.
   4. Type MS is a bare, stable, steel spring equipped with leveling bolts and with a minimum 1/4" thick ribbed neoprene pad under the base-plate. Bolt holes shall be provided in the base-plate to permit attachment to the building structure where required.
   5. Type MSL is a bare, stable, steel spring with a ribbed neoprene pad under the base-plate. Bolt holes shall be provided in the base-plate to permit attachment to the building structure. Limit stops shall be provided to prohibit spring extension if the load is removed. These stops may also serve as rigid blocking during erection so that the installed and operating heights shall be the same. Clearance shall be maintained around restraining bolts and between the limit stops and the housing so as not to interfere with the spring action.
   6. Type HS is a suspension hanger with a steel box frame and a steel spring resting on a neoprene cup. The cup shall contain a steel washer designed to evenly distribute the load to the neoprene and prevent its overload or extrusion. The spring diameter and hanger box lower hole size shall be large enough to permit the hanger rod to swing through a 30-degree arc before contacting the hole and short circuiting the spring. Hangers shall be provided with an eye bolt on the spring end.
7. Type CMS is prefabricated spring isolation curb for rooftop equipments. The lower member shall consist of a rectangular steel tube containing adjustable and removable steel springs that support the upper floating section. The upper frame must provide continuous support for the equipment and must resiliently resist wind and seismic forces. All-directional neoprene snubber bushings shall be a minimum of ¼” thick. Steel springs shall rest on ¼” thick neoprene acoustical pads and have a static deflection as indicated on the project drawings. Hardware must be cadmium plated or galvanized and the springs plated or provided with an approved rust-resistant finish. Weatherproofing shall be provided by a continuous flexible aluminum seal joined at the corners by flexible frictionless neoprene bellows. The aluminum seal must be nailed over and provided counter flashing to the curb’s waterproofing. Access ports with waterproof covers shall be provided at each spring location and 2” thermal insulation shall be included on the lower sides of the curb.

8. Type SF is a flexible neoprene pipe connector. They shall be manufactured of multiple plies of nylon tire cord fabric and neoprene both molded and cured in hydraulic rubber presses. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres. Neoprene elbows shall be manufactured with a single sphere forming the corner of the joint itself. Connectors up to and including 2” diameter may have threaded ends. Connectors 2-1/3” and larger shall be manufactured with floating steel flanges recessed to lock the connector’s raised face neoprene flanges. All connectors shall be rated with either flanged or screwed twin spheres properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure. Connectors shall be provided with control units, in accordance with the manufacturer’s recommendations to limit expansion.

B. Specifications are based on the following Mason Industries models:

C. Type Description  Mason Model #

1) PN Neoprene Pad  W
2) MN Neoprene Mount  ND
3) HN Neoprene Hanger  HD
4) MS Spring Mount  SLF
5) MSL Spring Mount with Limit Stop  SLR
6) HS Spring Hanger  W30
7) CMS Spring ISO Curb  RSC
8) SF Flexible Pipe Connector  SFDEJ

2.03 EQUIPMENT FRAMES

A. General: Mounting frames and/or brackets shall be provided to carry the load of the equipment without causing mechanical distortion or stress to the equipment.
2. Frame Types:
   1. Type A frame is a wide flange structure steel frame with height saving brackets as shown on the drawings. Mason WFSL
   2. Type B frame is a channel steel structural frame with brackets as shown on the drawings. Mason MSL
   3. Type C no frame required, isolators directly attached to equipment.

2.04 SEISMIC RESTRAINTS

A. Type I, Rigidly Mounted Equipment: Attach to the structure with attachments to resist a lateral force per code requirements.

B. Type II, Vibration Isolated Equipment:
   1. Mount all vibration isolated equipment on rigid steel frames as described in the vibration control specifications unless the equipment manufacturer certified direct attachment capability.
   2. Each vibration isolated frame shall have a minimum of four all-directional seismic snubbers that are double acting and located as close to the vibration isolators as possible to facilitate attachment to the base and the structure.
   3. The snubber shall consist of interlocking steel members restrained by shock absorbent rubber material compounded to bridge bearing specifications.
   4. Elastomeric materials, replaceable and a minimum of 1/4 inch thick. Snubbers, manufactured with an air gap between hard and resilient material of not less than 1/8 inch or more than 1/4 inch. Install snubbers with factory set clearances.
   5. Snubbers shall be pre-approved by the State of California.
   6. The capacity of the seismic snubber at 3/8 inch deflection shall be 3 to 4 time the load assigned to the mount grouping in its immediate area. Submittals shall include the load deflection curves up to ½-inch deflection in the x, y and z planes. Conduct test in an independent laboratory or under the signed supervision of an independent registered engineer. Bolt snubber assemblies to the test machine as the snubber is normally installed.
   7. Test report shall certify that neither the neoprene elements nor the snubber body sustained any obvious deformation after release of load.

C. Type III, Seismic Restraint of Vibration Isolated Suspended Piping:
   1. Brace all piping per the 2013 CBC and ASCE 7-10.
   2. The cable size and attachment to the pipe and structure shall be designed and signed by a licensed engineer in the State of California.
   3. Use a slack cable system of a minimum 5/16" aircraft at a minimum of 40 feet on center.
   4. Support insulated piping systems per DSA Approved “SMACNA Guidelines for Seismic Restraint of Mechanical Systems”.
   5. Piping 2 inches and smaller is exempt from special seismic bracing requirement.

D. Type IV, Suspended Vibration Isolated Equipment:
   1. Utilize a slack cable restraint system.
   2. The cable size and attachment shall be designed and signed by an engineer licensed in the State of California.
E. All Mechanical ductwork shall be installed with seismic restraint per DSA Approved “SMACNA Guidelines for Seismic Restraint of Mechanical Systems”. A copy of the guidelines published by SMACNA shall be kept on the job site at all times during construction.

2.05 DUCTWORK

A. Brace all ductwork including insulated ductwork per DSA Approved “SMACNA Guidelines for Seismic Restraint of Mechanical Systems”.

B. Flexible connections shall be incorporated in the ductwork attachment to all fan and coil units.

PART 3 - EXECUTION

3.01 GENERAL

A. Report - The vibration isolation manufacturer, or his representative, shall be responsible for providing such supervision as may be necessary to assure correct installation and adjustment of the isolators. Upon completion of the installation and after the system is put into operation, the manufacturer, or his representative, shall make a final inspection and submit his report to the Architect in writing, certifying the correctness of installation and compliance with approved submittal data.

B. No equipment or pipe shall be installed which makes rigid contact with the "building" unless it is approved in this specification or by the architect. "Building" includes slabs, beams, studs, walls, latch, etc.

C. Install flexible connectors at all connections to pumps and chillers. Connectors shall be Mason Safeflex constructed of peroxide cured EPDM material and Kevlar reinforcing.

3.02 MOUNTING

A. Isolation Configuration for Floor Mounted or Suspended Equipment: Provide a maximum of four vibration isolators located at the corners of the equipment unless approval is obtained for additional isolators. Where feasible, provide three isolators.

3.03 EQUIPMENT ISOLATOR

A. The equipment to be isolated shall be supported by a structural steel frame or attached directly to the machine where no frame is required.

B. Brackets shall be provided to accommodate the isolator. The vertical position and size of the bracket shall be specified by the isolator manufacturer.

C. The minimum operating clearance between the frame and the pad or floor shall be 1 inch.

D. The minimum operating clearance between the bracket and the pad or floor shall be 1 inch.
E. The frame shall be placed in position and the brackets supported temporarily by 1 inch shims prior to the installation of the machine or isolators.

F. After the entire system installation is completed and under full operation load, the isolator shall be adjusted so that the load is transferred from the shims to the isolator. When all isolators are properly adjusted, the shims shall be used as a gauge to check that the clearance is maintained so that the system will remain free of stress.

3.04 PIPING ISOLATOR, VERTICAL RISER OR HORIZONTALLY SUPPORTED

A. The objective and installation procedure is similar to the Equipment Isolator Installation procedures.

3.05 PIPING ISOLATOR, HORIZONTALLY SUSPENDED PIPING

A. The isolators shall be installed with the isolator hanger box as close as possible to the structure.

B. The isolators shall be suspended from beams, never from slab diaphragms between beams unless specifically approved by the Architect.

C. Hanger rods shall be aligned to clear the hanger box.

3.06 DUCTWORK

A. Flexible connections shall be incorporated in the ductwork attachment to all air moving units supported with isolators. Connections shall be as herein specified.

3.07 INSTALLATION OF SEISMIC RESTRAINT

A. All seismic restraints must be installed and adjusted so that the equipment and piping vibration isolation is not degraded by utilization of the restraints.

B. Equipment:
   1. Position all seismic restraints with equipment in operation for proper operating clearances.
   2. Weld or bolt seismic restraints to the structure.

C. Piping:
   1. Install seismic bracing without compromising vibration isolation.
   2. Provide seismic restraint for all piping in equipment rooms, in shafts, and in ceilings of occupied spaces.

D. Ductwork:
   1. Install seismic bracing without compromising vibration isolation.
   2. Provide seismic restraint for all ductwork in equipment rooms, in shafts, and in ceilings of occupied spaces.
# 3.08 Isolation Schedule

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Isolation Spec. Type</th>
<th>Deflection</th>
<th>Restraint Type</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chilled Water &amp; Heating Water Piping at Pumps &amp; Coil Connections</td>
<td>SF</td>
<td>N/A</td>
<td>SFDEJ</td>
<td>Flexible Pipe Connector</td>
</tr>
<tr>
<td>Split Air Conditioner Outdoor Condenser unit</td>
<td>SLREBP</td>
<td>1.0”</td>
<td>MSL &amp; Integral To SLREBP</td>
<td>Welded Angle Iron Frame</td>
</tr>
<tr>
<td>Suspended Chilled &amp; Heating Water Piping</td>
<td>HS</td>
<td>1.0”</td>
<td>PC 30 / Cable</td>
<td>Clevis or Trapeze Mount With Seismic Cables</td>
</tr>
<tr>
<td>Roof or Floor Supported Chilled &amp; Heating Water Piping</td>
<td>SLRS</td>
<td>1.0”</td>
<td>MSL &amp; Integral To SLRS</td>
<td>Welded Angle Iron Frame</td>
</tr>
<tr>
<td>Roof Mounted Exhaust Fan Unit</td>
<td>ISC</td>
<td>1.0”</td>
<td>Integral to ISC</td>
<td>Rooftop Spring Isolation Curb</td>
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<tr>
<td>Air Handling Units Exterior To Unit:</td>
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<td>N/A</td>
<td>N/A</td>
<td>Down Discharge Air Handling Units</td>
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<tr>
<td>Interior To Unit:</td>
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<td>N/A</td>
<td></td>
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<tr>
<td>Suspended Equipment</td>
<td>HS</td>
<td>1”</td>
<td>PC30</td>
<td>Fan Coil Units &amp; Inline Exhaust Fan Units</td>
</tr>
</tbody>
</table>

End of Section 23 0548
SECTION 23 0553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of mechanical identification work required by this section is indicated on drawings or specified in other Division 23 Sections, and includes the following:
   1. Painted Identification Materials
   2. Plastic Pipe Markers
   3. Plastic Tape
   4. Underground-Type Plastic Line Marker
   5. Plastic Duct Markers
   6. Valve Tags
   7. Diagram and Schedule Frames
   8. Engraved Plastic-Laminate Signs
   9. Plastic Equipment Markers
   10. Plasticized Tags
   11. Equipment Marker

1.02 RELATED SECTIONS

A. This section makes reference to identification devices specified herein.

B. Mechanical identification furnished as part of factory-fabricated equipment, is specified as part of equipment assembly in other Division 23 Sections.

C. Refer to Division 26 Sections for identification requirements of electrical work; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.

C. Schedules and Diagrams:
   1. Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule.
   2. Submit temperature control diagrams and Sequence of Operation on bond paper suitable for framing.
D. Maintenance Data: Include product data and schedules in maintenance manuals; in accordance with requirements of Division 01 and Division 23, Section 23 0500 "Common Work Results for HVAC".

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.
   2. No adhesive type identification markers will be accepted. All markers and tags shall be permanently attached to pipe, etc.
   3. All identification markers installed exterior of buildings shall be ultra-violet resistant.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
   1. Allen Systems, Inc.
   3. Industrial Safety Supply Co., Inc.
   4. Seton Name Plate Corp.

2.02 MECHANICAL IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 Sections. Where more than a single type is specified for application, selection is Installer's option, but provide a single selection for each product category.

2.03 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.

B. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on un-insulated pipes subject to fluid temperatures of 125oF (52oC) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

C. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
   1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   2. Laminated or bonded application of pipe marker to pipe (or insulation).
   3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

D. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, taped lapped 3".
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

E. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.
   1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

2.04 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.05 UNDERGROUND-TYPE PLASTIC LINE MARKER

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.
   1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.06 VALVE TAGS

A. Brass Valve Tags: Provide 19-gage polished brass valve tags with stamped-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high and with 5/32" hole for fastener.
   1. Provide 1-1/2" diameter tags, except as otherwise indicated.
   2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

C. Access panel markers: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

D. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.
2.07 DIAGRAM AND SCHEDULE FRAMES

A. General: For each page of schedule and/or diagrams, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.08 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in the sizes and thicknesses indicated, engraved with engraver’s standard letter style of the sizes and wording indicated, white with black core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16” for units up to 20 sq. in. or 8” length; 1/8” for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.09 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

2.10 EQUIPMENT MARKERS

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
   a. Manufacturer, product name, model number, and serial number.
   b. Capacity, operating and power characteristics, and essential data.
   c. Labels of tested compliances.

2. Location: Accessible and visible.

3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.

2. Data.

3. Name and plan number.
   a. Equipment service.
   b. Design capacity.
   c. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

4. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine sub-core, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
   1. Data: Instructions for operation of equipment and for safety procedures.
   2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
   3. Retain and edit subparagraph above or first subparagraph below.
   4. Thickness: 1/16 inch for units up to 20 sq. in. or 8 inches in length, and 1/8 inch for larger units.
   5. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.11 PLASTIC DUCT MARKERS

A. Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finishes, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
   1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot-non-insulated pipes.

B. Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
   1. Near each valve and control device.
   2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls, floors ceilings, or enter non-accessible enclosures.
4. At access doors, manholes similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit immediately spaced markers.

3.03 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping systems, except sanitary sewer and storm drainage install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker.

3.04 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve on valve schedule for each piping system.

B. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

3.05 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
1. Fuel-burning units including boilers, furnaces, heaters.
2. Pumps, compressors, chillers, condensers and similar motor-driven units.
3. Fans and blowers.
4. Packaged HVAC central-station or zone-type units.
5. Split air conditioner indoor and outdoor units
6. Single Duct terminal units and all equipment in ceiling space.(In addition to the equipment tag, install an identification tag for VAV units in locations approved by architect to indicate where each unit is installed above the ceiling. Coordinate the Installation location, type, size and color of this tag with the architect.).

B. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
C. Test of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.06 ADJUSTING AND CLEANING

A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 23 0553
SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
   1. Balancing airflow and water flow within distribution systems, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
   2. Adjusting total HVAC systems to provide indicated quantities.
   4. Setting quantitative performance of HVAC equipment.
   5. Verifying that automatic control devices are functioning properly.
   6. Reporting results of the activities and procedures specified in this Section.

B. Related Sections include the following:
   1. Testing and adjusting requirements unique to particular systems and equipment are included in the Sections that specify those systems and equipment.
   2. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment Sections.

1.03 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including sub-mains, branches, and terminals, according to design quantities.

C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

E. Report Forms: Test data sheets for recording test data in logical order.
F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

K. Test: A procedure to determine quantitative performance of a system or equipment.

L. Testing, Adjusting, and Balancing Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.


O. SMACNA: Sheet Metal and Air Conditioning Contractors’ National Association.

1.04 SUBMITTALS

A. Quality-Assurance Submittals: Within 30 days from the Contractor's Notice to Proceed, submit 6 copies of evidence that the testing, adjusting, and balancing Agent and this Project's testing, adjusting, and balancing team members meet the qualifications specified in the "Quality Assurance" Article below.

B. Strategies and Procedures Plan: Within 60 days from the Contractor's Notice to Proceed, submit 6 copies of the testing, adjusting, and balancing strategies and step-by-step procedures as specified in Part 3 "Preparation" Article below. Include a complete set of report forms intended for use on this Project.

C. Certified Testing, Adjusting, and Balancing Reports: Submit 6 copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.

D. Warranty: Submit 6 copies of special warranty specified in the "Warranty" Article below.

E. Provide a summary of any discrepancies found in the system, by Air balance contractor to each system as described hereafter. Include a complete list of deficiencies and problems found in system being tested and balanced. Add this report to final submittal package.
1.05 QUALITY ASSURANCE

A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC.

B. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
   a. Submittal distribution requirements.
   c. Testing, adjusting, and balancing plan.
   d. Work schedule and Project site access requirements.
   e. Coordination and cooperation of trades and subcontractors.
   f. Coordination of documentation and communication flow.

C. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
   2. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.

D. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC "National Standards for Testing, Adjusting, and Balancing."

E. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.

F. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.06 PROJECT CONDITIONS

A. Full Owner Occupancy: The Owner may occupy the site and existing building during the entire testing, adjusting, and balancing period. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.07 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.

B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

D. Review Division 23 contract documents to assure that the design has considered all required components necessary for a complete and successful testing, adjusting and balancing of the system as described hereafter. Prepare a report for this examination of contract documents and propose any additional components required to complete the scope of work this section no later than 45 days after the award of the contract.

1.08 WARRANTY

A. General Warranty: The national project performance guarantee specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. National Project Performance Guarantee: Provide a guarantee on AABC "National Standards" forms stating that AABC will assist in completing the requirements of the Contract Documents if the testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
   1. The certified Agent has tested and balanced systems according to the Contract Documents.
   2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine Contract Documents to become familiar with project requirements and to discover conditions in systems' designs that may preclude proper testing, adjusting, and balancing of systems and equipment.
   1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
   2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine project record documents described in Division 01 Section "Project Record Documents."

D. Examine Architect's and Engineer's design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
E. Examine equipment performance data, including fan curves. Relate performance data to project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine strainers for clean screens and proper perforations.

L. Examine 2-way valves for proper installation for their intended function.

M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

N. Examine equipment for installation and for properly operating safety interlocks and controls.

O. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices operate by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multi-zone units, mixing boxes, and variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including 2-way valves, are properly connected.
   5. Thermostats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to design values.

P. Report deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.02 PREPARATION

A. Prepare a testing, adjusting, and balancing plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so design conditions for system operations can be met.

3.03 GENERAL TESTING AND BALANCING PROCEDURES

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC national standards and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.

C. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.04 FUNDAMENTAL AIR SYSTEMS' BALANCING PROCEDURES

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
D. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of fan coil unit components.

3.05 CONSTANT-VOLUME AIR SYSTEMS’ BALANCING PROCEDURES

A. The procedures in this Article apply to constant-volume supply-, return-, and exhaust-air systems. Additional procedures are required for variable-air-volume, multi-zone, induction-unit supply-air systems and process exhaust-air systems. These additional procedures are specified in other articles in this Section.

B. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
   1. Measure fan static pressures to determine actual static pressure as follows:
      a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   2. Measure static pressure across each air-handling unit component.
      a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
   3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers under final balanced conditions.
   4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
   5. Adjust fan speed higher or lower than design with the approval of the Architect. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
   6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
C. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to design airflows within specified tolerances.
   1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
      a. Where sufficient space in sub-mains and branch ducts is unavailable for pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
   2. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-mains and branch ducts to design airflows within specified tolerances.

D. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or the outlet manufacturer's written instructions and calculating factors.

E. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values. Make adjustments using volume dampers rather than extractors and the dampers at the air terminals.
   1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
   2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 MULTIZONE SYSTEMS' ADDITIONAL PROCEDURES

A. Set unit at full flow through the cooling coil if coil has that capacity.

B. Adjust each zone damper to design airflow.

3.07 MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
   1. Manufacturer, model, and serial numbers.
   4. Efficiency rating if high-efficiency motor.
   5. Nameplate and measured voltage, each phase.
   6. Nameplate and measured amperage, each phase.
   7. Starter thermal-protection-element rating.

3.08 CONDENSING UNITS

A. Verify proper rotation of fans and measure entering- and leaving-air temperatures. Record compressor data.

3.09 HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:
   1. Entering- and leaving-water temperatures.
   2. Water flow rate.
   3. Water pressure drop.
4. Dry-bulb temperatures of entering and leaving air.
5. Wet-bulb temperatures of entering and leaving air for cooling coils designed for less than 7500 CFM.
6. Airflow.
7. Air pressure drop.

3.10 TEMPERATURE TESTING

A. During testing, adjusting, and balancing, report need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of 2 successive 8-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.11 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Verify free travel and proper operation of control devices such as damper and valve operators.

F. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.

G. Confirm interaction of electrically operated switch transducers.

H. Confirm interaction of interlock and lockout systems.

I. Verify main control supply-air pressure and observe compressor and dryer operations.

J. Record voltages of power supply and controller output. Determine if the system operates on a grounded or non-grounded power supply.

K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.12 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans: Minus 5 to plus 5 percent.
   2. Fresh air intake: 0 to plus 5%.
3. Air Outlets and Inlets: 0 to plus 10 percent.
4. Heating-Water Flow Rate: 0 to minus 10 percent.
5. Cooling-Water Flow Rate: 0 to minus 5 percent.

3.13 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, prepare a report on the adequacy of design for systems’ balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 FINAL REPORT

A. General: Computer printout in letter-quality font, on standard bond paper, in a fine quality 3-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of the instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to the certified field report data, include the following:
   1. Fan curves.
   2. Manufacturers’ test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.

D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of testing, adjusting, and balancing Agent.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address and field technician responsible for the project.
   9. Signature of testing, adjusting, and balancing Agent who certifies the report.
   10. Summary of contents, including the following:
       a. Design versus final performance.
       b. Notable characteristics of systems.
c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.
12. Data for terminal units, including manufacturer, type size, and fittings.
13. Notes to explain why certain final data in the body of reports vary from design values.

14. Test conditions for fans and pump performance forms, including the following:
   a. Settings for outside-, return-, and exhaust-air dampers.
   b. Conditions of filters.
   c. Cooling coil, wet- and dry-bulb conditions.
   d. Face and bypass damper settings at coils.
   e. Fan drive settings, including settings and percentage of maximum pitch diameter.
   f. Inlet vane settings for variable-air-volume systems.
   g. Settings for supply-air, static-pressure controller.
   h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air distribution systems. Present with single-line diagrams and include the following:
   1. Quantities of outside, supply, return, and exhaust airflows.
   2. Water and steam flow rates.
   3. Duct, outlet, and inlet sizes.
   4. Pipe and valve sizes and locations.
   5. Balancing stations.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
   1. Unit Data: Include the following:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.
      f. Unit arrangement and class.
      g. Discharge arrangement.
      h. Sheave make, size in inches, and bore.
      i. Sheave dimensions, center-to-center and amount of adjustments in inches.
      j. Number of belts, make, and size.
      k. Number of filters, type, and size.
   2. Motor Data: Include the following:
      a. Make and frame type and size.
      b. Horsepower and RPM.
      c. Volts, Phase, and Hertz.
      d. Full-load amperage and service factor.
      e. Sheave make, size in inches, and bore.
      f. Sheave dimensions, center-to-center and amount of adjustments in inches.
   3. Test Data: Include design and actual values for the following:
      a. Total airflow rate in CFM.
      b. Total system static pressure in Inches WG.
      c. Fan RPM.
      d. Discharge static pressure in Inches WG.
      e. Filter static-pressure differential in Inches WG.
f. Preheat coil static-pressure differential in Inches WG.
g. Cooling coil static-pressure differential in Inches WG.
h. Heating coil static-pressure differential in Inches WG.
i. Outside airflow in CFM.
j. Return airflow in CFM.
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

G. Apparatus-Coil Test Reports: For apparatus coils, include the following:
1. Coil Data: Include the following:
   a. System identification.
   b. Location.
   c. Coil type.
   d. Number of rows.
   e. Fin spacing in Fins Per Inch.
   f. Make and model number.
   g. Face area in Sq. Ft.
   h. Tube size in NPS.
   i. Tube and fin materials.
   j. Circuiting arrangement.
2. Test Data: Include design and actual values for the following:
   a. Airflow rate in CFM.
   b. Average face velocity in FPM.
   c. Air pressure drop in Inches WG.
   d. Outside-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in GPM.
   i. Water pressure differential in Feet of Head or PSIG.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.
   l. Refrigerant expansion valve and refrigerant types.
   m. Refrigerant suction pressure in PSIG.
   n. Refrigerant suction temperature in deg F.
   o. Inlet steam pressure in PSIG.

H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data: Include the following:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and size.
   e. Manufacturer's serial number.
   f. Arrangement and class.
   g. Sheave make, size in inches, and bore.
   h. Sheave dimensions, center-to-center and amount of adjustments in inches.
2. Motor Data: Include the following:
   a. Make and frame type and size.
   b. Horsepower and RPM.
c. Volts, Phase, and Hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center and amount of adjustments in inches.
g. Number of belts, make, and size.
3. Test Data: Include design and actual values for the following:
   a. Total airflow rate in CFM.
   b. Total system static pressure in Inches WG.
   c. Fan RPM.
   d. Discharge static pressure in Inches WG.
   e. Suction static pressure in Inches WG.

I. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
   1. Report Data: Include the following:
      a. System and air-handling unit number.
      b. Location and zone.
      c. Traverse air temperature in deg F.
      d. Duct static pressure in Inches WG.
      e. Duct size in inches.
      f. Duct area in Sq. Ft.
      g. Design airflow rate in CFM.
      h. Design velocity in FPM.
      i. Actual airflow rate in CFM.
      j. Actual average velocity in FPM.
      k. Barometric pressure in PSIG.

J. Air-Terminal-Device Reports: For terminal units, include the following:
   1. Unit Data: Include the following:
      a. System and air-handling unit identification.
      b. Location and zone.
      c. Test apparatus used.
      d. Area served.
      e. Air-terminal-device manufacturer.
      f. Air-terminal-device number from system diagram.
      g. Air-terminal-device type and model number.
      h. Air-terminal-device size.
      i. Air-terminal-device effective area in Sq. Ft.
   2. Test Data: Include design and actual values for the following:
      a. Airflow rate in CFM.
      b. Air velocity in FPM.
      c. Preliminary airflow rate as needed in CFM.
      d. Preliminary velocity as needed in FPM.
      e. Final airflow rate in CFM.
      f. Final velocity in FPM.
      g. Space temperature in deg F.

K. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
   1. Unit Data: Include the following:
      a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flow-meter type.

2. Test Data: Include design and actual values for the following:
   a. Airflow rate in CFM.
   b. Entering-water temperature in deg F.
   c. Leaving-water temperature in deg F.
   d. Water pressure drop in Feet of Head or PSIG.
   e. Entering-air temperature in deg F.
   f. Leaving-air temperature in deg F.

L. Instrument Calibration Reports: For instrument calibration, include the following:
   1. Report Data: Include the following:
      a. Instrument type and make.
      b. Serial number.
      c. Application.
      d. Dates of use.
      e. Dates of calibration.

3.15 ADDITIONAL TESTS

   A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

   B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 0593
SECTION 23 0700

HVAC INSULATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Extent of HVAC insulation required by this section is indicated on drawings and schedules, and by requirements of this section, and includes the following:

1. Piping Systems Insulation:
   a. Fiberglass.
   b. Calcium Silicate.
   c. Flexible Unicellular.

2. Ductwork System Insulation:
   a. Fiberglass
   b. Flexible Unicellular.

3. Equipment Insulation:
   a. Fiberglass
   b. Calcium Silicate
   c. Flexible Unicellular.

4. Acoustical Insulation
   a. Fiberglass

1.02 RELATED SECTIONS

A. Refer to Division 23 Section "HVAC Identification" for installation of identification devices for piping, ductwork, and equipment; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of HVAC insulation. Submit schedule showing manufacturer's product number, K-value, thickness, and furnished accessories for each HVAC system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of HVAC insulation. Include this data and product data in maintenance manual.

1.04 QUALITY ASSURANCE

A. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

B. As a minimum, insulation shall meet installed conductance as set forth in Title 24 California Code of Regulations (CCR) 2013 Building Energy Efficiency Standards or as indicated in contract documents, whichever is greater.
1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.

B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corp.
   3. Knauf Fiber Glass GmbH.
   4. Manville Products Corp.
   5. Owens-Corning Fiberglas Corp.

2.02 PIPING INSULATION MATERIALS


B. Calcium Silicate Piping Insulation: ASTM C533, Type I. Owens-Corning Fiberglass Corp. "Kaylo Asbestos Free" or equivalent.

C. Flexible Unicellular Piping Insulation: ASTM C534, Type I. Armstrong World Industries, Inc. meeting ASTM E-84 25/50 index.

D. Jackets for Piping Insulation: ASTM C921, Type I (Vapor Barrier) for piping with temperatures below ambient. (Type II (Water Vapor Permeable) for piping with temperatures above ambient. Type I may be used for all piping at Installer's option.
   1. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers, fastened as per manufacturer's recommendations. Zeston PVC Insulated fitting covers or equivalent.
   2. Encase exterior piping insulation with aluminum jacket with weather-proof construction.

E. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

F. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

G. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.03 DUCTWORK INSULATION MATERIALS

A. Flexible Fiberglass Ductwork Insulation: ASTM C553, Type I, Class B-2, Owens-Corning Fiberglas Inc. un-faced duct wrap insulation, Type 100 or equivalent.
1. Nominal thickness or equivalent to provide installed R-value as follows:
   a. 1.5" thick - Installed R = 4.2
   b. 2.0" thick - Installed R = 5.6

B. Flexible Fiberglass Ductwork Insulation: ASTM C612, with ASTM C921 Type I vapor barrier jacket. Owens/Corning Fiberglas All Service Wrap Insulation, Type 100 or equivalent:
   1. Nominal thickness or equivalent to provide an installed R-value as follows:
      a. 1.5" thick - Installed R = 4.2
      b. 2.0" thick - Installed R = 5.6

C. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

D. Rooftop ductwork and ductwork that are not in conditioned space or indirectly conditioned spaces are to be insulated with material to achieve minimum installed R value equal to 8.0 to meet the 2013 Building Energy Efficiency Standards. For double wall rooftop ductwork see HVAC drawings.

E. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

F. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.04 EQUIPMENT INSULATION MATERIALS

A. Flexible Fiberglass Equipment Insulation: ASTM C553, Type II, Class F-1, Owens-Corning Fiberglass, Inc., Type 701 1.5 lbs/Ft3.

B. Calcium Silicate Equipment Insulation: ASTM C533, Type I, Block; Owens/Corning Fiberglass, Inc., Kaylo Asbestos Free, U-Grooved block insulation.

C. Jacketing Material for Equipment Insulation: Provide canvas jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.

D. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

E. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape corner angles, anchors and stud piping as recommended by insulation manufacturer for applications indicated.

F. All Insulation shall be U.L. listed showing flame spread not greater than 25, nor smoke greater than 50, per NFPA 90A.

2.05 ACOUSTICAL INSULATION

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which HVAC insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 HVAC PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on the following:
   1. Hot piping within radiation enclosures
   2. Hot unions, flanges, strainers, flexible connections and expansion joints.

B. Cold Piping (40°F to ambient):
   1. Application Requirements: Insulate the following cold HVAC piping systems:
      a. HVAC chilled water supply and return piping.
      b. Air conditioner condensate drains piping.
   2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
      a. Fiberglass: 1" thick for pipe sizes up to and including 4", 1-1/2" thick for pipe sizes over 4".
      b. Flexible Unicellular: 1/2" thick for pipe sizes up to 1-1/2" (A.C. condensate piping only).

C. Hot Low Pressure Piping (to 250°F):
   1. Application Requirements: Insulate the following hot low pressure HVAC piping systems (steam piping up to 15 psi, water piping up to 250°F (121°C).
      a. HVAC heating water supply and return piping.
   2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
      a. Fiberglass: 1" thick for pipe sizes up to and including 1", 1-1/2" thick for pipe sizes 1-1/2"; 2" thick for piping over 2".

3.03 DUCTWORK SYSTEM INSULATION

A. Insulation Omitted:
   1. Do not insulate outside air and exhaust air ductwork unless otherwise indicated.
   2. Do not insulate exhaust air ductwork unless otherwise indicated.
   3. All ductwork specified to be insulated that is located in mechanical rooms, located on roofs, or where exposed in conditioned spaces or to weather shall be internally lined under Section 23 3113 "Metal Ducts"; unless noted otherwise in these specifications or on the drawings.

B. Insulate the following with flexible fiberglass insulation, un-faced, 1.5" thickness unless otherwise noted. Firmly wrap insulation around duct work with all joints lapped a minimum of 2 inches. Secure insulation to ducts by means of 16 gauge soft-annealed galvanized wire spaced 12 inches on centers at loose ends.
   1. Warm air heating ductwork in concealed spaces, unless in ceiling plenum provide all service wrap insulation.
2. Return air ductwork in non-conditioned concealed spaces unless in ceiling supply plenum uses all service wrap insulation.
3. Return air ductwork located in return air ceiling plenums outside air ductwork supplying fan coil units.

C. Insulate the following with Flexible Fiberglass insulation with all service vapor barrier facing, 1.5" thickness unless noted otherwise.
1. HVAC hot/cold mixed air ductwork between fan discharge or HVAC unit discharge, and room terminal unit.
2. Outdoor air intake ductwork between air entrance and indoor fan inlet or indoor HVAC unit inlet.

Installation:
   a. Neatly wrap insulation around ducts with all joints tightly butted together.
   b. Seal transverse joints with vapor barrier facing tab overlapping all joints 2-inches and secure with vapor barrier adhesive or outward-clinch staples on 4-inches centers.
   c. Seal longitudinal joints with 4-inch wide vapor barrier adhesive tape.
   d. Secure insulation to underside of ducts, 100 percent coverage, with ductwork insulation adhesive.
   e. In addition to adhesive, on underside of ducts 24-inches or greater in width, use mechanical fasteners on maximum 12-inch centers.
   f. Seal all penetrations of vapor barrier facing with vapor barrier mastic.

D. Insulate the following with Rigid Fiberglass Insulation, 2.0" thickness unless noted otherwise.
1. HVAC and unit housings not pre-insulated at the factory or where lining has been specifically omitted.
2. Installation: Fasten to ductwork with adhesive and pins per manufacturer's recommendations. Butt all joints and provide 16 gage corner angles at corners. Seal all joints with approved duct tape.

E. Contractor's Option: Contractor may provide duct liner as set forth in Section 23 3113, using equivalent installed "R" values; in lieu of external duct wrap or rigid insulation as specified above unless ductwork is specifically indicated as being unlined.

F. Hot Ductwork:
1. Application Requirements: Insulate range and hood exhaust ductwork with PABCO "Super Fire Temp" asbestos free, non-combustible fireproofing board.
   a. Provide 1 to 4 hour fire rating as indicated.
   b. Install per manufacturer's instructions.

3.04 EQUIPMENT INSULATION

A. Cold Equipment (Below Ambient Temperature):
1. Application requirements: Insulate the following cold equipment:
   a. Refrigeration equipment, including chillers, tanks and pumps.
   b. Drip pans under chilled equipment.
   c. Cold and chilled water pumps.
   d. Pneumatic water tanks.
2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
a. Fiberglass: 2" thick for cold surfaces above 35°F and 3" thick for surfaces 35°F and lower.

B. Hot Equipment (Above Ambient Temperature):
   1. Application Requirements: Insulate the following hot equipment:
      a. Boilers (not pre-insulated at factory).
      b. Water heaters.
      c. Hot water expansion tanks.
      d. Hot water pumps.
   2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation.
      a. Fiberglass: 2" thick, except 3" thick for low-pressure boilers and steam-jacketed heat exchangers.

C. Breeching and Stacks:
   1. Application Requirements: Insulate the following breechings and stacks:
      a. Breechings between heating equipment outlet and stack or chimney connection, except for double wall or factory insulated breechings.

3.05 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer’s written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulated each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer’s option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

H. Butt pipe insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For cold piping apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3" wide vapor barrier tape or band.

3.06 INSTALLATION OF DUCTWORK INSULATION

A. General: Install insulation products in accordance with manufacturer’s written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor barrier on ductwork insulation, and protect it to prevent puncture and other damage.

E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.

F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.

G. Ductwork Exposed to Weather: Where external insulation has been specifically indicated, protect outdoor insulation from weather by installing outdoor protective finish or jacketing as recommended by manufacturer.

H. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

3.07 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Do not apply insulation to equipment, breechings, or stacks while hot.

E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

F. Coat insulated surfaces with layer of insulating cement, trowel in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

G. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2”. Apply over vapor barrier where applicable.

H. Do not insulate boiler manholes, hand-holes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.

I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.

J. Equipment exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by the manufacturer.
3.08 ACOUSTICAL INSTALLATION

A. Install within confines of roof curbs for roof mounted air handlers and air conditioning units, and elsewhere as indicated on drawings

B. Cut to fit snugly within curb and around duct at duct penetrations, 4” minimum thickness.

3.09 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 0700
SECTION 23 1123
FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This Section includes distribution piping systems for natural gas and manufactured gas within the building and extending from the point of delivery to the building to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:
   1. Pipes, fittings, and specialties;
   2. Special duty valves.

B. This Section does not apply to LP-gas piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.

C. Natural gas yard piping is not included in this section.

D. Gas pressures for systems specified in this section are limited to 5 PSIG, unless otherwise specified.

E. Products not furnished under this Section include gas meters which will be provided by the utility company, to the site, ready for installation.

1.02 RELATED SECTIONS

A. The following Sections contain requirements that relate to this Section:
   1. Division 23 Section "Mechanical Identification" for labeling and identification of gas piping systems.

1.03 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Gas Distribution Piping: A pipe within the building which conveys gas from the point of delivery to the points of usage.

C. Gas Yard Piping: That portion of gas distribution system which is underground.

D. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system and/or gas yard piping system being served.

E. Point of Delivery is the outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).
1.04 SUBMITTALS

A. Product data for each gas piping specialty and special duty valves. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

B. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 01 and Division 23 Section "Common Work Results for HVAC."


1.05 QUALITY ASSURANCE

A. Installation Qualifications: Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

B. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."

C. Regulatory Requirements: Comply with the requirements of the following codes:
1.   NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installations, and inspection, testing, and purging of gas piping systems.

1.06 SEQUENCING AND SCHEDULING

A. Notification of Interruption of Service: Except in the case of an emergency, notify all affected users when the gas supply is to be turned off.

B. Work Interruptions: When interruptions in work occur while repairs or alterations are being made to an existing piping system, leave the system in safe condition.

C. Coordinate the installation of pipe sleeves for wall penetrations.

1.07 EXTRA MATERIALS

A. Valve wrenches: Furnish to Owner, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.
PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:
   1. Gas service cocks: Semi-steel 175 pound with tapered bronze plug and bolted yoke. Furnish one operating wrench for each valve.
      
      PowellFig. 2200 & 2201
      NordstromFig. 142 & 143
      WalworthFig. 1796 & 1797F
      HomesteadFig. 611 & 612
   
   2. Gas valves at equipment: All bronze, flathead screwed gas cocks.
      
      PowellFig. 947
      CraneFig. 270
      HealeyFig. 20F
      WalworthFig. 591

2.02 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the below specified pipe and fitting materials are used.

B. Steel Pipe: ASTM A 53, Schedule 40, seamless, black steel pipe, beveled ends. Piping shall be of domestic manufacture.

2.03 FITTINGS

A. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1. Fittings shall be of domestic manufacture.
   1. Joint compound or tape suitable for gas being handled.

B. Steel Fittings: ASTM A 234, seamless or welded, for welded joints. Fittings shall be of domestic manufacture.

C. Steel Flanges and Flanged Fittings: ANSI B16.5, including bolts, nuts, and gaskets of the following material group, end connection and facing. Fittings shall be of domestic manufacture:
   1. Material Group: 1.1
   2. End Connections: Butt Welding.
   3. Facings: Raised face.
2.04 PIPING SPECIALTIES

A. Unions: ANSI B16.39, Class 150, black malleable iron; female pattern; brass to iron seat; ground joint. Domestic manufacture.

B. Dielectric Unions: ANSI B16.39, Class 250; malleable iron and cast bronze; with threaded or soldered end connections suitable for pipe to be joined; designed to isolate galvanic and stray current corrosion. Domestic manufacture.

C. Protective Coating: When piping will be in contact with material or atmosphere exerting a corrosive action, pipe and fittings shall be factory-coated with polyethylene tape, having the following properties:
   1. Overall thickness; 20 mils;
   2. Synthetic adhesive;
   3. Water vapor transmission rate, gallons per 100 square inch; 0.10 or less;
   4. Water absorption, percent; 0.02 or less.
   5. Prime pipe and fittings with a compatible primer prior to application of tape.

2.05 VALVES

A. Gas Cocks 2 inch and Smaller: 150 psi WOG, bronze body, straightaway pattern, square head, and thread ends.

B. Gas Cocks 2-1/2" Inch and Larger: MSS SP-78; 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.

C. Ball Valves: Rated for 400 psi WOG pressure, two piece construction; with bronze body conforming to ASTM B62, Standard (or regular) post, chrome plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl covered steel handle; with threaded ends.

D. Solenoid Valves: aluminum body, 120 volts AC, 60 Hz, Class B continuous duty molded coil NEMA 4 coil enclosure; electrically opened/electrically closed; dual coils; normally closed; UL and FM approved and labeled.

E. Gas Line Pressure Regulators: Single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; with threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for inlet and outlet gas pressures, specific gravity, and volume flow indicated.

PART 3 - EXECUTION

3.01 PREPARATION

A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves.

Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.

B. Conform to the requirements in NFPA 54, for the prevention of accidental ignition.
3.02 PIPE APPLICATIONS

A. Install steel pipe above ground with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2" inch and larger.

3.03 PIPING INSTALLATIONS

A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.

B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangements of piping. Take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.

C. Concealed Locations: Except as specified below, install concealed gas piping in an air-tight conduit constructed of Schedule 40, seamless black steel with welded joints. Vent conduit to the outside and terminate with a screened vent cap.
   1. Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves shall not be located in such spaces.
   2. Piping in Partitions: Concealed piping shall not be located in solid partitions.
   3. Prohibited Locations: do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumb waiter or elevator shaft.

D. Install pipe sleeve seals at foundation penetrations.

E. Seal pipe penetrations of fire barriers using fire barrier penetration sealers acceptable to State Fire Marshal.

F. Use fittings for all changes in direction and all branch connections.
   1. Weld-o-lets may be used in lieu of tees for branch connections two sizes or more, smaller than main.
   2. Mitered elbows or tees not permitted.

G. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

H. Install piping free of sags or bends and with ample space between piping.

I. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

J. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Allow sufficient space above removable ceiling panels to allow for panel removal.

K. Locate groups of pipes parallel to each other, spaced to permit servicing of valves.

L. Install gas piping at a uniform grade of 1/4 inch in 15 feet, upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.
M. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

N. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.

O. Hangers, supports, and anchors are specified in Division 22 Section "Hangers and Supports." Conform to the table below for maximum spacing of supports:

<table>
<thead>
<tr>
<th>ROD SIZE</th>
<th>SPACING IN FT</th>
<th>SIZE IN IN.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>5</td>
<td>3/8</td>
</tr>
<tr>
<td>3/4 to 1-1/4</td>
<td>6</td>
<td>3/8</td>
</tr>
<tr>
<td>1-1/2 to 3 (horizontal)</td>
<td>12</td>
<td>1/2</td>
</tr>
<tr>
<td>3-1/2 to 5 (vertical)</td>
<td>all sizes</td>
<td></td>
</tr>
<tr>
<td>every floor level</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P. Install unions in pipes 2 inches and smaller, adjacent to each valve, at final connections each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

Q. Install dielectric unions where piping of dissimilar metals is joined.

R. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

S. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.

T. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division 23 Section "Common Work Results for HVAC."

3.04 PIPE JOINT CONSTRUCTION

A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.

B. Threaded Joints: Conform to ANSI B1.20.1 tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
   1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint. Refer to NFPA 54, for guide for number and length of threads for field threading steel pipe.
   2. Align threads at point of assembly.
   3. Apply appropriate tape or thread compound to the external pipe threads.
   4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
5. Damaged Threads: Do not use pipe with threads which are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

C. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

3.05 VALVE APPLICATIONS

A. General: The drawings indicate valve types, locations, and arrangements.

B. Shut-off duty: Use gas cocks specified in Part 2 above.

3.06 VALVE INSTALLATIONS

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

B. Install a gas cock upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.

C. Install ball valves in all locations required for quick emergency shut off.

D. Install pressure relief or pressure limiting devices so they can be readily operated to determine if the valve is free; so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position.

E. Install low pressure gas check in primary gas supply line to each laboratory room. Valve to be installed immediately downstream of manual emergency shut off valve.

3.07 TERMINAL EQUIPMENT CONNECTIONS

A. Install gas cocks upstream and within 6 feet of gas appliance. Install a union or flanged connection downstream from the gas cock to permit removal of controls.

B. Sediment Traps: Install a tee fitting with the bottom outlet plugged or capped as close to the inlet of the gas appliance as practical. Drip leg shall be a minimum of 3 pipe diameters in length.

3.08 ELECTRICAL BONDING AND GROUNDING

A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code."

B. Do not use gas piping as a grounding electrode.

C. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.
3.09 FIELD QUALITY CONTROL

A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

B. Prepare test reports and submit.

END OF SECTION 23 1123
SECTION 23 3113
METAL DUCTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Rectangular and round metal ducts and plenums for heating, ventilating, and air conditioning system from minus 2" to plus 5" water gage.

B. Section does not include laboratory exhaust system ductwork.

1.02 RELATED SECTIONS

A. Refer to other Division 23 Sections for exterior insulation of metal ductwork.

B. Refer to other Division 23 Sections for ductwork accessories

C. Refer to other Division 23 Sections for fans and air handling units

D. Refer to other Division 23 Sections for testing, adjusting and balancing of metal ductwork systems.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products including but not limited to flexible ductwork, acoustical flexible ductwork, pre manufactured ductwork, duct liner, duct sealant and duct liner adhesive.

B. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division 01.

C. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division 01.

D. Certified test data for the flexible duct.

1.04 QUALITY ASSURANCE

A. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

B. Codes and Standards:
   1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.

C. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.01 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A527, lock forming quality, with G90 zinc coating in accordance with ASTM A525; and mill phosphatized for exposed locations.

2.02 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 18-degree change of direction per section. Unless specifically detailed otherwise, use 45-degree laterals and 45-degree elbows for branch takeoff connections. Where 90-degree branches are indicated, provide conical type tees.

C. Duct Liner:
   1. Rectangular ductwork: one and two inch thick fiberglass with approved fire resistant coating for erosion control, located as shown on the drawings and as outlined on table below. Apply to flat sheets with full coverage adhesive and insulation pins prior to fabrication of duct or fittings. Duct liner to be from R. J. Manville, Knauf, Owen-Corning, CertainTeed, Manson or an approved equal manufacturer.
2. **Circular Ductwork:** Fiberglass duct liner manufactured to fit small and large radius round ducts. One inch thick with approved fire resistant coating for erosion control located as shown on the drawings. Apply to round ducts with full coverage adhesive prior to fabrication of ducts or fittings. Duct lining to be R. J. Manville Spiracoustic Plus in ducts over 24” diameter and Schuler/Manville Permacote Spiracoustic in ducts under 24” diameter. Equal by Owen-Corning or CertainTeed. Duct sizes shown are net inside diameter. Increase duct sizes accordingly.

3. **Duct Liner:** Shall comply with Thermal Insulation Manufacturer's Association (TIMA) AHC-101; of thickness indicated above and on the drawings. Provide 2” thick above roofline, unless indicated otherwise.

D. **Duct Liner Adhesive:** Comply with ASTM C 916 "Specifications for Adhesives for Duct Thermal Insulation". Adhesive used on the project shall meet the requirements of CalGreen Section 5.504.4.1.

E. **Duct Liner Fasteners:** Comply with SMACNA “HVAC Duct Construction Standards”, Article S2.11.

F. **Duct Sealant:** Non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork. Sealant used on the project shall meet the requirements of CalGreen Section 5.504.4.1.

G. **Duct Cement:** Non-hardening migrating mastic or liquid neoprene based cement, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for cementing fitting components, or longitudinal seams in ductwork. Cement used on the project shall meet the requirements of CalGreen Section 5.504.4.1.

H. **Ductwork Support Materials:** Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork. Provide seismic restraint as required.

I. **Flexible ducts:** Acoustical flexible air duct for connection between air distribution ductwork and air inlets and outlets shall be factory fabricated assembly consisting of a porous inner sleeve of spun-bounded non-woven nylon, insulation and an outer moisture barrier, flameproof vinyl jacket, complying with UL 181; with factory installed metal collar connectors and maximum length 5 feet. Acoustical performance of the acoustical air duct shall be in accordance with Air Diffusion Council Flexible Air Duct Test FD72R1: Paragraph 3.2.1, sound attenuation. The test data shall be made by an accredited independent laboratory in accordance with the above testing procedure. The sound attenuation (Insertion loss) of the acoustical flexible air duct shall meet or exceed the values tabulated below:
METAL DUCTS

### Straight Duct Insertion Loss in Decibels per Foot of Length:

<table>
<thead>
<tr>
<th>Octave Band Center Frequency, Hertz</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1000</th>
<th>2000</th>
<th>4000</th>
<th>8000</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>3.0</td>
<td>4.0</td>
<td>3.6</td>
<td>3.8</td>
<td>3.8</td>
<td>3.4</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td>8&quot;</td>
<td>1.6</td>
<td>3.4</td>
<td>3.2</td>
<td>3.5</td>
<td>4.0</td>
<td>3.6</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td>12&quot;</td>
<td>2.0</td>
<td>2.6</td>
<td>2.8</td>
<td>3.4</td>
<td>3.6</td>
<td>2.6</td>
<td>2.0</td>
<td></td>
</tr>
</tbody>
</table>

J. Provide Acoustical flexible ductwork of one of the following:
1. JP Lamborn Co. AMF-07 (www.jplflex.com), Fresno, CA
2. Casco, Silent-Flex II (www.casco-flex.com)
3. Or approved equal.

K. Under slab Ducts: For ductwork placed in concrete slabs, or under slabs on grade, fabricate ductwork of one of the following materials:
1. Galvanized Steel.

### 2.03 FABRICATION

A. Shop-fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

B. Shop-fabricate ductwork of gages and reinforcement complying with SMACNA "HVAC Duct Construction Standards".

C. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

D. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division 23 Section "Air Duct Accessories" for accessory requirements.

E. Fabricate ductwork with duct liner in each section of duct where indicated. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners.

### 2.04 FACTORY-FABRICATED LOW PRESSURE DUCTWORK

A. General: At Installer's option, provide factory-fabricated duct and fittings, in lieu of shop-fabricated duct and fittings.
B. Material: Galvanized sheet steel complying with ASTM A517, lock forming quality, with ASTM A525, G90 zinc coating, mill phosphatized.

C. Gage: 28-gage minimum for round and oval ducts and fittings, 4" through 24" diameter.

D. Elbows: One-piece construction for 90 degrees and 45 degree elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.

E. Divided Flow Fittings: 90-degree tees, constructed with saddle tap spot welded and bonded to duct fitting body.

F. Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork of one of the following or equal:
   1. Semco Mfg., Inc.
   2. United Sheet Metal Division, United McGill Corp.

PART 3 - EXECUTION

3.01 INSPECTION

A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF METAL DUCTWORK

A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type, which will hold ducts true-to-shape, and to prevent buckling. Support vertical ducts at every floor.

B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation.
Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

D. Electrical Equipment Spaces: Do not route ductwork through transformer vaults and their electrical equipment spaces and enclosures.

E. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.
   1. Where ducts pass through fire-rated floors, walls, or partitions, provide fire stopping between duct and substrate.

F. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

G. Installation: Install metal ductwork in accordance with SMACNA “HVAC Duct Construction Standards”.

3.03 INSTALLATION OF DUCT LINERS

A. General: Install duct liner in accordance with SMACNA “HVAC Duct Construction Standards”.

3.04 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 5'-0" extended length.

B. Installation: Install in accordance with Section III of SMACNA, "HVAC Duct Construction Standards, Metal and Flexible" and shall be installed in accordance with the manufacturer’s installation guide lines and recommended procedures. Before entering to the rear of any diffuser or grille, acoustical flex duct shall be straight and perpendicular to the diffuser for at least 3 duct diameters. Provide plenum box as shown on mechanical drawings for connection of flexible duct to the air inlet or outlets.

C. Bends in flexible ducts shall have a radius of not less 1.5 times the internal diameters.

3.05 INSTALLATION OF KITCHEN EXHAUST DUCTS

A. General: Fabricate joints and seams with continuous welds for watertight construction. Provide for thermal expansion of ductwork through 2000 degrees F (1093 degrees C) temperature range. Install without dips or traps, which may collect residues, except where traps have continuous or automatic residue removal. Provide access openings at each change in direction, located on sides of duct 1-1/2" minimum from bottom, and fitted with grease-tight covers of same material as duct.
3.06 EQUIPMENT CONNECTIONS

A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.07 ADJUSTING AND CLEANING

A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances, which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

B. Temporary closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

C. Balancing: Refer to Division 23 Section "Testing, Adjusting and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

END OF SECTION 23 3113
SECTION 23 3300

AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Types of ductwork accessories required for project include the following:
   1. Dampers.
      a. Low pressure manual dampers.
      b. Control dampers.
      c. Counter-balanced relief dampers.
   2. Fire and smoke dampers.
   3. Turning vanes.
   4. Duct hardware.
   5. Duct access doors.
   6. Flexible connections.
   7. Duct Silencer.

1.02 RELATED SECTIONS

A. Refer to other Division 23 Sections for testing, adjusting, and balancing of ductwork accessories; not included in work of this section.

B. Division 23 Section "Metal Ducts".

C. Division 23 Section "Identification of HVAC Piping And Equipment".

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction, performance; and installation instructions.

1.04 QUALITY ASSURANCE

A. Codes and Standards:
   1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
   2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
   3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
   4. Fire dampers shall bear California State Fire Marshal Listing Number.
PART 2 - PRODUCTS

2.01 DAMPERS

A. Low Pressure Manual Dampers: Provide dampers of single blade type of multi-blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards". "Jiffy" type dampers are not acceptable.

2.02 BACKDRAFT DAMPERS

A. General: Provide back-draft dampers of types and sizes indicated. Construct casings of 0.090-thickness aluminum with mitered corners.

B. Blades, 0.025" formed aluminum with extruded vinyl edge seals. Bearings, Zytel. Linkage 1/8" x 1/8" aluminum tie bars concealed in frame.

C. Counter-balance: Zinc plated bar on blades (except top blade). Adjustable for final setting Mill finish.

D. Manufacturers: Subject to compliance with requirements, provide dampers of one of the following:
   1. Ruskin Manufacturing Co.
   2. Air Balance Co.
   3. Pottorff Company, Inc.

E. Counterbalanced Relief Dampers: Provide dampers with parallel blades, counterbalanced and factory-set to relieve at indicated static pressure. Construct blades of 16-ga. aluminum provide 1/2" diameter ball bearings, 1/2" diameter steel axles spaced on 9" centers. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1-1/2" x 16-ga channel for face areas over 25 sq. ft. Provide galvanized steel finish on frame with aluminum touch-up.

F. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:
   1. Air Balance, Inc.
   3. Pottorff Company, Inc.

2.03 FIRE AND SMOKE DAMPERS

A. California State Fire Marshal approved, designed and constructed in accordance with NFPA 90A and UL Standard 555 and bear stamp showing compliance.

B. Fire Dampers: Provide fire dampers, of types and sizes indicated. Construct casings of 11-ga galvanized steel. Provide fusible link rated at 160 to 165 degrees F (71 to 74 degrees C) (unless otherwise indicated.) Provide damper with positive lock in closed position, and with the following additional features.
   1. Damper Blade Assembly: Curtain type.

C. Manufacturer: Subject to compliance with requirements, provide fire and smoke dampers of one of the following:
   1. Air Balance, Inc.
3. Pottorff Company, Inc.

### 2.04 TURNING VANES

A. Manufactured Turning Vanes: Provide turning vanes constructed of 1-1/2" wide curved blades set at 3/4" O.C., supported with bars perpendicular to blades set at 2" O.C., and set into side strips suitable for mounting in ductwork.

B. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusion with perforated faces and fiberglass fill.

C. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:
   1. Aero Dynen Co.
   2. Anemostat Products Div.; Dynamics Corp. of America.
   3. Duro Dyne Corp.
   4. Environmental Elements Corp.; Subs, Koppers Co., Inc.
   5. Souther, Inc.

### 2.05 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
   1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
   2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:
   1. Ventfabrics, Inc.
   2. Young Regulator Co.

### 2.06 DUCT ACCESS DOORS

A. General: Provide duct access doors where required.

B. Construction: Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for un-insulated ductwork, extended frames for externally insulated duct. Provide one side hinged other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

C. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:
   1. Air Balance Inc.
   2. Duro Dyne Corp.
   3. Register & Grille Mfg. Co., Inc.
2.07 FLEXIBLE CONNECTORS

A. General: Provide flexible duct connections wherever ductwork connects to vibration-isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse and torsional movement, and also capable of absorbing vibration of connected equipment.

B. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:
2. Duro Dyne Corp.
3. Flexaust (The) Co.
4. Ventifabrics, Inc.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer’s installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Install turning vanes in square or rectangular 90-degree elbows in supply and exhaust air systems, and elsewhere as indicated.

C. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

E. Install duct silencer strictly per manufacturer’s recommendation based on project specific sound attenuation requirements and to meet all requirements by acoustical engineer of the record.

3.03 FIELD QUALITY CONTROL

A. Operate install ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.
3.04 ADJUSTING AND CLEANING

A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
   1. Label access doors in accordance with Division 23 Section "Identification of HVAC Piping And Equipment".
   2. Final positioning of manual dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing For HVAC".

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.05 EXTRA STOCK

A. Furnish extra fusible links to Owner, one link for every 10 installed of each temperature range; obtain receipt.

END OF SECTION 23 3300
SECTION 23 3700
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Types of outlets and inlets required for project include the following:
   1. Linear slot diffusers and returns.
   2. Ceiling air diffusers, rectangular, square, round.
   3. Wall registers and grilles.

1.02 RELATED SECTIONS

A. Refer to other Division 23 Sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

B. Refer to other Division 23 Sections for balancing of air outlets and inlets; not work of this section.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer’s technical product data for air outlets and inlets including the following:
   1. Schedule of air outlets and inlets indicating drawing designation, room location, quantity furnished, model number, size, and accessories furnished.
   2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
   3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Shop Drawings: Submit manufacturer’s assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

C. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 01.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiberboard type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors, when necessary to store outdoors, store above grade and enclose with waterproof wrapping.
1.05 QUALITY ASSURANCE

A. Codes and Standards:
   2. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

PART 2 - PRODUCTS

2.01 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.

2.02 MANUFACTURER

A. Subject to compliance with requirement diffusers of one of the following:
   2. Nailor Industries, Inc.
   3. Titus Air Distribution Products.
   5. Anemostat Air Distribution Products.

B. Manufacturers and model numbers are listed and/or scheduled to set a standard of quality. Equivalent manufacturers and models accepted by Architect/Engineer may be used. Equivalents must be for review.
   1. Equivalents: Other manufacturers offering a similar product which is in accordance with the design criteria indicated may be submitted upon architect’s written acceptance prior to bidding. The cost to conduct all tests as may be directed by the architect to demonstrate that the equivalent product can achieve the criteria indicated, including all travel costs, shall be born by the submitting contractor.

2.03 LINEAR SLOT DIFFUSER AND RETURN

A. General: Provide acoustical ceiling air distribution system. Consisting of ceiling slot air diffusers, base frames air chambers and entry collars.

B. Air Distribution Base Frames:
1. Linear air diffusers base frames shall mechanically lock into the grid system. The base frames shall be extruded aluminum sections. Length shall be 48” unless otherwise noted or required.

2. Provide air distribution base frame with full supply air pattern control air weir gates. When used for return air, these air weir gates act as a return airflow control damper. Close air weir gates where return is not necessary.

3. Base frame shall present a substantially uniform appearance through the air slot when used as supply, returns or fully closed. All interior portions of the throat, including the vertical stems of the extrusions, shall be painted flat black to prevent unsightly visual deviations. Paint all exposed surfaces baked white enamel. Base frame shall be compatible with type of ceiling where linear slot diffuser is installed.

4. Base frame shall be provided with spacer channels located on the ceiling module. The spacer channel shall act as the support means for the adjustable full pattern control air weir gates, which are provided throughout the entire length of the base frame.

5. The noise criteria of the air distribution base frame shall be expressed in sound power levels (decibels 10-12 watts) in octave bands 2 through 7 with a room attenuation of 10 decibels and shall not exceed noise criteria of 30. All data shall be based on tests performed in a certified laboratory.

6. Where noted on drawings or as required, blank-off airtight backside of supply air linear slot where duct connection is not made.

C. Supply or Return Air Chambers:
1. Supply or Return air plenum chambers shall be designed, tested, and fabricated by the same manufacturer that furnishes the base frames. Shop fabricated air chambers not acceptable. Provide with damper at inlet to plenum, which is accessible through face of linear diffuser for adjustment.

2. Provide adjustable air pattern controllers that are accessible through the base frame slot for field adjustment of the spread of the air stream. This will be accomplished without the removal of acoustical tile.

3. Provide a round neck air entry collar sized for maximum average air entry velocity of 750 FPM. A volume damper shall be installed at connection to plenum, which is accessible through face of diffuser for adjustment.

4. Construct supply air chamber from not less than 26 gauge galvanized steel and will be lined with one-quarter inch 2 Lbs./Cu. Ft. density thermal acoustical insulation. All surfaces visible through the slot will be painted flat black.

5. Provide spring clip keepers to securely attach the chamber to the base frame when in operation. These spring clips permit releasing of the air chamber for easy relocation.

6. The supply air chamber shall have been tested as composite assembly with the linear base frame for air distribution and noise level performance. The tests shall be conducted in accordance with ANSI/ASHRAE Standard 70-1991.

7. For return air plenums above the ceiling, install Krueger Model DFRH plenum hood on all linear return air bars.

D. Manufacturer: Krueger Model DFL linear slot diffuser or approved equal.

2.04 CEILING RETURN AND EXHAUST GRILLES AND REGISTERS
(All constant air volume systems unless otherwise noted.)

A. Concealed Spline - Krueger ASDT.
B. Glued on Acoustile - Krueger ASDT.

C. Plaster or drywall - Krueger EGC5 or EGC5-01.

D. 24" x 24" T-bar - Krueger EGC5 or EGC5-01.

Note: For 24" x 48" T-bar ceilings, coordinate with ceiling installer for auxiliary tees as required to provide 24" x 24" space.

2.05 SIDEWALL SUPPLY AND RETURN REGISTERS AND GRILLES

A. Supply register - Krueger 880V.

B. Return register - Krueger S80.

C. Return grille - Krueger S80.

2.06 TRANSFER GRILLES

A. Ceiling - Same as return grilles.

2.07 CEILING DIFFUSERS (SUPPLY)
(Constant air volume systems unless otherwise noted.)

A. Concealed Spline - Krueger ASDT

B. Glued on Acoustile - Krueger ASDT

C. Plaster or Drywall - Krueger 1240

D. 24" x 24" T-Bar - Krueger 1240

Note: For 24" x 48" T-bar ceilings, coordinate with ceiling installer for auxiliary tees as required to create 24" x 24" space.

2.08 MODULAR CEILING DIFFUSERS
(All V.A.V. systems unless otherwise noted.)

A. Krueger Model 1900SQ and shall have a frame style to interface with the ceiling grid system being used.

B. Manufactured from extruded aluminum. Provided with air pattern control weirs, and an integral deflection rail allowing for one- to four-way direction air flow producing uniform ceiling effect.

C. The air motion in the occupancy zone at maximum cubic feet per minute shall not exceed 50 feet per minute. Inner panel of matching acoustical tile shall provide an airtight joint.

D. Supply, Return and Exhaust Chambers:
1. Designed and fabricated by the manufacturer of the base frames. Field fabricated chambers will not be accepted. Chamber to be supplied with spring clips to attach to the base frame. Constructed from not less than 26 gauge galvanized steel and lined with 1/4" 2 Lbs./Cu. Ft. density thermal insulation. All surfaces visible through the air slot painted flat black.

2. Chamber shall be supplied with a factory installed round entry collar for flex duct connection. Collar shall be sized for maximum average air entry velocity of 750 fpm. Chamber must be tested as a composite assembly with the base frame for air distribution and noise level performance by a certified testing laboratory. If used with side inlet, furnish and install vertical pressure equalizing baffle.

2.09 MODULAR CEILING RETURN
(All V.A.V. systems unless otherwise noted.)

A. Krueger Model 1900SQ Return diffuser.

B. Base frame from extruded aluminum. Frame shall have fixed weirs creating a continuous one-inch closed slot. Provide opposite blade volume damper.

C. The slots connection to each other is provided with tabs at each corner of slots. These tabs shall be solid and no holes shall be on these tabs, to reduce the visibility of these tabs paint with dark color (Black).

2.10 SUPPLY, RETURN AND EXHAUST CONNECTIONS TO METAL LINEAR CEILING

A. Air Factors sheet metal air boot, eight-slot for connecting to back of metal linear ceiling with slot openings (with labyrinths, as applicable) for supply, return, and exhaust. Air boot shall lock onto back of ceiling system.

2.11 CIRCULAR CEILING DIFFUSERS
(All circular ceiling diffusers unless otherwise noted.)

A. Krueger Model RA2 circular diffuser with adjustable inner cone.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
C. Coordinate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

D. Supply outlets to provide the required air throw and spread with no apparent drafts or excessive air movement within space being supplied. Contractor to provide necessary accessories to accomplish satisfactory air distribution.

E. Provide felt, cork or rubber gasket between finish surface and frame to prevent vibration and assure tight fit. Contractor shall be responsible for the correct location of ductwork and outlets.

F. For filler panel type outlets the manufacturer shall coordinate his design with the ceiling suspension system being used. The Contractor and manufacturer shall match up sizes of outlets to properly fit in ceiling systems, between concrete or masonry components, between architectural items before fabrication.

G. When installing removable core type outlets, secure to frame with screws.

H. Secure outlets to ceiling suspension systems as required by Division of the State Architect.

END OF SECTION 23 3700
SECTION 23 8113
WALL MOUNTED HEATING AND COOLING UNITS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes package sidewall mounted heating and cooling units.

1.02 RELATED SECTIONS

A. Division 23
   1. Section "Common Motor Requirements For HVAC Equipment."
   2. Section "Facility Natural Gas Piping."
   3. Section "Metal Ducts."
   4. Section "Testing, Adjusting, And Balancing For HVAC."

B. Division 26
   1. Section "Electrical Connections for Equipment"

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities at scheduled conditions of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings:
   1. Submit shop drawings detailing the manufacturer's electrical requirements for power supply wiring for wall mount heating and cooling units. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
   2. Submit shop drawings detailing the mounting, securing, and flashing of the unit to building structure.
   3. Submit shop drawings for installation of top discharge plenum and flashing the plenum with units.
   4. Submit shop drawings detailing method of securing unit to wall to meet seismic restraint requirement.
   5. If an equal unit is being proposed to be used in lieu of the base specified unit, the contractor shall coordinate all differences as hereinafter described and note such differences on the shop drawings and incorporate all changes (if any) required by the structural and electrical engineers to accommodate the equal unit.
C. Operation and Maintenance Data: Submit maintenance data and parts list for each unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual in accordance with requirements of Division 01.

1.04 QUALITY ASSURANCE

A. Codes and Standards:
1. Gas-Fired furnace section construction shall be in accordance with AGA safety standards. Furnace section shall bear the AGA label.
2. Testing and rating of wall mount units of 135,000 Btu/hr capacity or over shall be in accordance with ARI 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".
3. Testing and rating of wall mount units under 135,000 Btu/hr capacities shall be in accordance with ARI 210 "Standard for Unitary Air-Conditioning Equipment", and provide Certified Rating Seal. Sound testing and rating of units shall be in accordance with ARI 270 "Standard for Sound Rating of Outdoor Unitary Equipment". Units shall bear Certified Rating Seal.
4. Refrigerating system construction of wall mount units shall be in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
5. Energy Efficiency Ratio (EER) or (SEER) of wall mount units shall be equal to or greater than prescribed by Title 24 - California Code of Regulations" (CCR) or as scheduled.
6. Wall mount units shall be designed, manufactured, and tested in accordance with UL requirements.
7. Wall Mounted units shall comply with ASHRAE 62-89.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Handle units and components carefully to prevent damage. Replace damaged wall mount units or components with new.

B. Store units and components in clean dry place, off the ground and protect from weather, water, and physical damage.

C. Rig units to comply with manufacturer's rigging and installation instructions for unloading units, and moving them to final location.

1.06 SCHEDULING AND SEQUENCING

A. Coordinate installation of wall mounted units with wall framing system.

B. Coordinate wall opening locations for mechanical and electrical connections.

1.07 SPECIAL WARRANTY

A. Warranty on Compressor (and Heat Exchanger): Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors (and heat exchangers) with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required;
provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

1. Warranty Period: 4 years extension from date of basic 1-year warranty - See Division 01.

1.08 MAINTENANCE

A. Extra Materials: Furnish to Owner, with receipt, the following spare parts for each heating and cooling unit:
   1. One set of matched fan belts for each belt-driven fan.
   2. One set of filters for each unit.

PART 2 - PRODUCTS

2.01 WALL MOUNT UNITS (GENERAL)

A. General Description: Units shall be factory-assembled and tested, designed for sidewall installation, and consisting of compressors, condensers, evaporator coils, (heat exchanger), condenser and evaporator fans, refrigeration and temperature controls, filters, and dampers.

B. Units as manufactured by Bard Air Conditioning, were used for the basis of design, and their capacities, weights and electrical characteristics are scheduled on the drawings. Equal manufacturers as hereinafter specified may be used; however, any differences between the base unit and the equal unit, such as weight, electrical characteristics, physical dimensions, etc., shall be coordinated by the contractor, and any differences which affect the building structural framing or electrical requirements shall be incorporated into the project at no additional cost to the Owner.

2.02 WALL MOUNT AIR CONDITIONING UNIT

A. Unit shall be of the single-package type, combination air-to-air cooling and gas-fired heating. Unit shall be AGA certified and meet requirements of CCR Title 24.

B. Unit shall be equipped with the manufacturer's installed NEMA rated disconnect switch and built-in circuit breaker.

C. Unit shall be ERR or SEER rated in accordance with ARI Standard 210-81 and California Administrative Title 24.

D. Compressor(s) - The unit shall contain (one or two) as scheduled, welded, Sroll with suitable vibration isolators and shall have a 5-year warranty.

E. Coils shall be constructed of aluminum (copper) fins mechanically bonded to copper tubes. Evaporator coils shall have a minimum 2" thick filter upstream of the coil. 1" filters are not acceptable. Condenser coils shall be equipped with screen protection grille.
F. Fans and motors - The evaporator air fan shall be of the forward-curved centrifugal type, direct-drive multi-speed or adjustable belt-driven as shown on the equipment schedule. Condenser fan motor shall have ball bearings. Sleeve type bearings are not acceptable. Condenser air fan shall be of the propeller type, directly driven and discharging upward.

G. Heat exchanger shall be tubular in design and constructed of tubular 18-Gauge stainless steel. Heat exchanger shall carry a 10-year non-prorated warranty.

H. Safety controls - Cooling section shall be protected by low pressure stat, high pressure switch, compressor motor overloads, crankcase heaters, freeze stat and lockout circuit that prevents compressor short cycling as a result of a rapid change in thermostat setting by automatically preventing compressor restart for at least 5 minutes.

I. Heating controls shall consist of a redundant gas valve, intermittent pilot ignition system, limit switches, centrifugal switch, and rollout switch.
   1. Economizer control shall include return air (R.A.) and outdoor air filter and hood and exhaust air outlet at the unit.
   2. Thermostat assembly shall provide staged heating and cooling, manual and automatic changeover and fan control.

2.03 MANUFACTURERS

A. Subject to compliance with requirements, provide wall mount eating and cooling units as manufactured by Carrier Corporation or an equal unit of one of the following manufacturers:
   1. Bard HVAC
   2. Or Approved Equal

B. All electrical data shall be based on 115°F ambient; 95°F data is not acceptable.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which wall mount units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. General: Install wall mount units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support: Install and secure unit to wall structure, in accordance contract documents and manufacturer's installation guides. Coordinate Wall penetrations and flashing.

C. Electrical Connections: Refer to Section "Electrical Connections for Equipment" for final connections to equipment and installation of loose shipped electrical components.
3.03 DEMONSTRATION

A. Start-Up Services:
   1. Provide the services of a factory-authorized service representative to start-up Wall mount units, in accordance with manufacturer's written start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Operating and Maintenance Training:
   1. Provide services of manufacturer's service representative to instruct Owner's personnel in operation and maintenance of wall mount units. Training shall include start-up and shutdown, servicing and preventative maintenance schedule and procedures, and trouble shooting procedures plus procedures for obtaining repair parts and technical assistance. Review operating and maintenance data contained in the Operating and Maintenance Manuals specified in Division One.

END OF SECTION 23 8113
SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to, the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. Electrical General Provisions and requirements for electrical work.
   3. Division-1; General Requirements; General Conditions.

B. Organization of the Specifications into Divisions, Sections and Articles, and arrangement of Drawings shall not control the CONTRACTOR in dividing the Contract Work among Sub-Contractors or in establishing the extent of work to be performed by any trade.

1.02 GENERAL SUMMARY OF ELECTRICAL WORK

A. The Specifications and Drawings are intended to cover a complete installation of systems. The omission of expressed reference to any item of labor or material for the proper execution of the work in accordance with present practice of the trade shall not relieve the CONTRACTOR from providing such additional labor and materials.

B. Refer to the Drawings and Shop Drawings of other trades for additional details, which affect the proper installation of this work. Diagrams and symbols showing electrical connections are diagrammatic only. Wiring diagrams do not necessarily show the exact physical arrangement of the equipment.

C. Before submitting a bid, the CONTRACTOR shall become familiar with all features of the Building Drawings and Site Drawings, which may affect the execution of the work. No extra payment will be allowed for failure to obtain this information.

D. If there are omissions or conflicts between the Drawings and Specifications, clarify these points with the District’s Representative before submitting bid and before commencing work.

E. Provide work and material in conformance with the Manufacturer’s published recommendations for respective equipment and systems.

1.03 LOCATIONS OF EQUIPMENT

A. The Drawings indicate diagrammatically the desired locations or arrangements of conduit runs, outlets, equipment, etc., and are to be followed as closely as possible. Proper judgment must be exercised in executing the work so as to secure the best
possible installation in the available space and to overcome local difficulties due to space limitations or interference of structure conditions encountered.

B. Where outlets are placed on a wall, locate symmetrically with respect to each other, furniture, cabinets, and other features or finishes on the wall.

C. In the event changes in the indicated locations or arrangements are necessary, due to developed conditions in the building construction or rearrangement of furnishings or equipment, such changes shall be made without cost to the Contract, providing the change is ordered before the conduit runs, etc., and work directly connected to same is installed and no extra materials are required.

D. Lighting fixtures in mechanical spaces are shown in their approximate location only. Do not install light outlets or fixtures until mechanical piping and ductwork is installed; then install lights in a location to provide best lighting.

E. Coordinate and cooperate in every way with other trades in order to avoid interference and assure a satisfactory job.

F. The location of the existing utilities, building, equipment and conduit shown on the Drawings is approximate. Verify exact locations and routing of existing systems by potholing all trench routes prior to digging the trench. Pothole at least 100 feet ahead of the actual trenching to allow space to alter the new conduit routing to accommodate existing conditions.

G. Underground Detection Services Existing Utility Structures
   1. Detection/location services shall be provided utilizing the latest detection equipment available. Services shall be performed by a company regularly engaged in the business of existing Underground Utility Structure Detection for the past 5-years.
   2. Prior to excavation and prior to directional boring the following work shall be performed:
      a. Contractor to mark excavating and trenching/directional boring locations and indicate width and depth.
      b. Locate, by way of vertical and horizontal control dimensions, existing subgrade petroleum product pipes, process piping, conduits, sewer, water, gas, storm drain, electrical, telephone, and irrigation lines in the affected areas of Contract construction work.
      c. Arrange and meet with the District’s Representative to review existing underground conditions.
      d. The proposed route of each excavation shall be continuously surveyed along the entire excavation path using Ground-Penetrating Radar (GPR) operating from the surface grade. The GPR shall detect and map existing underground metal and non-metal, both private and public utility lines, pipes, conduits, conductors, etc. The GPR shall identify the horizontal and vertical location of existing underground conditions located at a depth of up to 3-meters below finish grade and located with a vertical and horizontal accuracy within ± 12-inches of actual condition. The Contractor shall add this information to the existing conditions site plan.
   3. Exercise extreme caution in directional boring, excavating and trenching on this site to avoid existing underground utilities and structures, and to prevent hazard to personnel and/or damage to existing underground utilities or structures. The Contract Documents, Drawings and Specifications do not
include necessary components for construction safety, which is the responsibility of the CONTRACTOR.

4. Repair/replace, without additional cost to the Contract, and to the satisfaction of the District any existing work damaged that was identified in the Record Drawings provided; Identified by the District’s Representative; Identified by the Underground Detection Services performed; or any existing work damaged as a result of failure to comply with all the referenced requirements.

5. The CONTRACTOR shall contact Common Ground Alliance (CGA) telephone #811 “Know What’s Below-Call Before You Dig” and Underground Service Alert (USA), not less than 72-hours prior to excavation. Contractor shall not excavate until verification has been received from CGA and USA that existing underground utilities serving the site have been located, identified, and marked.

H. The locations of existing underground utilities, where shown on Drawings, are shown diagrammatically and have not been independently verified by the District, the District’s Representative, the Architect/Engineer. The District, the District’s Representative, and the District’s Architect/Engineer are not responsible for the location of underground utilities or structures, whether or not shown or detailed and installed under this or any other Contracts. The CONTRACTOR shall identify each existing utility line prior to excavation and mark the locations on the ground of each existing utility line.

1.04 AIR CONDITIONING, HEATING, PLUMBING EQUIPMENT WIRING

Provide electrical work, materials, and control components required for proper operation of the air conditioning, heating and plumbing systems as indicated on the Electrical, Mechanical, and Plumbing Contract Documents and specified herein.

1.05 PERMITS

Take out and pay for all Required Permits, Inspections and Examinations without additional cost to the DISTRICT.

1.06 QUALITY ASSURANCE

A. Work and Materials shall be in full accordance with the latest Rules and Regulations as follows. The following publications shall be included in the Contract Documents requirements. If a conflict occurs between the following publications and any other part of the Contract Documents, the requirements describing the more restrictive provisions shall become the applicable Contract definition:

2. California Part 3 "California Electrical Code" CEC, Title 24 and Title 8 "Division of Industrial Safety".
4. California Fire Code – CFC
9. Underwriter’s Laboratory – UL.
10. Other applicable State and Local Government Agencies Laws and Regulations.
11. Electrical Installation Standards National Electrical Contractors Association (NECA) and National Electrical Installation Standards (NEIS):
   a. NECA/NEIS-1: Standard of Practices for Good Workmanship in Electrical Contracting
   b. NECA/NEIS-101: Standard for Installing Steel Conduit (Rigid, IMC, etc.)
   c. NECA/NEIS-104: Recommended Practice for Installing Aluminum Building Wire and Cable
   d. NECA/NEIS-105: Recommended Practice Installing Metal Cable Trays
   e. NECA/NEIS-111: Recommended Practice Installing Nonmetallic Raceways
   f. NECA/NEIS-230: Recommended Practice for Installing Motors
   g. NECA/FOA-301: Standards for Installing and Testing Fiber Optic Cables
   h. NECA/NEIS-305: Standard for Fire Alarm System Job Practice
   i. NECA/NEIS–331: Standards for Installing Building and Service Entrance Grounding
   j. NECA/NEIS-400: Recommended Practice for Installing and Maintaining Switchboards
   k. NECA/NEIS-402: Recommended Practice for Installing and Maintaining Motor Control Centers
   l. NEIS/NECA and EGSA-404: Recommended Practice for installing Generator Sets
   m. NECA/NEIS-405: Recommended Practices for installing and Commissioning Interconnected Generation Systems
   n. NECA/NEIS-407: Recommended Practice for Installing Panelboards
   o. NECA/NEIS-408: Recommended Practices for Installing Busway
   p. NECA/NEIS-409: Recommended Practice for Installing and Maintaining Dry-Type Transformers
   q. NEIS/NECA and IESNA-500: Recommended Practice for Installing indoor Commercial Lighting Systems
   r. NEIS/NECA and IESNA-501: Recommended Practice for Installing Exterior Lighting Systems
   s. NEIS and IESNA-502: Recommended Practice for Installing Industrial Lighting Systems
   t. NECA/BICSI-568: Standards for Installing Commercial Building Telecommunications System
   u. NECA/NEIS-600: Recommended Practice Installing Medium-Voltage Cable

B. All Material and Equipment shall be new and shall be delivered to the site in unbroken packages. All material and equipment shall be listed and labeled by Underwriters Laboratories or other recognized Testing Laboratories, where such listings are available. Comply with all installation requirements and restrictions pertaining to such listings.

C. Work and Material shown on the Drawings and in the Specifications are new and included in the Contract unless specifically indicated as existing or N.I.C. (not in Contract).

D. Keep a copy of all applicable Codes and Standards available at the job site at all times for reference while performing work under this Contract. Nothing in plans or Specifications shall be construed to permit work not conforming to the most stringent of Building Codes.
E. Where a conflict or variation occurs between applicable Codes, Standards and/or the Contract Documents, the provisions of the most restrictive provision shall become the requirement of the Contract Documents.

1.07 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. General

1. Review of CONTRACTOR’S submittals is for General Conformance with the design concept of the Project and General Compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the Plans and Specifications. CONTRACTOR is responsible for quantities; dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of work with that of all other trades and satisfactory performance of their work.

2. The CONTRACTOR shall review each submittal in detail for compliance with the requirements of the Contract Documents prior to submittal. The CONTRACTOR shall "Ink Stamp" and sign each item of the submittal with a statement "CERTIFYING THE SUBMITTAL HAS BEEN REVIEWED BY THE CONTRACTOR AND COMPLIES WITH ALL THE REQUIREMENTS OF THE CONTRACT DOCUMENTS". The CONTRACTOR shall clearly and specifically identify each individual proposed substitution, substitution of equal or proposed deviation from the requirements of the Contract Documents with a statement "THIS ITEM IS A SUBSTITUTION". The burden of research, preparation of calculations and the furnishing of adequate and complete Shop Drawings information to demonstrate the suitability of CONTRACTOR’S proposed substitutions and suitability of proposed deviations from the Contract Documents is the responsibility of the CONTRACTOR.

3. Departure from the submittal procedure will result in resubmittals and delays. Failure of the CONTRACTOR to comply with the submittal requirements shall render void any acceptance or any approval of the proposed variation. The CONTRACTOR shall then be required to provide the equipment or method without variation from the Contract Documents and without additional cost to the Contract.

4. The CONTRACTOR at no additional cost or delays to the Contract shall remove any work, material and correct any deficiencies resulting from deviations from the requirements of the Contract Documents not approved in advance by the DISTRICT prior to commencement of work.

5. Shop Drawings submitted by the CONTRACTOR, which are not specifically required for submittal by the Contract Documents, or CONTRACTOR shop Drawings previously reviewed and resubmitted without a written resubmittal request to the CONTRACTOR, will not be reviewed, considered, or commented on. The respective shop drawing submittal /resubmittal will not be returned to the CONTRACTOR and will be destroyed without comment or response to the CONTRACTOR. The respective submittal shall be considered null and void as being not in compliance with the requirements of the Contract Documents.

6. Refer to Division-1 for additional requirements.

B. Material Lists and Shop Drawings

1. Submit material list and Equipment Manufacturers for review within 35 days of award of Contract. Give name of Manufacturer and where applicable, brand name, type and/or catalog number of each item. Listing of more than one Manufacturer for any one item of equipment, or listing items "as specified",
without both make and model or type designation, is not acceptable. Shop Drawings shall not be submitted before review completion of Manufacturers list. The right is reserved to require submission of samples of any material whether or not particularly mentioned herein.

2. After completion of review of the material and Equipment Manufacturers list, submit Shop Drawings for review. Shop Drawings shall be submitted in completed bound groups of materials (i.e., all lighting fixtures or all switchgear, etc.). The CONTRACTOR shall verify dimensions of equipment and be satisfied as to fit and that they comply with all code requirements relating to clear working space about electrical equipment prior to submitting Shop Drawings for review. Submittals, which are intended to be reviewed as substitution or departure from the Contract Documents, must be specifically noted as such. The requirements of the Contract Documents shall prevail regardless of the acceptance of the submittal.

3. Shop Drawings shall include catalog data sheets, instruction manuals, Dimensioned Plans, elevations, details, wiring diagrams, and descriptive literature of component parts where applicable. Structural calculations and mounting details, signed by a Structural ENGINEER registered by the State of California, shall be submitted for all equipment weighing over 400-pounds, and shall be in compliance with Title 21 of the California Code of Regulations.

4. Each Shop Drawing item shall be identified with the Specification Section and paragraph numbers, lighting fixture types and Drawing sheet numbers; the specific Shop Drawing is intended to represent. Shop Drawings 11-inches by 17-inches or smaller in size shall be bound in three ring binders. Divider tabs shall be provided in the three ring binders identifying and separating each separate Shop Drawing submittal item. Shop Drawings larger than 11-inches by 17-inches, Shop Drawing pages/sheets submittals shall be sequentially numbered with unique alphanumeric numbering system to facilitate correspondence referencing identification of individual sheets.

5. The time required to review and comment on the CONTRACTOR’S submittals will not be less than 14 calendar days, after receipt of the submittals at the office of FBA Engineering. The review of CONTRACTOR submittals and return to CONTRACTOR of submittals with review comments will occur in a timely manner conditioned upon the CONTRACTOR complying with all of the following:
   a. The submittals contain complete and accurate information, complying with the requirements of the Contract Documents.
   b. CONTRACTOR’S submittals are each marked with CONTRACTOR’S approval “stamp”, and with CONTRACTOR signatures.
   c. The submittals are received in accordance with a written, shop drawing submittal schedule for each submittal. The CONTRACTOR distributes the schedule not less than 35-calendar days in advance of the Shop Drawing Submittals, and the schedule identifies the calendar dates, the CONTRACTOR will deliver the various submittals for review.

6. Shop Drawings shall include the Manufacturers projected days for shipment from the factory of completed equipment, after the CONTRACTOR releases the equipment for production. It shall be the responsibility of the CONTRACTOR to insure that all material and equipment is ordered in time to provide an orderly progression of the work. The CONTRACTOR shall notify the District’s Representative of any changes in delivery, which would affect the Project completion date.
7. Submittal Identification
   a. Each submittal shall be dated: with submittal transmission date; sequentially numbered and titled with submittal contents identification and applicable Specification/Drawing references (i.e., Submittal dated: 5/12/98 Submittal #4 Contents: Branch circuit panelboards Sheet #E5.1 and Transformers Specification Section 26 0505 Paragraph 2.11, etc.).
   b. Each resubmittal shall be dated: with original submittal date and resubmittal transmission dates; sequentially numbered with original submittal number and sequential resubmittal revision number and titled with submittal contents identification and applicable Specifications/Drawing references (i.e., Original Submittal Date: 5/12/98 Resubmittal Date: 10/9/98 Original Submittal #4 resubmittal Revision R2 Contents: Transformer resubmittal Specification Section – 26 0505 Paragraph 2.11, etc.).
   c. Contractor shall provide a written response narrative with each resubmittal. Describe each response-action, resubmittal addition, change and deletion. Correspond each response to A/E specific review comment.

C. The CONTRACTOR shall be responsible for incidental, direct and indirect costs resulting from the CONTRACTOR’S substitution of; or changes to; the specified Contract Materials and Work.

D. The CONTRACTOR shall pay, upon request by the District’s Representative, a fee for the District’s Representative time involved in the review of substitution submittals and design changes resulting from the CONTRACTOR’S requested substitutions. The fee shall be not less than $125.00 per hour but, in no case, less than stated in Division-1, whichever is greater.

E. Maintenance and Operating Manuals
   1. The CONTRACTOR shall furnish three copies of type-written Maintenance and Operating Manuals for all electrical equipment, fire alarm equipment, sound system equipment, etc., to the District.
   2. Instruct the District’s Personnel in correct operation of all equipment at completion of Project. Provide the quantity and duration of instruction class as specified; but in no case less than two 4-hour durations separate instruction classes for each individual equipment group furnished as part of the Contract. Instruction classes shall be presented by Manufacturer’s Authorized Field Service ENGINEER at the Project Site. Instruction class size shall be at the District’s discretion, not less than one or more than fifteen students shall attend each instruction session. Submit fifteen written outline copies of the proposed instruction class curriculum, 14-days prior to the class-scheduled dates.
   3. Maintenance and operating manuals shall be bound in three ring, hard-cover, plastic binders with table of contents. Manuals shall be delivered to the District’s Representative, with an itemized receipt.

F. Portable or Detachable Parts: The CONTRACTOR shall retain in his possession, and shall be responsible for all portable and detachable parts or portions of the installation such as fuses, keys, locks, adapters, locking clips, and inserts until final completion of Contract Work. These parts shall then be delivered to the District’s Representative with an itemized receipt.
G. Record Drawings (Additional Requirements)
   1. Provide and maintain in good order a complete set of Electrical Contract "Record" prints. Changes to the Contract to be clearly recorded on this set of prints. At the end of the Project, transfer all changes to one set of transparencies to be delivered unfolded to the District's Representative.
   2. The actual location and elevation of all buried lines, boxes, monuments, vaults, stub-outs and other provisions for future connections shall be referenced to the building lines or other clearly established base lines and to approved bench marks. If any necessary dimensions are omitted from the Record Drawings, the CONTRACTOR shall, at the Contractor’s own expense, do all excavation required to expose the buried work and to establish the correct locations.
   3. The CONTRACTOR shall keep the "Record" prints up to date and current with all work performed.
   4. Refer to Division-1 for additional requirements.

1.08 CLEANING EQUIPMENT, MATERIALS, PREMISES

All parts of the equipment shall be thoroughly cleaned of dirt, rust, cement, plaster, etc., and all cracks and corners scraped out clean. Surfaces to be painted shall be carefully cleaned of grease and oil spots and left smooth, clean and in proper condition to receive paint finish.

1.09 JOB CONDITIONS - PROTECTION

Protect all work, materials and equipment from damage from any cause whatever and provide adequate and proper storage facilities during the progress of the work. Provide for the safety and good condition of all the work until final acceptance of the work by the District and replace all damaged or defective work, materials, and equipment before requesting final acceptance.

1.10 EXCAVATION, CUTTING, BACKFILL AND PATCHING ADDITIONAL REQUIREMENTS

A. General
   1. Perform excavation, cutting, backfill, core drilling, directional boring, and patching of the construction work required for the proper installation of the electrical work.
   2. Patching shall be of the same material, thickness, workmanship, and finish as existing and accurately match surrounding work to the satisfaction of the District’s Representative.
   3. Prior to penetrating, coring, drilling or cutting existing building elements, concrete and/or masonry, provide imaging equipment examinations of each specific location. The imaging process shall identify existing internal embedded components and locations, including structural elements/anchors, conduit, and piping that are present. Do not penetrate or damage the existing internal embedded elements. Imaging shall employ one of the following, with GPR methodology preferred:
      a. Non-invasive imaging employing high frequency, Ground Penetrating Radar (GPR), single side echo reflection technology.
      b. Non-invasive imaging employing x-ray radiography, through-and-through imaging technology.
B. Excavation Temporary Cover
   1. Excavations for Contract Work occurring in streets, vehicular drive areas, parking lots, sidewalks; any paved surface; or any area accessible to the public; provide temporary steel plating and shoring support for the plates, to completely cover the excavations under one or more of the following conditions:
      a. Excavation shall not remain "open" for more than 4-calendar days; provide temporary plating.
      b. Excavation shall not be "open" over weekends (Saturday, Sunday) or Holidays; provide temporary plating.
   2. The temporary plating shall be a minimum of 0.75-inch thickness steel, but in no case shall the thickness be less than required to support AASHO-H20 traffic loading.
   3. Provide a minimum of two 100% open lane(s) (12-foot lane width) for vehicular traffic at all times during construction, for vehicle access to all areas.

1.11 IDENTIFICATION

A. Equipment Nameplates
   1. Panelboards, terminal cabinets, circuit breakers, disconnect switches, starters, relays, time switches, contactors, push-button control stations, and other apparatus used for the operation or control of feeders, circuits, appliances, or equipment shall be properly identified by means of descriptive nameplates or tags permanently attached to the apparatus and wiring.
   2. Provide nameplate label on electrical service entrance equipment describing available short circuit information calculated by the CONTRACTOR, including:
      a. Calculation date, month-day-year.
      b. Calculate maximum available short circuit fault current.
      c. Description of parameters and changes affecting the requirements for recalculation of the fault current information.
   3. Electrical equipment including switchgear, switchboards, electric panels and control panels, motor control centers, combination motor starters, transformers, disconnects, etc., shall each be labeled by the Manufacturer with "Electric-ARC-FLASH" warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct personnel to wear the correct Protective Equipment/clothing (PPE) when working "Live", or operating "Live" electrical equipment and circuits.
   4. Nameplates shall be engraved laminated phenolic. Shop Drawings with dimensions and format shall be submitted before installation. Attachment to equipment shall be with escutcheon pins, rivets, self-tapping screws or machine screws. Self-adhering or adhesive backed nameplates shall not be used.
   5. Provide black-on-white laminated plastic nameplates engraved in minimum ¼-inch high letters to correspond with the designations on the Drawings. Provide other or additional information on nameplates where indicated.

B. Plates: All cover and device plates shall be furnished with engraved or etched designations under any one of the following conditions (minimum character size not less than 0.188 inch. Engraving shall indicate circuits and equipment controlled or connected):
   1. More than two devices under a common coverplate.
   2. Lock switches.
3. Pilot switches.
4. Switches in locations from which the equipment or circuits controlled cannot be readily seen.
7. As required on all control circuit switches, such as heater controls, motor controls, etc.
8. Receptacles other than standard 15 ampere 120 volt duplex receptacles; shall indicate circuit voltage, ampere, phase and source circuit number.
9. Where outlets or switches are connected to emergency power circuit; provide panelboard and circuit number engraved on plate.
10. Low voltage and signal system outlets.

C. For equipment and access doors or gates to equipment containing or operating on circuits of more than 100 volts AC or DC nominal. Provide red-on-white laminated warning signs engraved in ½-inch high letters to read: "DANGER - 480 (or applicable voltage) VOLTS KEEP OUT AUTHORIZED PERSONNEL ONLY".

D. Wire and Cable Identification
1. Provide identification on individual wire and cable including signal systems, fire alarm, electrical power systems (each individual phase, neutral and ground), empty conduit pull ropes, and controls circuit.
2. Permanent identification shall be provided at each termination location, splice location, pullbox, junction box and equipment enclosure.
   a. Individual wire and cable larger than #6AWG or 0.25-inch diameter, shall be provided with polypropylene identification tag holders, with yellow polypropylene tags interchangeable black alphanumeric characters, character height 0.25 inch. Attach identification tags with plastic “tie” wraps, minimum of two for each tag. As manufactured by Almetek Industries-“EZTAG” Series; or TECH Products - “EVERLAST” Series.
   b. Individual wire and cable #6AWG and smaller or smaller than 0.25 inch diameter, shall be provided with water and oil resistant, flexible, self-laminating pressure sensitive machine embossed plastic tags that wrap a minimum of 360 degrees around the wire/cable diameter. The entire tag shall then be covered with a clear flexible waterproof plastic cover wrapped a minimum of 540 degrees around the wire/cable diameter and completely covering the identification. As manufactured by Brady Identification; or 3M; or Panduit.
   c. Each identification tag location shall indicate the following information: circuit number, circuit phase, source termination and destination termination equipment name (or outlet number as applicable).
3. Install permanent identification after installation/pulling of wire/cable is complete, to prevent loss or damage to the identification.

E. Cardholders and cards shall be provided for circuit identification in panelboards. Cardholders shall consist of a metal frame retaining a clear plastic cover permanently attached to the inside of panel door. List of circuits shall be typewritten on card. Circuit description shall include name or number of circuit, area, and connected load.

F. Junction and pull boxes shall have covers stenciled with box number when shown on the Drawings, or circuit numbers according to panel schedule. Data shall be lettered in a conspicuous manner with a color contrasting to finish.
1.12 TESTING

A. The CONTRACTOR shall obtain an independent Testing Laboratory, provide all instrumentation and perform tests on the electrical system and equipment as hereinafter described and further directed by the District’s Representative. The test shall be performed after the completion of all electrical systems included in the Contract Scope of Work. All tests shall be recorded and documented and submitted to the District’s Representative for review.

1. All equipment and personnel required for set-up and testing shall be provided by the CONTRACTOR.

B. Test for Phase to Ground and Neutral Condition:

1. Open main service disconnects.
2. Isolate the system neutral from ground by removing the neutral disconnects link located in the service switchboard.
3. Close all submain disconnects.
4. Close all branch feeder circuit breakers.
5. Turn all switches to "on" position, unplug all portable equipment from outlet receptacles.
6. Measure the resistance of each phase to ground and phase to neutral. A properly calibrated "megger" type test instrument shall be used. The test voltage shall be a nominal 500 volts.
7. Record all readings after 1-minute duration and document into a complete report.
8. Isolating Grounds: In the event that low resistance ground neutral connections are found in the system, they shall be isolated and located by testing each circuit individually as outlined above. Make proper corrections to restore the resistance values to an acceptable value.

C. Method of obtaining ground resistance shall be in accordance with the latest edition of the James G. Biddle (Plymouth Meeting, Pennsylvania) manual published on this subject.

1. Perform "fall-of-potential" three point tests on the main grounding electrode of system per IEEE Standard No. 81, Section 8.2.1.5. when suitable locations for test rods are not available, a low resistance dead earth or reference ground shall be utilized.
2. Perform the two point method test per IEEE Standard No. 81, Section 8.2.1.1, to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.

D. The testing, calibrating and setting of all ground and ground fault equipment, circuit breakers, circuit device protection relays, and meters adjustable settings shall be by an independent Testing Laboratory. Set as recommended by the respective Manufacturer and Coordination Study so as to be coordinated with other protection devices within the electrical design. Bound and tabulated copies of the test and settings shall be sent to the District’s Representative.

E. Ampere and Voltage Measurements

1. Measure and record ampere and line voltage measurements under full load on all panel feeders, switchboard, and switchgear feeders, motor control centers.
and motor circuits provided in the Contract. Record measurements at the equipment tested and submit to the District’s Representative for review.

2. Ampere voltage readings shall be:
   a. Phase A-B, A-C and B-C.
   b. Phase A-Neutral, B-Neutral and C-Neutral.

3. The ampere and voltage readings shall be not less than 20-minutes duration for each test. Record and submit the measured minimum, maximum and 20-minute average for each ampere and voltage value and test location. Voltage and ampere measurements shall occur at the connected load end of each respective feeder, not at the source of supply end of each feeder.

4. Test equipment shall be accurate within plus or minus 1%.

5. Branch circuit devices 40 ampere or less and motor loads ten horsepower or smaller are excluded from ampere and voltage testing requirement.

6. If, in the opinion of the District’s Representative, the voltages and regulations are not met within acceptable limits, make arrangements with the serving utility for proper electrical service. Retest feeder line voltages, and submit to District’s Representative for review, after the Utility Company has completed corrective actions. Reset "voltage taps" on transformers provided or modified as part of the Contract Work, to adjust line voltages to within acceptable values, as directed by the District’s Representative.

F. The Contractor shall complete the following work before any electrical equipment is energized.

1. All equipment shall be permanently anchored.

2. All bus connections and conductor/wire connections shall be tightened per Manufacturer's instructions and witnessed by the District’s Representative.

3. All ground connections shall be completed and identified. Perform and successfully complete all required megger and ground resistance tests.

4. Feeders shall be connected and identified.

5. The interiors of all electrical enclosures including busbars and wiring terminals shall be cleaned of all loose material and debris, paint, plaster, cleaners or other abrasive's over spray removed and equipment vacuumed clean. The District’s Representative shall observe all interiors before covers are installed.

6. All wall, ceiling, and floor work and painting shall be completed within areas containing electrical equipment prior to installation of equipment. The equipment indoor rooms and spaces shall be weather-tight and weather protected from environmental incursions.

7. All doors to electrical equipment rooms shall be provided with locks in order to restrict access to energized equipment.

8. Electrical spaces and rooms shall not be used as storage rooms after power is energized.

9. Outdoor electrical equipment enclosures and housings shall be weather protected.

10. The electrical system time current coordination and ARC-Fault study shall be complete for circuit breakers, ground relays sets, and circuit relay sets, fuses; set-up, tested and calibrated accordingly.
1.13 COMMISSIONING - CX

A. General

1. The Commissioning shall verify the electrical systems for the term of the Contract, by observation; and by calibration; and by testing. The Commissioning shall ensure the electrical systems perform interactively and correctly, according to the Contract and Operational Requirements.

2. Commissioning shall provide startup, testing and documented confirmation of the Contract Constructed Systems, materials and work, functions in compliance within the criteria set forth in the Contract Documents to the satisfaction of the District’s needs. The Commissioning Scope shall encompass each system identified as requiring "Commissioning" by the Contract Documents, including but not limited to:
   a. Electrical circuits’ protection, short circuit, overcurrent, and ground fault devices.
   b. Electrical circuits monitoring and metering.
   c. Light fixtures, lamps and ballasts.
   d. Lighting control devices, equipment and lighting control systems.
   e. Standby and emergency electric power supply equipment and systems.
   f. Fire alarm, equipment, devices and fire alarm systems.
   g. Additional systems described in the Contract Documents.

3. Commissioning process shall review all of the Shop Drawing submittals, including:
   a. Controls, Operation and Maintenance requirements.
   b. Facility performance testing compliance.
   c. Project Contract requirements compliance.
   d. Compliance with basis for design and operational descriptions provided in the Contract.

4. Commissioning shall be the process of ensuring all the systems described in the Contract Documents comply with the Contract Document design; all systems are installed properly; all systems are functional, tested and capable of being operated and maintained to perform within the Contract requirements and design intent.

5. Functional setup, recalibration, correcting deficiencies, retesting and the associated costs, for system(s) that fail commissioning, shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall include all commissioning costs in the Contract Scope of Work.

6. Complete all commissioning functions prior to the occupancy of the facility by the District, unless directed otherwise by the District’s Representative.

7. Submit six copies of commissioning documentation to District’s Representative.

8. Commissioning, unless specifically indicated otherwise, shall be performed by Factory-Trained Technician(s) Authorized and Certified by the Manufacturers of the respective equipment/systems. Where specifically indicated, commissioning shall be performed by Independent Test Lab.

B. Commissioning Procedures

1. Prepare a Commissioning matrix identifying components and systems included in the Commissioning Scope; the status; actions completed and actions to be completed.

2. Verify CONTRACTOR compliance with Contract Document requirements Manufacturer's recommendations and approved Shop Drawings.

3. Perform startup, functional tests, reports, and document results.
4. Evaluate and document the setup parameters, software, operating condition and performance of each system at the time of functional test completion. Document and record each performance parameter and condition, in the commissioning report.

5. Schedule testing and prepare descriptions of testing.

6. Describe measures performed to correct deficiencies.

7. Verify that instructions to District’s Representatives, Operations and maintenance manuals comply with Contract Documents.

8. Prepare warranty matrix identifying the start dates, expiration dates, routine preventative maintenance dates and the District’s responsibility for performing preventative maintenance and keeping logs for each maintenance function and warranty claims.

9. Confirm completion of all punch list items that have been acceptably accomplished and a list of what has not been acceptably completed.

10. Describe uncorrected deficiencies accepted by the DISTRICT.

C. Commissioning Phasing
   The Commissioning Phases of work shall include the following activities:
   1. SDQ - Shop Drawing Qualification shall verify complete and correct Shop Drawings have been submitted.
   2. IQ – The Installation Qualification of Contract Work shall verify systems are correctly and properly installed.
   3. OQ - Verify systems interfaces and software are correctly and properly operational.
   4. ITM - Verify the Contract Inspection, Testing and procedures for Maintenance are complete.
   5. PQ - Performance Qualification complete the functional performance testing to validate each building system.

1.14 POWER OUTAGES

A. All electrical services in all occupied facilities of the Contract Work are to remain operational during the entire Contract period. Any interruption of the electrical services for the performance of this work shall be at the convenience of the District and performed only after consultation with the District’s Representative. Work involving circuit outages shall be only at such a time and of such a duration as approved in writing. Work involving circuit outages for the work required to connect new equipment and disconnect existing equipment shall be performed at the convenience of the DISTRICT.

B. Contract Work involving outages or disruption of normal function in electrical power systems, telephone/communication systems, fire alarms, shall be performed during the following time periods. The Contract Work shall be phased to limit outages in the respective systems to the stated periods:
   1. 11:30 p.m. Friday to 11:30 p.m. Sunday of the same weekend. Work shall occur on multiple weekend periods if a single weekend is not sufficient time to complete the work.
   2. The Contract Work involving outages shall be phased in multiple work time units, to comply with the permitted outage limitations.

C. Work involving system outages to the building fire alarm system shall be performed only after consultation with the DISTRICT and shall be only at such a time and of such duration as approved in writing. Contractor shall provide continuous “Fire-
Watch” during fire alarm system outages and comply with AHJ “Fire-Watch” requirements.

D. Provide overtime work; double shift work; night time work; Saturday, Sunday, and holiday work to meet outages schedule.

E. Provide temporary electrical power to meet the requirements of this Article.

F. Any added costs to CONTRACTOR due to necessity of complying with this Article shall be included in the Contract Scope of Work.

G. When electrical work involving power disruptions to existing areas is initiated, the work shall proceed on a continuous basis without stopping until electric power is restored to the affected areas.

H. The CONTRACTOR shall request in writing to the DISTRICT’S Representative a minimum of 3-weeks in advance, for any proposed electrical outage.

1.15 TEMPORARY ELECTRICAL POWER

A. Provide temporary electrical power if work requiring power outages cannot be completed in time permitted and approved by the DISTRICT’S Representative.

B. Temporary electrical power shall be a standby diesel engine generators. Voltage, frequency, regulation, etc. shall be equal to that of normal utility source. Exhaust system shall have a critical silencing muffler. Generator voltage shall match the existing secondary voltage required at the site. The CONTRACTOR shall furnish all necessary cables, switches, etc., to make all required connections to existing panels, feeders, etc. Generator shall be sized to adequately carry the demand load. If record of demand load is not available, size generator to match corresponding transformer, maximum capacity circuit as directed by the District’s Representative.

C. After completion of required usage of the temporary generators, prior to completion of the project, the CONTRACTOR shall remove the generators. All temporary cables, switches, etc. shall be removed and all permanent equipment left in satisfactory condition.

D. Each generator shall be housed in security type sound attenuated housing to prevent access by unauthorized personnel. Temporary power cables, connections, etc. shall be protected from unauthorized personnel.

E. The CONTRACTOR shall be responsible for complete operation of the generator including personnel, fuel supplies, proper safety precautions, etc. Generator shall not be left unattended while in operation.

F. The CONTRACTOR shall provide temporary construction lighting and power as required in areas where work is being performed. Temporary power arrangements, outages, installation, work schedules, etc., shall be submitted in writing 3-weeks prior to requested outage date, and approved by the DISTRICT’S Representative prior to start of work.
1.16 ASBESTOS, POLYCHLORINATED BIPHENYL (PCB) OR HAZARDOUS WASTE:

A. It is understood and agreed that this Contract does not contemplate the handling of asbestos, PCB or any hazardous waste material. If asbestos, PCB or any hazardous waste material is encountered, notify the District’s Representative immediately. Do not disturb, handle or attempt to remove.

B. Lighting Fixture Demolition Hazardous Materials
   1. The removal of existing lighting fixtures will generate hazardous material waste disposal Contract Documents.
      a. The existing lighting fixture ballast contains PCB material.
      b. The existing lighting fixture lamps contain mercury.
      c. The existing lighting fixture internal wire insulation may contain asbestos.
   2. Remove, handle, store, contain, dispose of and document the hazardous materials resulting from existing lighting fixtures work, as part of the Contract requirements.

1.17 TIME/CURRENT COORDINATION, SHORT CIRCUIT, ARC-FLASH AND SERIES RATED EQUIPMENT

A. Series Rated Equipment.
   1. Circuit protective Devices identified as "Series Rated" or "Current Limiting" (i.e., CLCB - Current Limiting Circuit Breaker; CLF - Current Limiting Fuse, etc.) shall be Series Rated and Tested (UL 489 and CSA5) by the Manufacturer with all equipment and circuit protective devices installed downstream of the identified series rated or current limiting device.
   2. Provide nameplates on all equipment located downstream, including the CLCB and CLF devices, to comply with CEC/NEC paragraphs 110-22 and 240-83 "CAUTION SERIES RATED SYSTEM - NEW DEVICE INSTALLATIONS AND REPLACEMENTS SHALL BE THE SAME MANUFACTURER AND MODELS".

B. Short Circuit, Coordination and ARC-Flash
   1. Perform Engineering Analysis and submit engineered settings for each equipment location, fuse and circuit breaker device, showing the correct time and current settings to provide the selective coordination within the limits of the specified equipment. Shall comply with the latest application standards of IEEE and ANSI. Provide electrical system short circuit worst case bolted-fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH calculations as part of the Coordination Analysis recommendations.
   2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six (6) copies.
   3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
d. CEC/NEC

4. Provide permanent warning labels on each equipment location. The labels shall describe ARC-FLASH, Short-Circuit and Time/Current Coordination, including safety precautions and protective clothing. Also described actions to be taken if any circuit changes or equipment modifications occur.

5. Shall be submitted with the Shop Drawing submittals for the respective equipment.

1.18 INDEPENDENT TESTING LABORATORY

A. Testing Laboratories Definition
   2. Membership in the National Electrical Testing Association (NETA) shall also constitute acceptance of meeting said criteria, for testing of electrical systems.

1.19 SPARE FUSES

Provide three spare fuses for each size and type at each location to match the installed fuses where the fuses are provided as part of the Contract. Provide spare fuse holders on inside door of each respective fuse compartment. Provide engraved nameplate on front of fuse access door indicating fuse type/catalog number ampere rating and Manufacturer of fuse.

1.20 EQUIPMENT SEISMIC AND WIND LOAD REQUIREMENTS (ADDITIONAL REQUIREMENTS)

A. Refer to Structural, Architectural, and Soils Report Contract Documents for additional requirements.

B. General
   1. Equipment supports and anchorage’s provided as part of the Contract shall be designed, constructed and installed in accordance with the Earthquake Regulations of the California Building Code (CBC), International Building Code (IBC).
   2. Provide equipment anchorage details, coordinated with the equipment mounting provision, prepared, signed and "stamped" with PE Registration in good standing, by a Civil or Structural Engineer Licensed as a Professional Engineer (PE) in the State of California.
   3. Mounting recommendations shall be provided by the Manufacturer based upon approved shake-table tests used to verify the seismic design of that type of equipment.
   4. The Equipment Manufacturer shall document the details necessary for proper wind-load and seismic mounting, anchorage, and bracing of the equipment for floor, ceiling, and wall/back installation location.
   5. Seismic performance shall be based on actual install location of the respective equipment in the building and height above or below grade.
   6. The seismic requirements are typical for each equipment item exceeding 19-pounds, including but not limited to the following:
      a. Switchgear, switchboards, and motor control equipment
      b. Transformers
      c. Equipment racks and terminal cabinets
      d. Panels
e. Conduits with floor, ceiling or wall attachment support and conduits with suspension attachments.
f. Busway, wire way and cable tray
g. Uninterruptable power supplies (UPS)
h. Inverters
i. Generators and related equipment
j. Lighting equipment
k. Fire alarm equipment

C. Certification
1. Electrical Equipment Manufacturers and Contractor shall provide Special Seismic Certification (SCC) for each specific equipment configuration with shake-table verification, all furnished as part of the Contract Documents requirements. The SCC shall include the specific installation location characteristics of the respective equipment including as follows:
   a. Ground or floor attachment
   b. Wall attachment
   c. Ceiling attachment
   d. Roof attachment
2. Wind Loading
   Electrical equipment and anchorages shall withstand the wind-load imposed at the install location. Wind loading withstand requirements shall apply to all electrical equipment installed in outdoor locations and to all electrical equipment exposed to the weather. The equipment shall be Tested and Certified by the Manufacturer and Contractor. The wind-load withstand qualification of the equipment and anchorages shall be verified by the following methods:
   a. Areo-dynamic wind tunnel test method.
   b. Analytical calculation method, for oversized equipment too large for wind tunnel test method.
3. The wind-load withstand rating and the SCC shall comply with the requirements of the Authority Having Jurisdiction (AHJ), and include the latest revisions, but not limited to the following:
   a. American Society of Civil Engineers; ASCE-7
   b. CBC/IBC; including but not limited to Sections 1702, 1708, 1709, 1708A and 1709A.
   c. California Office of Statewide Health Planning and Development OSHPD; OPA-Preapproval of Anchorage; Code Application Notice CAN 2-1708A.5 and OSP-Special Seismic Certification Approval
   d. US Department of Homeland Security; FEMA- (installing seismic restraints for electrical equipment)

D. Wall Mounted Electrical Equipment
1. Surface Mounted Equipment
   a. Provide multiple horizontal sections of metal “C” channels for support and attaching wall mounted equipment to walls. Channels shall provide “turned lips” at longitudinal edges to hold “lock-in” fasteners and shall comply with ANSI-1008 and ASTM-A569 latest revision. The channels shall be steel hot dip zinc galvanized. As manufactured by Unistrut or Kindorf.
   b. The “C” channels shall be positioned horizontally within 3-inches of the top and bottom of each, equipment section cabinet and located behind each equipment vertical section. Provide additional intermediate “C” channels
at not less than 36-inches on center between the “top” and “bottom” “C” channel positions, located behind each equipment vertical Section.

c. The “C” channels shall be of sufficient length to provide connection to not less than two vertical structural wall framing elements separated by not less than 16-inches; but in no case shall the “C” channel length be less than the width of the respective Equipment Section.

d. Attach the “C” channels to the wall structural elements after the wall, finish surface, installation (including painting) is complete.

e. Attach the “C” channels with fasteners to the building wall framing structural elements as follows: welded to steel framing; bolted to wood framing; cast in place concrete inserts for masonry and concrete construction; drilled “after-set” expansion anchors for existing masonry and concrete construction.

f. Attach the equipment to the “C” channels with threaded and bolted fasteners to “pre-locate” and lock into the channel “turned lips” and channel walls.

2. Flush mount equipment
   a. Provide anchor attachment of equipment into adjacent wall structural elements.

E. Housekeeping Pad

1. Provide cast-in-place, steel re-enforced concrete raised “housekeeping” pads under all floor standing electrical equipment (except data network equipment racks).

2. Pad sizes
   a. The raised housekeeping pad height shall extend 4-inches above the surrounding finished floor elevation for interior building locations.
   b. The pad shall extend 8-inches below finish grade plus 4-inches above finish grade for outdoor equipment location on grade.
   c. The pads shall extend 7-inches past the “footprint” edge of the respective floor standing equipment.

3. Anchor equipment to pads. Anchor pads to the building structural floor. Equipment pad, equipment re-enforcing and equipment anchoring shall comply with Seismic Earthquake requirements and Wind Load requirements.

4. Unless shown otherwise on Drawings. The equipment housekeeping pad steel re-enforcing shall consist of two layers of number 4-size steel-rebar laid horizontally and uniformly spaced 6-inches on center. Position rebar in two directions (90-degrees opposed) and centered inside the concrete housekeeping pad. Horizontal rebar shall extend to within 3-inches of the edge of the concrete pad in all directions. Metal wire “tie-wrap” shall be provided at each rebar crossing.

5. Equipment anchor attachments shall extend through the housekeeping pad and into the structural concrete below the pad a minimum of not less than 2-inches.

1.21 ELECTRICAL WORK CLOSEOUT

A. Prepare the following items and submit to the District’s Representative before final acceptance.
   1. Two copies of all test results as required under this Section.
   2. Two copies of Local and/or State Code Enforcing Authority’s Final Inspection Certificates.
3. Copies of Record Drawings as required under the General Conditions, pertinent Division One Sections and Electrical General Provisions.
4. Two copies of all receipts transferring portable or detachable parts to the District’s Representative when requested.
5. Notify the District’s Representative in writing when installation is complete and that a Final Inspection of this work can be performed. In the event any defect or deficiencies are found during this Final Inspection they shall be corrected to the satisfaction of the District’s Representative before final acceptance can be issued.
6. List of spare fuses and locations identified by equipment name and building designation.
7. Prior to energizing, retighten to the proper torque, each circuit conductor lug landing, each bus bar (phases, neutral and ground) and circuit protection device threaded connections in all switchboards, switchgear, motor control centers, transformers, busways, disconnect switches, motor starters, motor terminals and panelboards, after the equipment is installed/connected and prior to energizing the equipment. The torque values shall comply with Manufacturer’s recommendations.

B. Electrical Power Single Line Diagrams – SLD
1. Provide single line diagrams showing the Contract Document Work complete electrical power system (normal and emergency). SLD shall show inter-connection circuits, electrical equipment, panels, and circuit protection devices, nominal 50% (½-size) approximately 18-inches by 24-inches. Show installed voltages and electrical capacity sizes.
2. SLD shall be mounted in metal (picture frame) rigid enclosure frame with rigid-backing (backer-board) and clear/transparent front, for hanging on wall. Provide clear transparent cover over SLD inside the frame.
3. Provide a wall-hung (± 48-inches) SLD in each “main” and “sub” electrical equipment room. If wall space is limited, alternatively securely attach SLD frame to room door facing into the respective electrical room.

END OF SECTION 26 0500
032816/223031
SECTION 26 0505

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all outlet boxes, floor boxes, wiring devices, device plates, relays, contactors, timeswitches, and disconnects fuses.

B. Submit Detailed Shop Drawings including Dimensioned Plans, elevations, details, schematic and point-to-point wiring diagrams and descriptive literature for all component parts for transformers, relays, time clocks, and photocells.

C. Submit Transformer Test Reports.

D. Submit Material List for Outlet Boxes.

PART 2 - PRODUCTS

2.01 OUTLET AND JUNCTION BOXES

A. General:
   1. Flush or concealed outlet boxes and junction boxes.
      a. Non-masonry and/or non-concrete locations provide pressed steel boxes. Steel thickness not less than 0.062-inch, hot-dip galvanized. Knockout (KO) type with conduit entrances and quantities size to match conduits shown connecting to respective junction box and outlet box.
      b. UL-514 listed and labeled.
      c. Minimum required box depth is exclusive of extension-ring depth.
      d. Provide all boxes with matching cover plates. Cover plates shall be gasketed water-tight in wet and outdoor locations.
      e. Boxes installed in masonry or concrete shall be UL "concrete-tight" approved for installation in concrete, and shall allow the placing of conduit without displacing reinforcing bars.
   2. Provide outlet boxes of proper Code size for the number of wiring devices, connecting conduits, and conductors/cables or conduits passing through or terminating therein. In no case shall outlet box be less than 4.0-inches square by 2.125-inches deep. Unless specified elsewhere or noted otherwise on the Drawings, 2.5-inches minimum depth for box width's exceeding 2-gang.
3. Increase the minimum outlet box size to 4.69-inches square by not less than 2.125-inches deep, where one or more of the following conditions occurs:
   a. More than two conduits connect to the outlet box.
   b. Circuit "Homerun" or Conduit "Homerun" connects to outlet box.

4. Signal, Communication and Low Voltage Outlet Boxes:
   a. Individual or duplex audio/visual, telephone, computer or data outlets: 4.69-inches square by 2.125-inches deep minimum with single gang wide extension ring.
   b. Combination AV/signal/telephone/data or computer outlets: 4.69-inches square by 2.125-inches deep minimum with 2-gang wide extension ring.

5. Junction boxes shall be sized to comply with the following:
   a. Code requirements size based on the conduit quantities, conduit sizes and wire-fill connected to the junction box.
   b. Junction box minimum size shall not be less than 4.69-inches square by 2.5-inches deep, but not less than size indicated on the Drawings or required by Code.

6. Provide extension rings on flush outlet boxes and flush junction boxes, to finish face of extension ring flush to (within ± 0.63-inches) of finished building surfaces. Extension ring shall match outlet box materials/construction and contain "attachment mounting-tabs" for wiring devices. Extension rings shall be "screw-attached" to respective box and maintain "ground" bonding continuity.

7. Outlet boxes installed in outdoor locations, or in wet locations, or in concrete/masonry, shall be cast-iron or cast-bronze, with threaded conduit hubs. UL rated for wet locations.
   a. Aluminum boxes shall NOT be in contact with concrete or masonry. Die-cast aluminum or cast aluminum water-tight electrical outlet boxes with threaded hubs may be provided as an alternate to cast-iron or cast-bronze outlet boxes, only where one or more of the following conditions occur:
      1) Outdoor locations above finish grade.
      2) Indoor wet locations surface or flush in walls or ceilings.
      3) Not in contact with concrete or masonry.

8. Provide fixture-supporting device in outlet boxes for surface mounted fixtures as required.

9. Provide solid gang boxes for three or more devices, typical for line and low voltage switches, receptacles, low voltage/signal outlets, etc. for mounting devices behind a common device plate.

10. Provide isolation barriers in outlet boxes:
   a. Between line voltage and low voltage devices.
   b. Where more than one device is installed in an outlet box, between and separating each device.
   c. Between 277-volt and 120-volt devices.
   d. Between devices connected to emergency and non-emergency circuits of all voltages.

11. Outlet boxes installed penetrating into fire rated walls, fire rated floors, fire rated ceilings and all fire rated construction. The outlet boxes shall be UL listed, classified and labeled, for fire rated and temperature rated penetration of the respective fire rated surface and fire rated construction. The outlet box fire rating and temperature rating shall equal or exceed the fire/temperature rating of the surface/construction being penetrated. Provide UL listed and labeled supplemental fire and temperature protection to maintain ratings:
   a. Wall and ceiling penetrations, supplemental tumescent fire wrap (external or internal of outlet box).
b. Floors provide subfloor supplemental fireproofing below floor box.

12. Outlet boxes installed in floors. The floor outlet boxes shall be UL listed and labeled for scrub water exclusion requirements, including but not limited to tiles, carpeting and exposed wood and concrete floor fishes.

13. Outdoor flush in wall device outlet boxes:
   a. Flush in wall outlet box with corrosion resistant gasketed water tight, hinged, key locking cast metal, self-closing cover. Tamper resistant and vandal resistant.
   b. UL-listed and labeled for installation in masonry, cast-in-place concrete, hollow-framed walls and wet locations.
   c. Flush cast-iron or cast-bronze or brass, device back-box, nominal 4.68-inch square by 2.25-inch deep.
   d. Internal metal adapter plate for wiring device types, in the box as indicated on the Drawings.
   e. As manufactured by Legrand/Pas and Seymour #4600 Series; or C.W. Cole #310 Series.

14. PVC Coating
   a. Metal outlet and junction boxes installed in outdoor or exposed non-weather protected locations shall be PVC coated.
   b. PVC coating shall be factory applied, to comply with NEMA-RN1 and 5-19.
   c. The adhesion of the PVC coating to the metal box shall exceed the strength of the coating itself, based on 0.5-inch "strip-pull" test.
   d. Uniform coating thickness shall be continuous without "breaks" or "pinholes" and shall not be less than the following:
      1) Box exterior surfaces, 40-millimeter coating thickness.
      2) Box interior surfaces, 10-millimeter coating thickness.

15. Refer to Architectural and Structural Contract Documents and Details for additional box and install requirements.

B. Surface Outlet Boxes
   1. Surface mounted outlet boxes, cast iron Type FS or FD, with threaded hubs as required. Box interior dimensions and interior volume capacity not less than required for “press steel boxes”, and “sheet steel boxes”. Provide plugs in all unused openings. Provide weatherproof gaskets for all exterior boxes.

C. Floor Boxes
   1. General:
      a. Outlet boxes installed in floors. The floor outlet boxes shall be UL listed and labeled for scrub water exclusion requirements, including but not limited to floor tiles, carpeting and exposed wood and concrete floor fishes.
      b. Electrical power receptacles in a floor box; shall be industrial grade wet location heavy-duty, high-abuse rated devices, tamper resistant. Grounding type, 125 volts, 60Hz AC, 20-amperes, NEMA 5-20R (duplex), or other NEMA configurations noted on the Drawings. Standard length receptacle mounting strap as required by the Manufacturer of floor box being furnished.
      c. Tested, listed and labeled to comply with UL-514A and/or UL514C.
   2. Concrete floor outlet box for chair/seat aisle light fixture connection:
      a. Flush-in -concrete floor box, brass or cast iron, nominal 18-cubic inches internal wire capacity, removable screw attached flush top cover.
      b. Minimum of three 0.75-inch conduit threaded entrances; one surface/top entrance location for aisle light fixture connection to box, plus two side and bottom locations for “in-out” branch circuit connections.
c. The top entrance conduit position shall not interfere with removal and reinstallation of the box top cover, with the top conduit connected between the box and aisle light fixture and the top of the box set flush with finish floor surface.

d. Box and conduit shall be protected and concealed, below each respective aisle seat containing an electric aisle light fixture. Orientation of top entrance conduit to match position of aisle light fixture.

e. As manufactured by Hubbell #F3185 Series; no known equal.

3. Poke-Thru floor boxes for “After-Set” Floor Outlets.

a. Through floor wiring for power and communication shall be UL listed with a fire and temperature rating of not less than 2-hours. The units shall include an internally divided floor fitting; a divided through-floor conduit/raceway, and a divided under floor junction “split-box” not less than 4.7-inches by 4.7-inches by 2.125-inches in size. Junction box shall be installed concealed in ceiling space of the floor below. The length of the floor “through-raceway” shall match the thickness of the finish floor and as recommended by the Manufacturer. Unit shall be self-supporting without the attachment of an above floor fitting. Internal isolation barriers between high potential and low potential circuits and sections. The integral fire barrier shall incorporate a cold smoke barrier to prevent the passage of smoke when heat is not present.

b. Poke-Thru Floor boxes shall contain dual services for high potential and low potential devices and circuits.

c. Poke-Thru Floor pedestal type; (internally divided high potential and low potential sections) service fittings die cast, brushed aluminum, single piece device housing, with stainless steel device cover plates front and rear of the housing as follows:

1) Front side (high potential) one 20-ampere, 120 volt, 60Hz, AC, grounding duplex convenience outlet plugs.

2) Rear side (low potential) shall contain “knockouts” or “keystones” as follows at locations shown on the Drawings:

   a) Knockouts for signal cables one 1-inch diameter and two ⅜-inch diameter with rubber bushing grommets for each knockout.

   b) Four (4) RJ-45 keystone, snap-in retainers for low potential plug-in signal connections.

   c) The CONTRACTOR shall provide the type of outlet(s) at each poke-thru location as required by the low voltage-signal Contract Documents.

3) Alternately where specifically indicated on the Drawings, the front and rear cover plates shall be supplied with knockouts for 1.0-inch flexible conduit “Furniture” connection, one per cover plate.

4) The pedestal shall provide 0.25-inch or greater protective over-hang (drip-lip) of the device coverplates. Provide stainless steel device coverplates.

d. Non-Pedestal Poke-Thru flush in floor type; (internal divided high potential and low potential sections) die cast, flush with finish floor, metal cover flip-open, locking, hinged access covers. Open-close die cast aluminum port-covers for plug-in portable cable connections. ADA compliant, wide trim matching flange.

1) Two 20-ampere, 120 volt, 60Hz, AC, grounding duplex convenience receptacles for high potential power connections.
2) Four RJ-45 keystone, snap-in retainers for low potential plug-in signal connections. The CONTRACTOR shall provide the type of outlet(s) at each poke-thru location as required by the Low Voltage-Signal Contract Documents.

3) Cover shall close and lock after portable plug-in cables have been inserted into respective connections, under the cover.

4) UL wet mop, scrub water rated for carpeted and non-carpeted floors.

e. Die cast aluminum cover, nominal 8-inch diameter metal housing flush in "core-hole", outlet metal body size.

f. Flush with floor or pedestal type as indicated on Drawings. As manufactured by Wiremold/Legrand# Evolution Poke-Thru 8AT Series, Smoke and Fire Rated Poke-Through fittings; no known equal.

4. Floor Boxes for Flush Floor Outlets (non-pedestal), recessed concealed inside outlet box, plug-in receptacles.

a. Provide cast-in-floor with concrete pour pan, rated for on grade to prevent direct earth contact, cast-in-place concrete floors on-grade and above-grade; adjustable "leveling-feet" for box.

b. UL wet mop, scrub water rated for carpeted and non-carpeted floors. UL-File E171211 installation fire rating and/or UL-Fire Resistance Classified.

c. Floor boxes shall contain dual services:
   1) High potential with not less than two 120 volt 60Hz AC 20-ampere grounding duplex convenience receptacles.
   2) Low potential for low voltage system outlets and signal circuits with up to and including eight RJ-45 plug-in keystone snap-in retainer receptacles. The CONTRACTOR shall provide the type of outlet(s) at each poke-thru location as required by the low voltage-signal Contract Documents.
   3) Internal isolating barrier between high and low potential circuits and sections of box.

   4) Also refer to Drawings for additional outlet requirements.

d. Conduit knockouts in bottom of box and in each side walls of box. Not less than one 1.25-inch and one 0.75-inch knockouts for both low potential and high potential conduits connections on each opposing box sides. Include the same configuration of knockouts on the bottom of the box, for high potential section and low potential sections.

e. Floor box cover:
   1) Flush tamper resistant "lock-down" removable main cover. Independent hinged "flip-out" port in the removable cover, to allow main box cover to be in a fully closed position with "plug-in" cords connected into box when the lock-down cover is closed. Main cover "lock-down" to prevent non-authorized access into box interior.
   2) Brass, removable recessed main cover, rated for carpet, or tile for floor finish, brass overlapping trim cover finish. Cover recess depth 0.25-inch, 0.5-inch or 0.75-inch as required to match respective floor covering thickness and type. ADA compliant, wide trim matching flange.

f. Floor box with metal body, nominal box size 10-inches by 12-inches by depth to match floor, but not less than 3.0-inches deep box.

g. Floor box as manufactured by FSR #FL-500P Series; no known equal.
2.02 PULL BOXES

A. General
1. Sizes as indicated on the Drawings and in no case of less size or material thickness than required by the Governing Code and AHJ.
2. Exercise care in locating pull boxes to avoid installation in drain water flow areas and to clear existing condition interferences.
3. UL listed and labeled for electrical circuits.

B. General Purpose Sheet Metal Pullbox
1. General purpose sheet steel pull boxes: Install only in dry protected locations with removable screw attached covers. Manufacturer's standard rust proofing and baked enamel finishes.

C. Concrete Pull Boxes and Hand-Holes for Electrical
1. AASHTO H-20 traffic loading rated box and cover, pre-cast concrete, steel reinforced pull boxes and hand-holes. Provide complete with pulling irons, hot-dip galvanized metal traffic cover with hot-dip galvanized metal cover frame, pull-box concrete base with sump. Four cable full height wall racks with porcelain cable support blocks.
2. Boxes shall be "Intercept" type with Multiple Box Sections. Extension cable-intercepts at both ends of box. Refer to Drawings for box size.
3. Covers shall be flush bolt down. Covers weighing more than 40-pounds shall be split cover type “Torsion-Sping” assist, hinged open-close.
4. Box covers shall comply with Federal ADA, UL, State and Local AHJ for slip resistance. Provide cast-or-bead weld on cover of pull box to indicate services within pull box (i.e., "480/277-VOLT, 3-PHASE, 4-WIRE ELECTRICAL" OR "SIGNAL/TEL/P.A./CLOCK/FIRE ALARM" etc.).
5. Shall be set on a machine-compacted pea gravel base 12-inches thick with gravel base extend 6-inches beyond box base on all sides. Provide a 0.75-inch by 10-feet copper clad ground rod through the box bottom with 9-inch projection into box, for grounding all metal parts and frames with continuous #10 AWG copper bond wire.
6. Seal all box joints and seal box between cover and frame with a mastic compound similar to Parmagum or Dukseal. After cables have been pulled, connected, tested and inspected, seal box cover and bolt-close cover.
7. As manufactured by Jensen Precast; or Oldcastle Precast.

2.03 SWITCHES, WIRING DEVICES

A. General
1. Provide wiring device circuit switches totally enclosed, electrical insulating Bakelite or electrical insulating composition base, manual operator type with 277 volt 60Hz AC rating for full capacity contacts rated for incandescent lamp loads, fluorescent lamp loads and motor loads. Switch mounting-ears for screw attachment to outlet box. Switches shall be UL listed and labeled; conform to NEMA-WD1 and WD6.
2. Switch controlling (on-off) rated for all lighting loads and all non-lighting loads; switch ratings shall be 20 ampere; unless indicated otherwise on Drawings.
3. Color as selected by OWNER’S Representative. Switches and wiring devices controlling circuits connected to emergency power shall be red.
4. All switches shall be of the same Manufacturer.
5. Where switches are mounted in multiple gang assembly and are operating at 277 volts and/or 277 volts and 120 volts or emergency/non-emergency and mounted in same outlet box, there shall be an insulating barrier installed between each switch.
6. Devices shall additionally be listed and labeled as UL-All Weather-Resistant wet-location for the following install locations:
   a. Devices indicated on Drawings as Weather-Proof (W.P.).
   b. Devices installed in outdoor locations
   c. Installed in classified wet or damp area locations both indoor and outdoor.
7. Wiring devices shall be listed and labeled for connection of both “solid” and “stranded” copper circuit conductors.
8. Switches with ampere and voltage ratings different than described herein. The different rated switches shall have the same characteristics and performance as the respective described switches, except for differing ampere and voltage characteristics.

B. Switches Heavy Duty (Toggle – Type)

1. Single Pole Switches – 20 Amp at 277V

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Toggle Type</th>
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<tr>
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<td>#HBL1221</td>
<td>#HBL1221-L</td>
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<tr>
<td>Legrand/P&amp;S</td>
<td>#20AC1</td>
<td>#20AC1-L</td>
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<tr>
<td>Leviton</td>
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<td>#1221-L</td>
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<tr>
<td>Cooper-Arrow/Hart</td>
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2. Double Pole Switch – 20 Amp at 277V

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<tr>
<td>Legrand/P&amp;S</td>
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<td>Leviton</td>
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<td>Cooper-Arrow/Hart</td>
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3. Three-Way Switches – 20 Amp at 277V

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<tbody>
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4. Four-Way Switches – 20 Amp at 277V

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<tr>
<td>Legrand/P&amp;S</td>
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<td>#20AC4-L</td>
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<tr>
<td>Leviton</td>
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<tr>
<td>Cooper-Arrow/Hart</td>
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<td>#AH1224-L</td>
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5. Momentary Contact Switches – 20 Amp at 277V

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<tr>
<th>Manufacturer</th>
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<td>Legrand/P&amp;S</td>
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<td>Leviton</td>
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<tr>
<td>Cooper-Arrow/Hart</td>
<td>#AH (extra)</td>
<td>#AH (extra)</td>
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6. Maintained Contact Switches (Double Throw, Center Off) – 20 Amp at 277V

<table>
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<tr>
<th>Manufacturer</th>
<th>1-Pole</th>
<th>2-Pole</th>
<th>1-Pole</th>
<th>2-Pole</th>
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<tbody>
<tr>
<td>Legrand/P&amp;S</td>
<td>#1225</td>
<td>#1226</td>
<td>#12250L</td>
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</table>
7. Pilot lights used in conjunction with circuit switches shall be LED type with red jewel.

C. Switches – Shall be Decorator (“Rocker” type operations) Style, for residential locations only.
1. 120 volt 60Hz AC, rated 15 ampere for lighting loads and rated 20 ampere for non-lighting loads, unless indicated otherwise on Drawings.
2. Single Pole Switches
   Manufacturer  | Rocker Type
   Legrand/P&S  | #TM870
   Hubbell  | #RSD115
   Leviton  | #5621-2
   Cooper-Arrow/Hart  | #7501
3. Double Pole Switch
   Manufacturer  | Rocker Type
   Legrand/P&S  | Hubbell  | #RSD215
   Leviton  | #5622-2
   Cooper-Arrow/Hart  | #7502(extra)
4. Three-Way Switches
   Manufacturer  | Rocker Type
   Legrand/P&S  | #TM873
   Hubbell  | #RSD315
   Leviton  | #5623-2
   Cooper-Arrow/Hart  | #7503
5. Four-Way Switches
   Manufacturer  | Rocker Type
   Legrand/P&S  | #TM874
   Hubbell  | #RSD415
   Leviton  | #5624-2
   Cooper-Arrow/Hart  | #7504
6. Momentary Contact Switches
   Manufacturer  | 3-Position Regular
   Legrand/P&S  | #TM870(extra)
   Hubbell  | #RSD(extra)
   Leviton  | #5624-2
   Cooper-Arrow/Hart  | #7521
7. Maintained Contact Switches (Double Throw, Center Off).
   Manufacturer  | 1-Pole 2-Pole
   Leviton  | #5685-2 #5686-2
8. Pilot lights used in conjunction with circuit switches shall be LED type with red jewel.

D. Weather-Proof (W.P.) Switches
1. Outdoor switches provide heavy-duty, tamper resistant gasketed weather proof metal, hinged door cover for each switch.
2. Cover door shall be key locking-type or padlock-type.
E. Other Switches, Receptacles, Devices, and Outlets
   1. Special devices outlets and outlet locations shall be as indicated on the Drawings. Modify device and outlet characteristics to accommodate the actual install location conditions for each outlet.

2.04 ELECTRIC RECEPTACLE WIRING DEVICES

A. General
   1. All receptacle wiring devices in flush type outlet boxes shall be installed with a bonding jumper to connect the box to the receptacle ground terminal. Grounding through the receptacle mounting straps is not acceptable. The bonding jumper shall be sized in accordance with the branch circuit protective device as tabulated herein under "Grounding". Bonding jumper shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws 6-32 or larger (except isolated ground receptacles). For receptacles in surface mounted outlet boxes direct metal-to-metal contact between receptacle mounting strap (if it is connected to the grounding contacts) and outlet box may be used. Receptacle mounting-ears for screw attachment to outlet box. Receptacle shall be UL listed and labeled; conform to NEMA-WD1 and WD6.
   2. All receptacles shall be a product of the same Manufacturer.
   3. Receptacle color as selected by OWNER’S Representative. Receptacles connected to emergency power circuits shall be red.
   4. Tamper Resistant Receptacle
      a. Devices shall additionally be listed and labeled as tamper resistant, provide tamper resistant receptacles in buildings containing: dormitories, guestrooms, condominiums, housing/residences, apartments, dwellings, hotels/motels, classrooms, secondary schools K through 12th grade, childcare/day-care/kindergarten, hospital pediatric-care units and other locations required by AHJ.
      b. The electrical receptacles shall be rated “Tamper-Resistant-Receptacle” (TR), UL-TR (RTRT). Spring loaded shutters shall automatically open-close (unblock-block) the receptacle slots, when the plug-in (cap) insertion and removal occurs.
      c. Typical for 15-ampere and 20-ampere receptacles. Modify Manufacturer’s catalog number description to include tamper resistant receptacle function.
   5. Wiring devices shall be listed and labeled for connection of both “solid” and “stranded” copper circuit conductors.
   6. Duplex convenience receptacles and 120-volt single phase branch circuits.
      a. Duplex (convenience) receptacle, wiring device with two single receptacles with the same electrical rating, integrated into a single assembly by the Manufacturer.
      b. 20-ampere branch circuits with a single duplex convenience receptacle connection on each circuit, receptacles shall be rated for 20-ampere.
      c. 15-ampere and 20-ampere branch circuits with two or more duplex convenience receptacle connections each circuit, receptacle shall be rated 15-ampere or 20-ampere.
   7. Devices shall additionally be listed and labeled as UL-All Weather-Resistant, provide weather resistant receptacles for the following install locations. Modify Manufacturer’s catalog number descriptions, shall include all-weather-resistant UL listing and labeling:
      a. Devices indicated on Drawings as Weather-Proof (W.P.).
      b. Devices installed in outdoor locations.
c. Devices installed in classified as damp or wet locations both indoor and outdoor.
d. All GFCI (ground-fault) receptacles all locations.

8. Receptacles with ampere and voltage ratings different than described for duplex convenience receptacles. The different rated receptacles shall have the same characteristics and performance as the respective duplex convenience receptacles, except for differing ampere and voltage characteristics. Refer to “Floor Boxes” for additional receptacle requirements.

9. Receptacles shall be GFCI type for the following locations:
a. located within 84-inches of a sink or hosebib shall be GFCI receptacles.
b. Devices installed in outdoor locations.
c. Devices installed in classified as damp or wet locations both indoor and outdoor.
d. Devices indicated on Drawings as GFCI or Weather-Proof (W.P.).

10. “Split-wire” duplex convenience receptacles. Each split-wire receptacle plug connects on independent common circuit. Provide nameplate or graphic on face of receptacle describing the receptacle function and control source. Comply with California Title-24 and ASHRAE-90.1, latest revisions.

B. Duplex convenience receptacles.
1. Shall be grounding type, 120 volt and shall have two current carrying contacts and one grounding contact which are internally connected to the frame. Outlet shall accommodate standard parallel blade cap and shall be side wired. Receptacles shall be tamper resistant–TR, UL-TR.
2. GFCI receptacles shall be all Weather-Resistant and wet location rated. Duplex, rated 120 volt 60Hz AC, 20 ampere, unless indicated otherwise on Drawings.
3. Heavy Duty Industrial Grade
Manufacturer NEMA 5-15R NEMA 5-20R NEMA 5-20R-GFCI
Legrand/P&S . . . #5262 . . . #5362 . . . #2095HG
Leviton . . . #5262 . . . #5362 . . . #W7899
Hubbell . . . #CR5252 . . . #5362 . . . #GFR8300
Cooper-Arrow/Hart . #AH5262 . . . #AH5362 . . . #WFRVG20

C. Isolated Ground Receptacles-IGR
1. The receptacle insulation barrier shall isolate the receptacle ground contact system from ground. Connect the ground plug contact to a separate dedicated insulated ground-bonding conductor. The receptacle ground plug contact shall not be grounded to the raceway or outlet box. Isolated ground duplex convenience receptacle 20-ampere minimum, with two (2) current carrying contacts and one grounding contact, or as noted on the Drawings.
2. High-abuse, heavy-duty industrial grade, NEMA 5-20R, duplex convenience receptacles.
3. Identify receptacle with an orange triangle on the receptacle face and orange receptacle body. Red body for receptacles connected to emergency power.
Manufacturer NEMA 5-20R
Legrand/P&S . #IG6300
Leviton . . . #5362IG
Hubbell . . . #CR5352IG
Cooper-Arrow/Hart . . . #IG5362
D. Hospital Grade Duplex Convenience Receptacles
1. Receptacles shall be Underwriters Laboratories listed hospital high abuse, heavy-duty rated grade.
2. Duplex convenience receptacles shall be grounding type 120 volt with two current carrying contacts and one grounding contact which is internally connected to the frame. Outlets shall accommodate standard parallel blade cap and is side wired.
3. Ground Fault Circuit Interrupter (GFCI or GFI) 20-ampere duplex convenience receptacles with test-reset buttons and visual pilot. Shall be all Weather-Resistant and wet location rated.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>NEMA5-15R</th>
<th>NEMA5-20R</th>
<th>NEMA5-20R-GFCI</th>
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<tbody>
<tr>
<td>Legrand/P&amp;S</td>
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<td>Cooper-Arrow/Hart</td>
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<td>#TRVGFH20</td>
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</tbody>
</table>

E. Weather Proof (W.P.) Receptacle
1. Outdoor receptacles shall be duplex convenience GFCI type rated 20-ampere 120 Volt 60Hz AC weatherproof, GFCI, unless indicated otherwise on Drawings. Test-reset buttons and visual pilot.
2. GFCI receptacles shall be wet location and Weather-Resistant rated weatherproof, gasketed, key locking tamper resistant, wet location.
3. Outdoor, flush mount outlet with hinged, key-locking, weather-proof cover (CEC/NEC – 406.8 compliant). As manufactured by Pass and Seymour/Legrand #4600 Series; or C.W. Cole #310 Series.
4. On exposed conduit runs, provide weatherproof ground fault circuit interrupter type GFCI receptacles installed in "FS" conduit water tight cast metal body, with weather-proof spring door type covers, gasket water tight. Door shall be key locking-type or padlock-type.

F. Duplex convenience receptacles, for residential locations only.
1. Receptacles shall be “Decorator” type, grounding type, 120 volt, 60Hz AC, and shall have two current carrying contacts and one grounding contact which are internally connected to the frame.
2. Outlet shall accommodate standard parallel blade cap and shall be side wired.
3. GFCI receptacles shall provide test-reset buttons and visual pilot. Rated 120 volt 60Hz AC, unless indicated otherwise on Drawings. GFCI receptacles shall be wet location and all Weather-Resistant rated.
4. Tamper Resistant Receptacles
   a. All the electrical receptacles shall be rated “Tamper Resistant Receptacles” for 120 volt, 15-ampere and 20-ampere (TR), UL-TR (RTRT). Spring-loaded shutters shall automatically open-close (unblock-block) the receptacles slots, when the plug-in (cap) insertion and removal occurs.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>NEMA 5-15R</th>
<th>NEMA 5-20R</th>
<th>NEMA 5-20R-GFCI</th>
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<td>Legrand/P&amp;S</td>
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<td>Cooper-Arrow/Hart</td>
<td>#TR1107</td>
<td>#TR6350</td>
<td>#TWRVG20</td>
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</table>
G. Other Switches, Receptacles, Devices, and Outlets.
1. Special devices, outlets and outlet locations shall be as indicated on the Drawings. Modify device and outlet characteristics to accommodate the actual install location conditions for each outlet.

2.05 PLATES

A. Metal Cover Plates for Devices
1. Provide cover plates for every line voltage and low voltage switch, receptacle, telephone, computer, television, signal and other device outlets.
   a. All line voltage circuit plates shall be metal, 0.040-inch stainless steel Type 302 alloy, composed of 18% chromium and 8% nickel.
   b. Plates for low voltage signal systems may be metal or non-metal. Non-metal plates shall be high-abuse, hard-service and high-impact resistant.
2. Plates shall be as manufactured by P&S; or Hubbell; or Leviton; or General Electric.

B. Residential Location Project non-metal cover plates for line voltage and low voltage devices.
1. Provide plates for every line voltage and low voltage switch, receptacle, telephone, computer, television, signal and other device outlets. Non-metal, heavy-duty, high-abuse and high-impact resistant plates.
2. Plates shall be same Manufacturer as the respective wiring device.

2.06 VANDAL-PROOF FASTENINGS

Provide approved vandal-proof type screws, bolts, nuts where exposed to sight throughout the Project. Screws for such items as switch plates, receptacle plates, fixtures, communications equipment, fire alarm, blank covers, wall and ceiling plates to be spanner head stainless steel, tamperproof type. Provide OWNER with six screwdrivers for this type.

2.07 STRUCTURAL AND MISCELLANEOUS STEEL

Structural and miscellaneous steel used in connection with electrical work and located out-of-doors or in damp locations, shall be hot-dip galvanized unless otherwise specified. Included are underground pull box covers and similar electrical items. Galvanizing averages 2.0 ounce per square foot and conforms to ASTM A123.

2.08 FLASHING ASSEMBLIES

A. General
1. Flashing shall be compatible with the material being penetrated and with the pipe passing through the flashing. Coordinate with and comply with Manufacturer's recommendations, for both the flashing and the material being penetrated.
2. Provide lead metal flashing assemblies at all roof penetrations, unless recommended otherwise by Manufacturer.
3. Seal the joint between the flashing and pipe passing through the flashing with waterproofing compound.
4. Lead flashing for roof penetrations, as manufactured by: Santa Rosa Lead Products; or Semco; or Flashco.
B. Storm Collars
   1. In addition to penetration flashing, provide a storm-collar counter-flashing for each roof penetration flashing. Shall attach to the structure of the penetration and form a water-tight “umbrella” counter flashing over the roof penetration flashing.
   2. As manufactured by: STD-Storm collars; or ASI-Storm collars.

2.09 RELAYS, CONTACTORS, AND TIMESWITCHES

A. Individual Control Relays (HVAC Plumbing of the Control Functions)
   1. Individual control relays shall have convertible contacts rated a minimum of 10 amperes, 600 volts regardless of usage voltage. Coil voltage, number and type of contacts shall be verified and supplied to suit the specific usage as shown in the wiring diagrams and/or schedules on the Electrical and Mechanical Drawings. Coil control circuit shall be independently fused, sized to protect coil. Relays shall be installed on prefabricated mounting strips. Each relay shall have a surge suppressor to limit coil transient voltages. Furnished in the NEMA Type I enclosure unless indicated otherwise.
   2. The following relays are approved:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooper-Arrow/Hart</td>
<td>IMP</td>
</tr>
<tr>
<td>General Electric</td>
<td>Class CR 2811</td>
</tr>
<tr>
<td>Square D Co.</td>
<td>Class 8501, Type A</td>
</tr>
<tr>
<td>Westinghouse</td>
<td>Bul. 16-321, Type NH</td>
</tr>
<tr>
<td>Allen Bradley</td>
<td>Approved Equal</td>
</tr>
</tbody>
</table>

B. Contactors and/or Relays
   1. Contactors and/or relays for control of lighting shall be 600 volt AC, electrically operated, and mechanically held units, open type for panel mounting with number of poles and of size as indicated on the Drawings. Provide auxiliary control relay for operation of each contactor and/or relay with a 2-wire control circuit.
   2. Contactors and/or relays shall be mounted in panelboards in barriered section under separate hinged lockable doors or in contactor and/or relay cabinets as called for on the Drawings. Contactors and/or relays shall be installed on Lord sound absorbing rubber mounts.
   3. Contactors and/or relays shall be Automatic Switch Co. Bulletin #920 Series for 2-pole and 3-pole, Automatic Switch Co. Bulletin 917 Series with poles as indicated on Drawings. Coil control circuit shall be independently fused, sized to protect coil.
   4. Contactors and/or relays shall be equipped with a switch, in the proper configuration, to disconnect the control circuit controlling the coil of the respective device. Control circuit disconnect switch shall be labeled showing function of device.

C. Time-Switches
   1. All timeswitches shall have synchronous motor drive for operation on 120 or 277 volts, 60Hz, AC and shall be furnished with a 10-hour, spring-driven, reserve-power motor. Contacts shall be rated 40A per pole.
      a. Exterior lighting timeswitches for control of individual circuits or electrically operated relays shall have astronomic dial and shall be Tork 7000ZL Series or approved equal by Paragon or Intermatic.
b. Interior lighting timeswitches for control of individual circuits or electrically operated relays shall be Tork 7000 Series or approved equal by Paragon or Intermatic.

c. Timeswitches for control of air conditioning or plumbing equipment shall have seven day dial and shall be Tork WL Series or approved equal by Paragon or Intermatic.

2. All timeswitches shall be mounted in separate section in top of panelboards under separate lockable door unless otherwise indicated on Drawings. Clear opening for timeswitch shall be a minimum of 12-inches by 12-inches.

D. Contactors and/or Relays/Timeswitch Cabinet

1. Contactors, relays, and/or timeswitches not indicated to be mounted in electrical panels shall be mounted in a cabinet, size as required, with hinged lockable door keyed same as panelboards. Construction of cabinet shall be similar to terminal cabinets.

2. Each contactor, relay or timeswitch mounted in the contactor cabinet shall be barriered in its own compartment, and shall be installed on Lord sound absorbing mounts.

3. Contactor cabinets shall be of the same Manufacturer as the panelboards.

4. Where relays and/or contactors occupy the same enclosure as timeswitches they shall have a clear acrylic shield installed over each relay or contactor to guard line exposed parts from accidental contact by nonauthorized personnel.

2.10 DISCONNECTS (SAFETY SWITCHES)

A. General

1. Disconnect switches shall all be rated:
   a. 600 volt 60Hz AC for all disconnect safety switches.
   b. NEMA Type HD, quick-make, quick-break, H.P.-rated.
   c. Fused Class "R", in NEMA Type I indoor location enclosure. Where enclosure is indicated outdoor or W.P. (Weather-Proof) switches shall be rain tight NEMA 3R enclosure. Lockable access door.
   d. Number of poles horse power rating and amperage as indicated on the Drawings.

2. Provide internal neutral bus, ground-lug and conductor landing lugs, size to match conductors shown on Drawings. Switch access door shall be interlocked with switch to prevent access inside switch when switch is “on” closed position.

3. Maximum voltage, current and horsepower rating clearly marked on the switch enclosure and switches having dual element fuses shall have rating indicated on the nameplate.

4. Disconnect switch and fuses ampere rating shall also comply with Manufacturer’s recommendation for the connected load.

2.11 SPARE FUSE CABINETS

Provide a cabinet in each room where a switchboard or motor control center is installed and contains fuses. Cabinets shall be as specified for "Terminal Cabinets" and shall be of sufficient size to contain all spare fuses hereinbefore specified. Provide clips (two (2) per fuse) for each spare fuse. Mount clips in plywood backboard in cabinet. Label cabinet "SPARE FUSES".

BASIC ELECTRICAL MATERIALS AND METHODS

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### 2.12 CONCRETE WORK (ADDITIONAL REQUIREMENTS)

A. Portland Cement
   1. ASTM C33-(latest revision), Type II, Low Alkali Cement. Composed of Portland cement, coarse aggregate, fine aggregate, and water.
      a. Concrete for use as electrical equipment footings, lighting pole bases and equipment slabs on grade, concrete shall attain minimum 28-day compressive strength of 4000psi, using not less than 5.75 sacks of cement per cubic yard of wet concrete.
      b. Concrete for underground duct/conduit encasement, the minimum 28-day compressive strength shall be 2000 psi. Provide a minimum of 10-pounds of red oxide concrete coloring per yard of concrete.
      c. Mix shall obtain a 6-inches slump, measured with standard slump cone per ASTM C143/C143M (latest revision).

2. Coarse Aggregate: Uniformly graded between maximum size not over 1½-inch and not less than 0.75-inch and minimum size #4, crushed rock or washed gravel. For concrete encased conduit only, maximum aggregate size shall be ⅝-inch.

3. Fine Aggregate: Clean, natural washed sand of hard and durable particles varying from fine to particles passing ⅜-inch screen, of which at least 12% shall pass fifty mesh screens.

B. Water: Clean and free from deleterious quantities of acids, alkalis, salts, or organic materials.

C. Reinforcement
   1. Bars: Intermediate Grade Steel conforming to ASTM A615/A615M grade 60, with pattern deformations.
   2. Welded Wire Fabric: ASTM A185/A185M.
   3. Bending: Conform to requirements of ACI 318.

D. Form Material: For exposed work, use PS 1-66 "B-B Concrete Form" plywood forms, or equal. Elsewhere, forms may be plywood, metal, or 1-inch by 6-inch boards. Forms for round lighting pole bases shall be sono-tube.

### 2.13 TRANSIENT VOLTAGE SURGE PROTECTOR (TVSS) – DIRECT CONNECT

A. General
   1. The unit shall be modular in construction and operate in parallel with 60Hz AC line voltage, 4-wire or 5-wire, grounded or ungrounded systems, as applicable; voltage, kVA and ampere capacity as indicated on the Drawings. Suitable for direct connection through an external circuit breaker or combination switch/fuse protective device rated 30-ampere, continuous duty, rated for Service Entrance equipment connection. Transient electrical surge protection sequences shall include circuit configurations as follows:
      a. Line-to-Line (Phase-to-Phase).
      b. Line-to-Ground (Phase-to-Ground).
      c. Line-to-Neutral, where neutral is present.
      d. Ground-to-Neutral, where neutral is present.
   2. The unit shall operate correctly with any combination of resistive, inductive, or capacitate loads. The unit shall automatically shunt to ground the electrical transients and EMI/RFI noise occurring above the specified values. The unit shall automatically reset after transient condition has passed. Operating temperature minus 40°C centigrade to plus 85°C centigrade.
3. Provide one or more individual self-contained protection module(s) for each line voltage phase, ground and neutral, suitable for direct connect with line-side C/B protection and disconnect. Provide one spare individual plug-in protection module. Provide incoming line, neutral and ground conductor termination lugs rated CU/AL #14 through #4 AWG. Lugs shall be barriered from and prewired to the respective protection modules.

4. Provide a NEMA twelve housing to contain all unit modules, devices and conductor terminations. The housing shall include a hinged pad-lockable access door.
   a. Flush housing for mounting internally inside related equipment.
   b. Surface mounted, with conduit entrance knockouts for external mounting. Maximum housing size shall not exceed 36-inches wide by 72-inches high by 8-inches deep.

5. As manufactured by Total Protection Solutions Model #ST-TVSS; or MCG Electronics; or Advantage Protection Technologies, Inc.

B. Operational Characteristics

1. Transient voltage protection, testing, listing and certification.
   a. UL 1449 (latest edition) and CSA listed and labeling, for Transient Voltage Surge Supresser, UL 1283 for transient voltage electrical noise attenuation, ANSI/IEEE C62.45, C62.1 for C62.41, (latest edition) bi-directional transient clamping voltages for both Normal Mode and Common Modes against Category A and B ring wave and Category B impulse wave.
   b. The unit connected to the service entrance shall also withstand a minimum of two thousand (2000) sequential ANSI/IEEE C62.41 Category C surges without failure following IEEE Test procedures in C62.1, C62.41 and C62.45.

2. Transient voltage protection, EMI noise rejection, and RFI noise rejection shall be provided for Common Mode (line-to-neutral and line-to-ground), Normal Mode (line-to-line) and neutral to ground.

3. EMI and RFI noise rejection.
   Conducted line noises interference both Electromagnetic (EMI) and Radio Frequency (RFI) shall be reduced by the unit over a continuous spectrum of 0.5MHz to 1.0MHz. The basis for reduction shall be a standarized 50-OHM insertion loss MIL-STD-220A test. Provide Spectrum Analysis Test dB attenuation reports showing RFI filtering over specified frequencies. Test data based on calculated or computer simulation is not acceptable.

4. Three phase and grounded "WYE" performance requirements.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>208/120 Volt</th>
<th>480/277 Volt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal line-to-line</td>
<td>208 Volt</td>
<td>480 Volt</td>
</tr>
<tr>
<td>Nominal line-to-neutral</td>
<td>120 Volt</td>
<td>277 Volt</td>
</tr>
<tr>
<td>Internal capacitance (Microfarads)</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>Maximum response time</td>
<td>1-nanosecond</td>
<td>1-nanosecond</td>
</tr>
<tr>
<td>EMI/RFI noise rejection</td>
<td>25-35dB</td>
<td>25-35-dB</td>
</tr>
<tr>
<td>Nominal peak clamp voltage</td>
<td>500 Volts</td>
<td>900 Volts</td>
</tr>
<tr>
<td>and line-to-ground</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum transient energy dissipation per phase (at 8x20 microseconds waveform)</td>
<td>1000 Joules</td>
<td>1500 Joules</td>
</tr>
<tr>
<td>Peak transient withstand (at 8x20 microseconds waveform) without failure of the unit</td>
<td>50,000 Amp</td>
<td>60,000 Amp</td>
</tr>
<tr>
<td>• Category-C3</td>
<td>300,000 Amp</td>
<td>500,000 Amp</td>
</tr>
<tr>
<td>• Category-B3</td>
<td>100,000 Amp</td>
<td>150,000 Amp</td>
</tr>
</tbody>
</table>
C. Diagnostic Indicators
   1. Shall display the "Normal" and "Fault" status of each line suppression circuit, along with protection circuit "on" indication.
   2. Shall provide a sonic audible fault alarm with silence push-button.

D. SurgeSuppressorProtectionCategories
   1. Surge protectors shall comply with ANSI C62.41 (Latest Revision) Standard Protection Categories for "impulse" and "ringwave" transients, based on the installation locations shown in the Contract Documents.
      a. Service entrance, main switchboard or substation locations - Category "C3", high exposure, Type-1.
      b. Mid building, distribution panels, distribution panels over 400-ampere main bus rating locations - Category "B3", high exposure, Type-1.
      c. Branch circuit panelboards 400-ampere or less main bus rating - Category "A3", high exposure, Type-1.
   2. The TVSS short circuit current withstand rating shall exceed the actual short circuit current available at the TVSS installation location.

2.14 PLUG STRIP TRANSIENT VOLTAGE SURGE SUPPRESSOR

A. General:
   1. Point-of-Use Type-3 self-contained unit rated 15-ampere, nominal 120 volt plus-or-minus 10%, 60Hz, AC, 1875 watts full continuous load. Internal 15 ampere resettable overload protection circuit breaker. Red illuminated on-off switch. 6-foot, 14 AWG 3-conductor, grounded, heavy duty jacketed AC line cord with NEMA 5-15 cap. Multi-outlet receptacles, suitable for use with the following types of plug in loads, data processing equipment, audio/video equipment, test instruments, medical equipment, photo graphic equipment and "switching type" power supplies.
   2. Protected outlets shall be NEMA 5-15R 15-ampere, AC 60Hz receptacles. Provide 4 protected outlet plugs on each plug strip, as indicated on the Drawings. Each group of two receptacles (duplex) shall be connected to separate protected load isolated filter banks. Each duplex shall be isolated from the other output receptacles, minimum isolation of 25dB at 1MHz line to line, line to neutral, line to ground and neutral to ground.
   4. As manufactured by TRIPP LITE-Isobar Series; or Advanced Protection Technologies; or equal.

B. Operation:
   Self-contained RFI and EMF shielded housing with mounting slots for temporary mounting of the unit. Protected outlet receptacles shall supply filtered, electrical line voltage power to the connected equipment. Line noise RFI and EMI interference filtering suppression, transient voltage surge and spike protection shall occur in all three modes of operation line to ground, line to neutral and neutral to ground rated as follows:
   1. 13,000-ampere, 210 joules (watt-seconds) peak withstands capacity.
   2. Transient response time less than 5-nano seconds.
   3. 140-volt AC RMS initiate spikes suppression 330 volt maximum let through.

NURSING FACILITIES INTERIM HOUSING
RIO HONDO COLLEGE
RIO HONDO COMMUNITY COLLEGE DISTRICT

• Category-A3
  60,000 Amp
  80,000 Amp
4. RFI and EMI Suppression—Provide Spectrum Analysis Test dB attenuation reports showing RFI filtering over specified frequencies.
   - 50KHz greater than 20dB
   - 150KHz greater than 40dB
   - 1MHz greater than 80dB

5. Diagnostic indicator lights located on the TVSS housing shall provide alarm alert for each of the following conditions:
   a. Loss of AC power.
   b. Damage, malfunction in the TVSS suppression circuits.
   c. Improper AC electrical outlet wiring.

6. Standards Testing, Listing, Labeling and Certification Compliance, latest revisions:
   a. IEEE 587 A and B compliance.
   b. UL 1449 transient voltage surge suppressers.
   c. UL 1363 temporary power taps.
   d. UL 1283 electromagnetic interference filters.

C. Rack Mounted TVSS
   1. TVSS units installed in equipment racks shall comply with all of the same performance requirements, except as follows.
      a. EIA/TIA – Equipment rack mount style (19-inches or 24-inches as applicable).
      b. Minimum of two front mounted receptacle outlets and not less than six rear mounted receptacle outlets.
      c. 20 ampere 120 volt 60Hz AC electric circuit rating, instead of 15 ampere.

2.15 WIREWAY

A. General:
   1. Unobstructed lay in type, metal wireway, fittings and connectors UL listed for use as wireway and auxiliary gutter. Length, elbows and "T-S" as shown on Drawings. Minimum cross-section size 4-inches by 4-inches, but not less than shown on the Drawings. Suitable for mounting in any position orientation.

B. Construction:
   1. Minimum metal gauge shall not be less than 14 gage.
   2. Cover shall be hinged entire length of cover. Cover shall be held in the closed position with bolts and nuts.
   3. Provide spring nuts on all hardware fastener penetrations into the interior of the wireway to protect against wire insulation damage.
   4. The inside of 90-degree corners in the wireway shall be a 45-degree bevel.
   5. Grounding continuity between wireway sections and fittings shall be continuous the entire length of the wireway.

C. Finish:
   1. Indoor non-raintight, rust inhibitor phosphatizing base coating and baked enamel finish, Manufacturer's standard color.
   2. Raintight outdoor-galvanized metal, with corrosion resistant phosphate primer and baked enamel finish, Manufacturer's standard color, NEMA 3R construction.
   3. All hardware shall be plated to prevent corrosion.
PART 3 - EXECUTION

3.01 GROUNDING (ADDITIONAL REQUIREMENTS)

A. Grounding shall be executed in accordance with all applicable Codes and Regulations, both of the State of California and Local Authorities Having Jurisdiction.

B. Each pull box or any other enclosure in which several ground wires are terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

C. The Maximum Resistance to Ground shall not exceed 5 ohms.

3.02 OUTLET AND JUNCTION BOXES

A. General:
   1. Accurately place boxes and securely fastens to structural members. Where outlets are shown at same location but at different mounting heights, install outlets in one vertical line. Where outlets are shown at same location and mounting height, mount outlets as close together in a horizontal row as possible. Where the outlet boxes for switches and receptacles are shown at the same location and mounting height, mount in common outlet box with barriers between devices. Provide single piece multi-gang cover plate for close mounted outlet boxes. Where switches are shown on wall adjacent to hinge side of doors, box shall be installed to clear door when door is fully opened.
   2. Flush mounted boxes shall be attached to not less than two parallel studs or structure members by means of metal supports. The supports shall span between and attach to the structure members.
   3. Boxes above accessible ceilings shall be attached to structural members. Where boxes are suspended, they shall be supported independently of conduit system by means of hanger rods and/or preformed steel channels. Boxes shall be supported independently of all piping, ductwork, equipment, ceiling hanger wires and suspended ceiling grid system.
   4. Surface mounted outlets shall be attached to concrete or masonry walls by means of expansion shields.
   5. Floor boxes shall be installed level with finish floor and within adjustable limits of floor ring. Where outlets are shown at same or adjacent location, use multi-gang boxes.
      a. Provide cut-outs in the sub-floor assembly, to accept the recess depth of each electrical floor box. Provide added “fire-proof” applications on the bottom of each floor box location extending through the sub-floor. The “fire-proof” application shall be equal to the floor fire-assembly withstand rating.
      b. Poke-thru floor outlets, core drill floor for installation of poke-thru. Install “split-box” in the ceiling space of the floor below. If the ceiling space of the floor below is not accessible ceiling type (lift-out), then provide 12-inches round removable fire-rated stainless steel access panel and trim-ring in the finish ceiling for hand-access to poke-thru “split-box” above the ceiling.
6. Outlet Box Horizontal and Vertical Separation: Outlet boxes and device outlet rings installed flush in walls shall be horizontally and vertically separated by not less than 24-inches (edge of box to edge of box) from device outlet boxes and rings in common wall surfaces located on the opposite (back) side of the same wall.
   a. Where the separation cannot be maintained, provide a solid backing behind and completely enclosing each outlet box.
   b. The backing shall extend the width of the wall cavity (i.e., between "studs" or masonry cells) behind the box and 12-inches above and below the outlet box centerline, completely enclosing the outlet box.
   c. The backing shall consist of the following:
      1) ⅝-inch thick gypsum board anchored in place for "stud" wall construction.
      2) Solid "mortar" to completely fill the outlet box "cell" behind the box in masonry construction.

7. Provide metal outlet box for each device. Install devices in metal outlet boxes. Typical for all wiring devices including, switches, receptacles, line voltage devices, and low voltage/signal system devices.

B. Fire Wrap:
   1. In fire rated walls and ceilings provide fire rated "box-wrap" around the outside of each outlet box placed in fire rated wall or ceiling. Install the fire wrap on exterior of box inside the wall or ceiling, to maintain the fire rating of wall or ceiling with the installed outlet boxes.

3.03 SWITCHES AND RECEPTACLES-DEVICES

A. General
   1. Provide outlet boxes for all devices, switches, receptacles, both line-voltage and low-voltage.
   2. Devices installed in wireways shall be installed flush in wireway assembly.
   3. Install and screw attach devices into outlet boxes and wireways.
   4. Provide ground circuit connections to all devices.
   5. Provide branch circuit connections to all devices.
   6. Provide testing and commissioning for proper operation and phase/ground connectors.
      a. Test each GFCI devices and ARC-Fault devices after installation and circuit connection is complete.
      b. Test all devices for correct polarity and proper electrical energization.
      c. Test On-Off operation of automatically controlled outlets and receptacles.
   7. Install and adjust all coverplates to be flush and level, with correct device and circuit identification.
   8. Were one or more device occurs at the proximity with other similar devices, all of the devices shall be "ganged" under one common coverplate as follows:
      a. Duplex convenience receptacles with other proximity (within 18-inches) duplex convenience receptacles.
      b. Lighting control switches not exceeding 20-ampere switch rating with other proximity (within 18-inches) similar switches.

B. Line-voltage Plug-In Type Receptacle Installation Orientation:
   1. The "ground-pin" shall face "up" at the receptacle top location (double duplex) 4-plex, individual and vertically mounted individual duplex receptacles.
2. The “neutral-blade” shall face “up” at the receptacle top location on horizontally mounted duplex receptacles.

3.04 CONCRETE WORK

A. Form:
1. Space forms properly with spreaders and securely tie together. Do not use twisted wire form ties. Keep forms wet to prevent joints from opening up before concrete is placed. Replace improper construction as directed. Do not use wood inside forms.
2. Build in and set all anchors, dowels, bolts, sleeves, iron frames, expansion joints and other materials required for the Electrical Work. Place all items carefully, true, straight, plumb, and even.
3. Carefully remove all exposed forms. Cut nails and tie wires below face of concrete and fill all holes. Rubbish will not be allowed to remain in, under, or around concrete.

B. Mixing: Use batch machine mixer of approved type. After ingredients are in mixer, mix for at least 1½-minutes.

C. Transit Mixing: In lieu of mixing at site, transit mixing may be used if rate of delivery, haul time, mixing time, and hopper capacity is such that concrete delivered will be placed in forms within 90-minutes from time of introduction of cement and water to mixer.

D. Placing of Concrete
1. Before placing concrete, remove wood, rubbish, vegetable matter and loose material from inside forms. Thoroughly wet down wood forms to close joints.
2. Clean reinforcement; remove paint, loose rust, scale and foreign material. Bars with bends not called for will be rejected. Hold securely in place to prevent displacement. Lap bar splices 24-diameters, min; lap fabric one mesh min. Tie intersections, corners, splices with 16-gallon annealed wire, or as otherwise called for.
3. Place concrete immediately after mixing. Do not use concrete that has begun to set; no tempering will be allowed. If chuting is used, avoid segregation. In placing new concrete against existing concrete, use bonding agent per Manufacturer's directions.
4. Give careful and thorough attention to curing of concrete. Keep concrete and forms wet for a minimum of 10-days, after placing concrete.

E. Concrete Finish
1. Finish of Exposed Concrete: Horizontal surfaces, steel troweled monolithic finish; vertical surfaces, smooth and free of fins, holes, projection, etc.
2. Exposed lighting pole bases shall be filled and sack finished to a smooth finish.
3. Remove concrete pour-forms.

3.05 TRANSIENT SURGE PROTECTOR INSTALLATION (TVSS)

A. Direct connect TVSS Installation
1. Install unit cabinet to insure a maximum connected circuit length of less than 5-feet from the equipment the transient surge unit is connected to, approximately plus 48-inches on wall.
2. Alternately, factory install TVSS unit directly into respective equipment, instead of remote from equipment. Install TVSS inside respective switchgear, switchboards, distribution panels, panelboards, etc.

3. Connect between transient surge unit and supply equipment with not less than 1.25-inch conduit containing 5#4 AWG, copper conductor, 600 volt THHN/THWN insulation, connection circuit.

4. Provide a subfeed overcurrent protective device in the respective panel or switchboard to supply the TVSS connection circuit, whether or not shown on the Drawings. The protective subfeed device shall be a thermal magnetic circuit breaker rated not less than 30-ampere 3-pole or a safety switch and fuse unit rated not less than 60-ampere 3-pole, voltage and short circuit fault interrupting class to match the respective circuit voltage.

5. Connect transient surge unit to main building ground bus or electric distribution equipment ground bus (whichever is closer distance), with 1.25-inch conduit - 1#4 AWG copper conductor 600 volt, THHN/THWN insulation.

B. Plug-in type TVSS
   1. Install in respective equipment racks.
   2. Install at respective workstation locations, cabinets and furniture.
   3. Connect to respective equipment and wall electrical outlets.

C. Install, Connect, and Test each TVSS Unit in accordance with Manufacturer's recommendations.

3.06 WIREWAY INSTALLATION

Wireway hangers shall provide clamp type, hanger rod type, direct bolted bracket type from ceiling or walls as indicated on the Drawings and required for field installation locations. Supports shall be installed a minimum of 5-feet on center.

END OF SECTION 26 0505
112316/223037
SECTION 26 0530
CONDUIT AND WIRE

PART 1 – GENERAL
1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all wire, supports, conduit, fittings and splicing materials.

B. Submit material list for all conduit and conduit fittings.

C. Submit details and structural engineering calculations for conduit support systems.

PART 2 - PRODUCTS
2.01 CONDUIT

A. General
   1. The interior surfaces of conduits and fittings shall be continuous and smooth, with a constant interior diameter. Conduits and conduit fittings shall provide conductor raceways of fully enclosed circular cross section. The interior surfaces of conduits and fittings shall be without ridges, burrs irregularities or obstructions. Conduits and fittings of the same type shall be of the same uniform weight and thickness.
   2. Type of conduit, type of conduit fittings and conduit supports shall be suitable for the conditions of use and the conditions of location of installation, based on the Manufacturer’s recommendations and based on applicable Codes.
   3. All fittings for metal conduit shall be suitable for use as a grounding means, pursuant to the applicable code requirements. All metal conduit and metal conduit fittings shall provide 3 second duration ground fault current carrying ratings, when installed and connected to the respective conduit, as follows:
      a. RMC and EMT conduit fittings.
         1) 0.5 inch through 1.5 inch conduit/fitting size - 10,000 ampere RMS.
         2) 2.0 inch and larger conduit/fitting size - 20,000 ampere RMS.
      b. FMC and LTFMC Conduit Fittings
         1) 0.5 inch through 1.25-inch conduit/fitting size-1,000 ampere RMS (without external bonding jumper).
         2) 1.5 inch through 4.0-inch fitting size-10,000 ampere RMS with bonding jumper.
4. Protective corrosion resistant finish for metal conduit fabricated from steel and metal conduit fittings fabricated from steel, shall be as follows:
   a. Clean all metal surfaces (including metal threads) with acid bath “pickle” prior to coating, to remove dirt, oil and prepare surfaces for galvanizing.
   b. Hot-dip galvanized zinc coating on all interior and exterior steel surfaces. Minimum finish zinc coating thickness shall not be less than 0.002 inches.
   c. Threads shall be hot-dip zinc coated after machine fabrication.
   d. Exterior metal surfaces shall be finished with clear organic polymer topcoat layer, after galvanizing.
   e. The inner metal surfaces of conduit fittings shall be finished with a lubricating topcoat after galvanizing, to facilitate conductor pulling through the conduit/fitting.

5. Threads for metal conduit and metal conduit fittings shall be taper-pipe-thread, National Pipe Standards (NPS) and shall comply with ANSI-B1.20.1.

6. Metal conduit termination connector fittings shall be provided with a Manufacturer installed, insulating throat bushing inside the fitting. The bushing shall protect the wire conductor insulation from cutting, nicks and abrasion during conductor installation and electrical load “cycling” after installation is complete. The bushing shall comply with UL 94V-0 flammability.

7. Provide conduit bonding/grounding jumper from metal enclosures with “concentric ring” knockouts, to positively ground/bond each respective conduit(s) to the metal enclosure.

8. Metal conduit fittings connecting to PVC coated metal conduit shall be PVC coated to match the conduit.

9. The conduit and fittings shall be watertight and airtight without cracks and pinholes.

B. Rigid Metal Conduit (RMC)

1. Rigid metal, round tubing, machine threaded at both ends.
   a. The conduit and conduit fittings shall comply with the requirements for an equipment grounding conductor, pursuant to applicable codes.

2. RMC raceway types shall be as follows:
   a. Rigid Galvanized Steel conduit (RGS), minimum yield strength shall be 35,000 PSI. Shall comply with NEMA Standard 5-19 (latest revision); ANSI C80.1 and ANSI C80.4 (latest revision); UL 514-B and UL 6 (latest revisions); National Pipe Standard Specification (latest revision).
   b. Intermediate steel Conduit (IMC). Shall comply with NEMA Standard 5-19 (latest revision) ANSI-C80.6 (latest revision); UL 2142 (latest revision).

3. RMC fittings:
   a. Fittings shall be compatible with RGS and IMC.
   b. Fittings shall be rated “liquid tight”.
   c. Fittings imbedded in concrete shall be rated “liquid tight” and “concrete tight”.
   d. Connectors and couplings for terminating, connecting and coupling to RMC conduit shall be threaded metal.
   e. Fittings shall comply with ANSI C80.4 and ANSI C33-84 (latest revision); NEMA FB1 (latest revision); UL 514 (latest revision).
   f. Conduit seal fittings:
      1) Conduit seals shall prevent the passage of gasses, liquids and vapors past the location of the seal installation in the conduit.
      2) Conduit seals shall be suitable for installation in both vertical and horizontal conduit locations.
3) Conduit seals shall be visible and accessible for inspection after installation is complete.
4) Conduit seals shall be rated for the following locations:
   a) Wet locations
   b) Classified hazardous location materials NEC Class 1 Division 1.
   c) Temperature ranges from 0 degrees centigrade through 90 degrees centigrade.
5) Conduit seals, sealing compound and sealing compound dam shall be the products of the same Manufacturer.

4. RMC fittings as manufactured by:
   a. For threaded enclosure, termination connection.
      1) Thomas & Betts - 106 Series bonding locknut, 5302 series sealing ring with stainless steel retainer.
   b. For non-threaded enclosure, termination connector.
       1) Thomas & Betts - 370 Series watertight threaded sealing hub, 106 series threaded bonding lock nut, Sta-Con Series enclosure bonding jumper and 3870 Series threaded ground bushing.
      2) Emerson-OZ/Gedney-CHMT/CHT watertight threaded hub with bonding locknut and GH50G Series enclosure bonding jumper.
   c. For RMC to RMC conduit-to-conduit coupling
      1) Thomas & Betts/Erickson - 674 (threaded) Series
      2) Emerson-OZ/Gedney Type TPC (threaded) Series
      3) Threaded RMC conduit couplings, product of the same Manufacturer as the RMC conduit.
   d. For RMC Conduit Seals
      1) Emerson-OZ/Gedney-EYA and EYAM (threaded) Series
      2) Appleton-EYF and EYM (threaded) Series

C. Electrical Metallic Tubing (EMT)
   1. Rigid metal round tubing, “thin wall” steel construction, with non-threaded ends.
      a. The conduit and conduit fittings shall comply with the requirements for an equipment grounding conductor pursuant to applicable codes.
      b. The conduit shall be watertight and airtight without cracks and pinholes.
   2. EMT shall be allowed for conduit size ranges from 0.5-inch through 4.0-inches.
   3. Comply with ANSI C80.3, C80.4, and ANSI C33.98 (latest revisions); UL 594 and UL 797 (latest revisions); CEC Section 12500 (latest revision).
   4. EMT fittings:
      a. Connectors and couplings for terminating, connecting and coupling to EMT conduit shall be non-threaded steel fabrication.
      b. EMT termination connector fittings shall be as follows:
         1) Set screw type “concrete tight” when installed in dry interior locations.
         2) Compression types “raintight” and “concrete tight” when installed in wet or damp locations, outdoors and in concrete or masonry construction.
      c. Fittings shall comply with ANSI C33.84 (latest revision); UL 514 (latest revision); NEMA FB-1.
   5. EMT fittings as manufactured by:
      a. For threaded and non-threaded enclosure, termination connector
         1) Thomas & Betts-TC721A (set screw type) Series (with locknuts).
         2) Emerson-OZ/Gedney-TC500I (set screw type) Series (with locknuts).
3) Thomas & Betts-5123 (compression type) Series (with 2 locknuts).
5) Thomas & Betts-4240 (compression type) Series (90 degree angle with locknut).
6) Emerson-OZ/Gedney-TWL (compression type) Series (90 degree angle with locknut).

b. For EMT to EMT conduit-to-conduit coupling:
1) Thomas & Betts-TK121A (set screw type) Series (with locknut).
2) Emerson-OZ/Gedney-5000 (set screw type) Series (with locknut).
3) Thomas & Betts-5120 (compression type) Series.
4) Emerson-OZ/Gedney-TC600 (compression type) Series.

c. For EMT to RMC conduit to conduit combination coupling:
1) Thomas & Betts-HT221 (set screw type) Series.
2) Emerson-OZ/Gedney-ESR (set screw type) Series.
3) Thomas & Betts-530 (compression type) Series.

D. Flexible Metal Conduit (FMC)
1. Round flexible conduit, fabricated from a single continuous steel strip. The steel shall be factory formed into continuous interlocking convolutions to form a complete lock between steel strips and provide raceway flexibility.
2. Metal to metal grounding contact shall be maintained throughout the length of the FMC conduit.
3. FMC shall be allowed for conduit size ranges from 0.5 inch through 4.0-inches.
4. FMC shall comply with ANSI-C.33.84 and ANSI C33.92; NEMA FB-1; CEC 12-1100.
5. FMC Fittings
   a. FMC fittings shall be malleable iron construction or steel construction.
   b. Fitting shall automatically cause the FMC raceway throat opening to be centered with respect to the fitting throat opening.
   c. Straight and angled connector termination fittings shall be threaded on one end and shall include a threaded locknut, suitable for connection to threaded and unthreaded enclosures.
   d. The attachment of the fittings to FMC shall be angled saddle type, to engage and interlock with the FMC spiral groove, and shall be unaffected by vibration. Direct bearing screw type fittings shall not be used.
   e. Direct FMC conduit-to-FMC conduit coupling of FMC shall not be permitted.
   f. Shall comply with ANSI C33.9, and ANSI C33.92 (latest revision); NEMA FB1 (latest revision); UL 514.
6. FMC fittings as manufactured by:
   a. Straight Termination Connectors
      Thomas & Betts-3110 Series (with locknut)
   b. 45 and 90 Degree Angle Connectors
      Thomas & Betts-3130 Series (with locknut)
   c. FMC to EMT conduit combination coupling
      Thomas & Betts 503TB Series.

E. Liquid Tight Flexible Metal Conduit (LTFMC)
1. The metal conduit core of LTFMC shall comply with the same requirements as FMC conduit, with the addition of a thermoplastic exterior flexible jacket over the metal core.
2. The exterior jacket shall be positively locked to the metal core to prevent jacket “sleeving”.
3. The LTFMC shall be rated for installation and operating service temperatures of between minus 20 degrees centigrade through plus 90 degrees centigrade.
4. The LTFMC jacket shall be suitable for continuous exposure to sunlight, rainwater, water vapor, mineral oils and liquid solvents, without penetrating into the conduit and without deteriorating the jacket.
5. LTFMC sizes from 0.5-inch through 1.25-inch shall include an additional internal ground conductor, fabricated by the Manufacturer, as an integral part of the conduit core.
6. Direct LTFMC conduit-to-LTFMC conduit coupling of LTFMC shall not be permitted.
7. LTFMC shall be allowed for conduit size ranges from 0.5-inch through 4.0-inches.
8. In addition to the requirements for FMC conduit, LTFMC shall also comply with ANSI C-33.84 (latest revision); NEMA-FB1 (latest revision); CEC 12-1400 (latest revision).
9. LTFMC fittings
   a. Fittings shall include an external mechanical ground/bond wire connector.
   b. The attachment of the fitting to LTFMC shall be threaded compression type onto the conduit core with locknut and liquid tight jacket compression seal. The fitting shall automatically prevent “sleeving” of the jacket.
   c. Straight and angled termination connector fittings shall be threaded on one end and shall include locknut suitable for connection to threaded and unthreaded enclosures.
10. LTFMC fittings as manufactured by:
    a. Termination connector fittings:
       1) Thomas & Betts-5331 GR Series. Thomas & Betts-5341GR and 5351GR Series.
       2) Appleton-STB & STN-L Series Appleton-STB-L Series; STN-L Series for use with preformed “knockouts”.
       3) Emerson- OZ/Gedney-4Q Series. Emerson-OZ/Gedney-4Q Series
    b. LTFMC to RMC conduit to conduit combination coupling fittings:
       1) Thomas & Betts-5271 GR Series.
       2) Emerson-OZ/Gedney-4Q Series
F. Rigid Non Metallic Conduit (RNMC)
1. General
   a. Conduit and fittings shall be 90 degree centigrade conductor rated. Fabricated from homogeneous material, free from visible cracks, holes or foreign inclusions, with integral “end-bell”. The conduit and conduit fittings shall be watertight and airtight.
   b. Conduit, conduit fittings and conduit fitting assembly “solvent cement” shall all be the product of the same Manufacturer. Conduit fittings shall be solvent cement welded watertight.
   c. Conduit and fittings shall be identified with legible markings showing ratings, size and Manufacturers name.
   d. RNMC and fitting shall be corrosion resistant, watertight.
   e. Conduit shall be suitable for conductor operating temperatures from minus 20 degrees centigrade to 90 degrees centigrade.
RNMC shall comply with NEMA TC-2 (PVC 40 conduit, latest revision) NEMA TC-6 (EB conduit latest revision) and NEMA TC-3 (fittings, latest revision); UL 514 and UL 651 (latest revision).

2. Polyvinyl Chloride (PVC)-RNMC
   a. PVC-schedule 40 heavy wall construction.
   b. PVC-schedule 80 extra heavy wall construction.
   c. PVC-type EB.

3. RNMC fittings connecting to metallic raceways shall be provided with a ground/bond jumper connection.

G. Combi-Duct
   1. Rigid nonmetallic conduit combining a continuous linear outer raceway (duct) with factory installed (inside the outer duct) multiple, segregated inner raceway (ducts). Rigid, schedule 40 PVC construction. Shall be modular lengths of 20-feet for each duct segment.
   2. The conduit shall be suitable for use with signal/telecommunications, fiber optic, telephone and computer/data circuits, operating at 100 volts or less, UL listed and labeled.
   3. Outer Duct, outer enclosing Schedule-40 PVC duct size. The outer enclosing duct shall be 4.2-inches inside nominal duct diameter and 4.5-inches outer duct nominal diameter.
   4. Inner-ducts (contained inside the enclosing outer duct), non-metallic SDR-19 or Type-C/CAO-8546:
      Triple Combi-Duct
      a. Quantity of three continuous round rigid inner linear ducts, nominal size inside diameter 1.5-inch for each inner duct.
      Quad Combi-Duct
      b. Quantity of four continuous round rigid inner linear ducts, nominal size inside diameter 1.19-inch for each inner duct.
   5. Manufacturer’s standard bends and offsets, minimum 72-inches radius.
   6. Combi-duct and combi-duct fittings shall be airtight and watertight. Approved for direct burial in earth and approved for encasement in concrete.
   7. As manufactured by Carlon # Multi-Guard/Multi-Cell Series; American Pipe and Plastic (AMTEL) #Multi-Bore Series; or equal.

H. Expansion Joint, Deflection Joint and Seismic Joint Conduit Fittings
   1. Expansion Conduit Fitting - Fitting shall provide for a minimum of 2-inches straight line movement between two connecting conduits in each direction (total 4-inches conduit expansion and Contraction) parallel to the respective conduit lengths. Fitting shall be watertight.
   2. Deflection Conduit Fitting - Fitting shall provide for a minimum of 30 degrees angular deflection movement (“Shear” deflection) between two connecting conduits, in any direction perpendicular to the length of the respective conduits. Fitting shall be watertight.
   3. Combination Expansion/Deflection Conduit Fitting - Fitting shall provide the combined “expansion” and “deflection” movement capacity between two connecting conduits as described for separate “expansion” and “Deflection” conduit fittings. Fitting shall be approved for installation concealed in both masonry/concrete construction and exposed non-masonry/concrete construction. Fitting shall be watertight.
   4. Fittings shall comply with UL.
5. Fittings as manufactured by:
   a. Conduit expansion fittings exposed or concealed locations as manufactured by:
      1) Emerson-OZ/Gedney – AXB-8 Series for RMC conduit.
      2) Emerson-OZ/Gedney - TX Series for EMT conduit.
      3) Appleton – AXB or XJ8 Series for RMC conduit and EMT conduits.
         Provide RMC to EMT combination conduit coupling fittings for each end of the expansion fitting.
   b. Combination expansion/deflection conduit fittings exposed or concealed locations as manufactured by:
      1) Emerson-OZ/Gedney - AXDX Series for RMC conduit.
      2) Emerson-OZ/Gedney - AXDX Series for EMT conduit.
      3) Appleton-DX Series for RMC conduit.
      4) Provide RMC to EMT combination conduit coupling fittings for each end of the expansion/deflection fitting.
   c. Conduit expansion/deflection fittings for FMC and LTFMC conduit.
      1) Provide a minimum of 12-inches of “slack” LTFMC in each FMC or LTFMC conduit at building and structure seismic or expansion joint conduit crossings.
      2) Note: Each FMC “slack” expansion/deflection location, shall be considered as not less than a 90 degree conduit bend location, for compliance with the maximum quantity of conduit bends allowed in a raceway.

6. Conduit fitting bonding jumper:
   a. The grounding/bonding path of metal conduit shall be maintained by the fitting.
   b. Provide a bonding jumper at each expansion, deflection and combination expansion deflection conduit fitting.
   c. The jumper shall be a bare flexible copper “braid”. The copper braid electrical current carrying capacity shall be equal to the metal conduit.
   d. Provide a factory terminated ground clamp on each end of the braid with adjusting steel conduit grounding clamps and connect to each respective conduit end.
   e. The jumper braid length shall be 8-inches longer than the respective conduit fitting.
   f. Bonding jumper for FMC and EMT fittings as manufactured by:
      1) Emerson-OZ/Gedney – BJ and BJE Series
      2) Appleton – BJ/XJ Series

I. Conduit Bodies Conduit Fitting
   1. Conduit bodies shall provide conductor access with a removable conduit body cover and wiring area enclosed in metal housing. The conduit body shall facilitate pulling conductors.
   2. In-line form “C” conduit bodies shall be prohibited.
   3. The interior space “length” of 90 degree “elbow” conduit bodies shall not be less than six times the diameter size of the largest conduit connecting to the conduit body.
   4. Conduit body covers shall be removable, gasketed; watertight “domed” metal covers “Mogul-Type” with threaded screw attachment to the conduit body.
   5. Lubricated, reusable, wire roller guards inside the conduit body shall protect wire from insulation damage during wire “pulling”.
   6. Conduit body fittings shall comply with UL 514.
7. Conduit bodies as manufactured by:
   a. For RMC Conduit
      2) Emerson-OZ/Gedney - LB 6X/Mogul (90 degree elbow) Series - threaded body.
      3) Appleton – NEC6X-LB/Mogul (90 degree elbow) Series - threaded body.
   b. For EMT Conduit
      1) Same as for RMC conduit. Provide EMT to RMC conduit combination coupling fitting for each outlet body connection.

2.02 PVC COATING

A. PVC coatings shall be provided as described for specified metal products.

B. PVC coating shall be factory applied, to comply with NEMA-RN1 and 5-19.

C. The adhesion of the PVC coating to the coated metal shall exceed the strength of the coating itself, based on 0.5-inch “strip-pull” test.

D. Uniform coating thickness shall be continuous without “breaks” or “pinholes” and shall not be less than the following:
   1. Exterior metal surfaces, 40-millimeter coating thickness.
   2. Interior metal surfaces, 10-millimeter PVC or urethane coating thickness (i.e. interior of conduits, interior of conduit fittings etc.).

2.03 CONDUIT SUPPORTS

A. General
   1. Conduit Supports, hangers and fasteners for metal conduit shall be steel, hot dip zinc galvanized.
   2. Conduit supports, hangers and fasteners for PVC coated conduit shall be PVC coated to match the conduit PVC coating.
   3. Threaded hardware shall be continuous, free running threads.
   4. Conduit support systems, including support channels, pipe clamps, braces, anchors, hardware, fasteners, shall be sized to support the full capacity circuit conductors weight, plus the installed conduit weight, plus the conduit fitting weight and support hardware weight, plus a 300% additional weight capacity safety factor.
   5. Provide lock washer at each “bolted”/threaded connection.
   6. Conduit supports, fasteners, channels, braces, hardware, anchors, pipe clamps, and hangers as manufactured by Unistrut or Kindorf.
   7. Supports shall be free of “BURRS” and sharp edges.
   8. Metal supports cut in the field shall be zinc galvanized after cutting to prevent rust.

B. Conduit Hangers
   1. Threaded steel hanger rods.
      a. Hanger rods smaller than 0.375-inches in diameter shall not be used for support of individual conduits.
      b. Hanger rods smaller than 0.5-inches in diameter shall not be used for support of multiple conduits.
   2. Conduit hanger wires shall be not less than 12-gauge steel.
3. Conduit hangers shall attach to structure fasteners with steel “Clevis” or “Swing” hangers and shall provide a minimum of 45 degrees of angular movement in any direction at the point of the conduit hanger attachment to the structure fasteners.

4. Conduits individually suspended by conduit hangers shall fasten to the respective hangers with “Clevis” type pipe hangers. The pipe hangers shall be steel, adjustable to fit conduit size and shall completely enclose the conduit circumference.

C. Conduit Support Channels

1. “C” channels shall be factory preformed with a minimum 12 gauge thickness metal. The channel shall be factory “punched” with regularly spaced slotted holes for fastener attachments along the length of the channel.

2. The “C” channel shall not deflect more than 0.1 inch between channel supports at maximum installed design load, including required safety factor.

3. Channels shall comply with ANSI-1008 (latest revision) and ASTM-A569 latest revision.

4. Channels shall provide “turned lips” at longitudinal edges to hold (lock-in) fasteners.

5. Conduit support channels suspended from conduit hangers shall attach to conduits with threaded connections. Provide a minimum of two hangers (trapeze style) connected to each channel.

6. Non-suspended conduit support channels shall connect to structure fasteners with threaded connectors.

D. Fasteners, Seismic Earthquake Rated

1. Channel fasteners:
   a. Channel fasteners shall “prelocate” and lock into the channel “turned lips” and channel “walls”.
   b. A separate metal strap shall “tie” each conduit to each channel with conduit channel fasteners.

2. Structure fasteners:
   a. Structure fasteners for wall and floor mounted conduit attachments shall attach to existing masonry and concrete structures with structure fasteners using drilled, mechanical, expansion shield anchors.
   b. Structure fasteners for wall and floor mounted conduit attachments shall attach to new masonry and concrete structures with structure fasteners using steel threaded inserts precast into the structures.
   c. Structure fasteners shall center the support load above or below the beam flanges and reduce torsion-rotation forces exerted on the structural beam. Attach to steel structural members with “swing-beam clamps”, with set-locking screw structure fasteners.
   1) Beam clamps shall include integral safety rod, strap or “J”-hook to secure the attachment clamp to the beam flanges on both sides of the beam, with integral hanger rod attachment.
   2) Or double-ended beam clamp to secure the attachment clamp to the beam flanges on both sides of the beam, with integral hanger rod attachment.
   d. Structure fasteners for wall and floor mounted conduit attachments shall attach to wood structural members with flush “through-bolted” wood beam/wood framing stud structure fasteners.
e. Structure fasteners for wall mounted conduit attachments shall attach to steel framing studs and steel structural elements with spot welded steel structure fasteners or drilled and bolted structure fasteners.

E. Brace Connectors
1. Provide lateral brace connectors to resist horizontal, lateral and vertical movement of suspended conduits during seismic earthquakes.
2. The braces shall connect from each conduit support, attach as close to the conduit as possible, and attach to fixed rigid, nonsuspended building “main” structural elements with fixed anchoring.
3. Brace attachment connectors and fasteners shall be rigid preformed steel channels or flexible #10 gauge steel hanger wire.
4. Connect and attach the brace connectors to fixed structural elements in the same manner as conduit support hangers. The connection of braces to structural elements shall be independent of the conduit support hanger structure fasteners.

2.04 ELECTRICAL POWER WIRE AND CABLE

A. General
1. All wire and cable shall be single-conductor, annealed copper, insulated 600 volt, #12AWG minimum unless specifically noted otherwise on the Drawings.
2. Conductors #10AWG and smaller shall be solid. Conductors #8AWG and larger shall be stranded.
3. Insulation of conductor connected to circuit protection devices required to be "100%" rated, shall be 90 degree centigrade rated insulation.
4. Insulation of conductors installed outdoors, on grade or underground, insulation shall be rated for wet locations.
5. Insulation of conductors installed outdoors, installed exposed to the sun, installed in exposed conduits, insulation shall be rated for high-temperature 90 degrees centigrade.
6. Insulation of branch circuit conductors installed in light fixtures, insulation shall be rated for 90 degrees centigrade.
7. Conductor exposed to oil, insulation and jacket shall be oil resistant, complying with “Oil Resistant-1” and “Oil Resistant-2” UL 83.

B. Conductor Insulation
1. 600 Volt AC and/or DC insulated conductors installed entirely inside conduits, or enclosed inside wireways, or enclosed inside raceways, insulation shall be rated as follows.
2. Indoor above Grade locations either concealed or exposed.
   a. Dual rated THHN and THWN
   b. Individually rated THHN-2
   c. Individually rated THWN-2
   d. XHHW-2
3. Outdoor above Grade either concealed or exposed.
   a. XHHW-2
   b. THWN-2
   c. THW-2
4. Outdoor below Grade or outdoor on Grade.
   a. XHHW-2
   b. THWN-2
   c. THW-2
5. All other enclosed raceway locations not described above.
   a. XHHW-2
   b. THWN-2
   c. THW-2

6. Health Care facilities all circuits insulation shall be XHHW-2, rated Hospital-Grade.

7. 600 Volt AC and/or DC insulated conductors installed in open cable tray or open wireway or exposed insulation also shall be rated for exposed install locations.

C. Insulation Color Coding and Identification
   1. The following color code for branch circuits:
      a. Neutral . . . White (Tape feeder neutrals with white tape near connections)
      b. Normal Power:
         - 120/208 Volt
         - Ground: Green
         - Phase A: Black
         - Phase B: Red
         - Phase C: Blue
      c. Isolated ground insulation shall be green with a longitudinal yellow stripe.
      d. Emergency power same insulation color as normal power except as follows:
         - 120/208 Volt
         - Provide a continuous stripe on each conductor insulation, orange or yellow, except ground

2. When individual neutral conductors are shown for each branch circuit, the color code for the neutral conductors shall be as follows:
   a. 120/208 volt; Phase A - White with Black stripe; Phase B - White with Red stripe; Phase C - White with Blue stripe.

3. Feeders identified as to phase or leg in each, switchboard, switchgear, panelboard and junction location with printed identifying tape.

4. Fire alarm conductors: Use 600-volt, type THHN-2/THWN-2 conductors and color-coded per Equipment Manufacturer's recommendations and approved and listed for use on fire alarm systems by the State Fire Marshal.

5. Color coding for mechanical and plumbing control wiring shall be an agreed upon color code between the Mechanical/Plumbing CONTRACTOR and the Electrical CONTRACTOR, and color code shall be submitted to the DISTRICT'S Representative in writing for approval prior to installation.

D. Panel Feeders, Copper or Aluminum:
   1. Wire size shown on the Drawings is for copper conductors, unless specifically indicated otherwise.
   2. If aluminum wire is proposed, increase wire size to ampere capacity of copper wire and voltage drop not to exceed that of copper feeders indicated on Drawings. Increase conduit size and quantity as required by Code. Provide feeder calculation sheet, eight copies, if aluminum wire is proposed, showing feeder number, length, size and voltage drop in percentage for original copper feeders and for equal aluminum feeders.
   3. Aluminum Conductors (600 Volt or Less Only): CONTRACTOR has the option of using aluminum conductors in lieu of copper conductors for feeders only to panels, distribution boards/panels, switchboards, switchgear, transformers, motor control centers, and dimmer switchboard.
4. Aluminum Conductors shall be Aluminum Association AA-8000 Series Alloy, compact-stranded, with the same insulation as called for under copper conductors.
   a. Aluminum conductor larger than 750 MCM shall not be used.
   b. Aluminum conductors smaller than #2AWG shall not be used.
5. If the conductor termination is to be made on a bus bar or similar flat surface, a Burndy Type YA-A HYPLUG compression terminal intended for the specific conductor size, factory filled with oxide inhibitor compound shall be used. Terminal must be installed using a hydraulic compression tool equipment with a die head for the particular terminal used. Only Burndy Hypress tools shall be used for compression.
6. If the conductor termination is to be made into a circuit breaker or similar insert compartment it shall be terminated by use of a Burndy AYP HYPLUG compression connector intended for the specific conductor size, factory filled with oxide inhibitor compound. Connector must be installed using only Burndy Hydraulic compression tool specifically approved for each respective connector.
7. Connector aid shall be used for all terminations and connections. Connector aid shall be Burndy Pentrox A, NO-OX-1D Grade “A”.
8. When an aluminum lug is terminated to a copper bus with a steel or copper stud or bolt, place aluminum lug on stud or bolt followed by a flat steel washer, a Belleville washer, and steel or copper nut, in that order.

2.05 CHEMICAL GROUND ROD

A. General
1. Self-contained ground rod(s) using chemically enhanced grounding shall be provided where specifically indicated on the Drawings. As manufactured by Lyncole XIT Grounding Systems, 22412 South Normandie Avenue, Torrance, CA. Telephone #(800) 962-2610; or Superior Grounding Systems, Irwindale, CA. Telephone #(800) 747-7925; or ERICO – Eritech Chemical Ground Electrode.
2. The ground rod shall operate from changes in atmospheric pressure pumping air through the ground rod, hygroscopically extracting moisture from the air to activate the ground electrolytic chemicals and improve the ground rod performance.
3. Ground rod system shall be UL-467 listed.
4. Ground rod system shall be 100% self-activating, sealed and maintenance free. The addition of chemical or water solutions shall not be required.

B. Ground Rod
1. Ground rod shall consist of a 2-inches nominal diameter hollow, copper tube. The tube shall be permanently capped on the top and bottom. Air breather holes shall be provided in the top of tube. Drainage holes shall be provided in the bottom and sides of the tube for electrolyte drainage into the surrounding soil.
2. The ground rod shall be chemically filled at the factory with environmentally non-hazardous water-soluble metallic salts to enhance electrical grounding performance.
3. Ground rod shall be a minimum of 10-feet long for straight (vertical) installation; or “L” shape minimum 20-feet long for horizontal installation.
4. Ground wire clamping “U-Bolt” with pressure plate on the top end of the tube sized for 1#2 through 500 MCM AWG ground electrode conductor connection, and stranded 4/0AWG copper pigtail exothermically welded to the side of rod for ground electrode conductor connection.

C. Ground Box
1. Precast concrete box with slots for conduit entrances. Approximately 10-inch diameter by 12-inches high. Cast iron grate flush cover with “Breather” slots XIT Box #XB-12.

D. Backfill Material
1. Natural volcanic, non-corrosive Bentonite Clay backfill material.
2. Shall absorb water at a minimum of thirteen times its dry volume or approximately 14 gallons for 50 pounds of clay.
3. PH value 8-10 with maximum resistivity of 2.5 OHMS-M at 300% moisture content by weight.

2.06 FLEXIBLE CORDS AND PORTABLE CABLES

A. General
1. Multi-conductor insulated flexible cable with jacket rated extra heavy duty, extra hard-use and high abuse duty; ozone, sunlight, grease, oil resistant-UL 83 and water resistant; rated for indoor/outdoor use.
2. Quantity of conductors and conductor sizes as indicated on the Drawings but in no case less than five 16AWG.
3. Characteristics:
   a. Conductors - stranded copper, soft annealed conforming to ASTM-B-174 and ASTM-B-172. 600 volt individually insulated and color-coded. Separate green insulated ground conductor. Aluminum conductors shall not be permitted for cords and cables.
   b. Insulation - rubber conforming to UL 62; temperature range plus 105° Centigrade to minus 50° Centigrade.
   c. Flame resistance shall conform with MSHA-P123-103.
   d. Jacket - black for equipment connections and yellow for outlet connections. Rated for temperature range plus 105° Centigrade to minus 50° Centigrade, water, sunlight and ozone resistant. Permanently mark jacket a minimum of 40-inches on center with rated voltage, Manufacturer's name, wire/insulation type, AWG conductor size and quantity (minimum 24-inches on center).

2.07 CABLE RACKS

A. Cable racks, installed on the vertical walls of the structure, including hooks and porcelain insulator cable cradles, shall be sufficient to accommodate the cables and splices.

B. Vertical racks shall be installed on all walls of the structure a minimum of 24-inches on center within 6-inches of floor and top of wall. A rack shall be installed within 18-inches of each corner of each wall. Additional racks spaced equally on each wall shall be installed; spacing between vertical wall racks shall not exceed 24-inches.
1. Wall racks shall be slotted to accept removable hooks and lock hooks into place.
2. Non-metallic, 50% (minimum) glass reinforced nylon or non-metallic material of the same characteristics.

3. The installed cable racks, cable support hooks with arms and wall anchor bolts shall support the following minimum loads for each hook/arm, with a 200% minimum safety factor. Based on multiple hook/arms located not less than 9-inches on center along the entire vertical length of the support rack:

<table>
<thead>
<tr>
<th>Hook/Arm Length</th>
<th>Arm Supported</th>
<th>Max. Allowable Hook/Arm Deflection</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 8-inches</td>
<td>450 pounds</td>
<td>0.25-inch</td>
</tr>
<tr>
<td>b. 14-inches</td>
<td>350 pounds</td>
<td>0.37-inch</td>
</tr>
<tr>
<td>c. 20-inches</td>
<td>250 pounds</td>
<td>0.37-inch</td>
</tr>
</tbody>
</table>

(Based on load concentrated 1-inch from the end of each hook/arm.)

4. Racks shall be bolted to the precast and cast-in place structure walls, within 3-inches of each rack end and not less than 9-inches on center. Provide cast-in place or after-set drilled expansion concrete anchors.

PART 3 - EXECUTION

3.01 TRENCHING, FOOTINGS, SLEEVES

A. Provide trenching, concrete encasement of conduits, backfilling, and compaction for the underground electrical work, in accordance with applicable Sections of this Specification.

B. Provide footings for all post and/or pole-mounted lighting fixtures: concrete shall conform to the applicable Sections of this Specification.

C. Sleeves

1. Provide sleeves for raceways, conduit and wire/cables passing through the following construction elements:
   a. Concrete and masonry foundations, floors, walls and slabs.
   b. Gypsum, Lath, and plaster walls and ceilings.
   c. Building structures (i.e., foundations, walls, floors, ceilings, beams, and roofs) with a fire rating exceeding 20-minutes.

2. Sleeves shall extend 1.5-inch above and below floors, except under floor standing electrical equipment. Sleeves shall be flush with wall ceiling foundations and partitions exposed to public view and extend approximately 0.5-inch past penetration in fire rated construction. Sleeves shall be installed at exact penetration locations and angles to accommodate wire/cable, raceway and conduit routings.

3. Joists, girders, beams, columns or reinforcing steel shall not be cut or weakened. Where construction necessitates the routing of conduit or raceways through structural members, framing or footings, written permission to make such installation shall first be obtained from the DISTRICT’S Representative. Such permission will not be granted, however, if any other method of installation is possible.

4. The layout and design of raceways and conduits located in or routed through masonry or reinforced beams or the DISTRICT’S Representative shall review walls before any work is performed. All sleeving shall be accomplished according to the instructions of the DISTRICT’S Representative and shall be accepted before any concrete is poured.

5. Sleeves, raceways and conduit shall be located to clear steel reinforcing bars in beams. Reinforcing bars in walls shall be offset to clear piping and sleeves.
6. Provide a continuous clearance between the inside of a sleeve and exterior of wire/cables, conduits and raceways passing through the sleeve not less than the following:
   a. 0.5-inch clearance except as required otherwise.
   b. 1.0-inch clearance through outside walls below grade.
   c. 3.0-inch clearance through seismic joints.

7. Sleeves set in fire rated construction shall be caulked between sleeve and building structure, additionally sleeves shall be caulked between the sleeve and the wire/cables, conduits/raceways passing through the sleeve. The caulking shall be a fireproof sealant, equal to the fire rating and temperature being penetrated. Clearance between components inside of sleeve and exterior of components passing through sleeve and between components inside the sleeve shall comply with Fireproof Sealant Manufacturer’s recommendations.

8. Sleeve material:
   a. In floor construction: Schedule 40 black steel pipe, with upper surface to be sealed watertight.
   b. In concrete or masonry walls roofs or ceilings: Schedule 40 black steel pipe. When installed in roofs or outside walls, seal outer surface watertight.
   c. In fire rated construction; 24 gauge galvanized iron or steel.
   d. Sleeves through waterproof membranes: Cast iron or Schedule 40 steel with flashing clamp device and corrosion resistant clamping bolts. Caulk space between pipe and sleeve and surfaces between sleeve and conduits sealed watertight.

3.02 GROUNDING

A. Grounding shall be executed in accordance with all Applicable Codes and Regulations, both of the State and Local Authorities Having Jurisdiction.

B. Where nonmetallic conduit is used in the distribution system, the CONTRACTOR shall install the proper sized copper ground wire in the conduit with the feeder for use as an equipment ground. The electrical metallic raceway system shall be grounded to this ground wire.

C. The maximum ground/bond resistance to the grounding electrode shall not exceed 1 ohms from any location in the electrical system. The maximum ground resistance of the grounding electrode to earth shall not exceed 5 ohms.

D. Ground/Bond Conductors
   1. Provide an additional, dedicated, green insulation equipment ground/bond wire inside each conduit type and raceway as follows. Size the ground/bond conductors to comply with CEC/NEC requirements. The metal conduit or raceway shall not be permitted to serve (function) as the only (exclusive) electrical ground return path:
      a. All types of nonmetallic conduit and all types of non-metallic raceways including but not limited to: RNMC - Rigid Nonmetallic Conduit.
      b. FMC - Flexible Metal Conduit.
      c. LTFMC - Liquid Tight Flexible Metal Conduit.
      d. Metal and non-metal raceways.
      e. RMC - Rigid Metal Conduit.
      f. EMT - Electrical Metal Tubing.
2. The equipment ground/bond wire shall be continuous from the electrical circuit source point of origin to the electrical circuit end termination utilization point as follows:
   a. Every conduit and raceway path containing any length of the above identified conduits or raceway.
   b. Every conduit path and raceway path connected to any length of the above-identified conduits and raceways.

3. The equipment ground/bond wire shall be sized as follows, but in no case smaller than indicated on the Drawings. Install equipment ground/bond wire in each conduit/raceway, with the respective phase conductors:
      
      | Amp   | Wire Size |
      |-------|----------|
      | 15    | #12      |
      | 20    | #12      |
      | 30 to 60 | #10     |
      | 70 to 100 | #8       |
      | 101 to 200 | #6      |
      | 201 to 400 | #2       |
      | 401 to 600 | #1       |
      | 801 to 1000 | 2/0    |
      | 1001 to 1200 | 3/0    |
      | 1201 to 1600 | 4/0    |
      | 1601 to 2000 | 250 MCM |
      | 2001 to 2500 | 350 MCM |
      | 2501 to 4000 | 500 MCM |

4. Isolated grounds - Raceways containing branch circuit or feeder phase conductors connected to panelboards equipment, or receptacles with isolated grounds or isolated ground bus shall contain a dedicated insulated ground conductor connected to the isolated ground system only. The isolated ground conductor shall be continuous the length of the raceways and connected only to the isolated ground terminals in addition to and independent of the equipment bonding/ground conductor. The isolated ground conductor shall be sized as indicated above, for equipment ground/bond wire.

5. Splices in ground/bond wires shall be permitted only at the following locations:
   a. Ground buses with listed and approved ground lugs.
   b. Where exothermic welded ground/bond wire splices are provided.

6. Provide ground/bond wire jumpers for conduit fittings with ground lugs, expansion and deflection conduit fittings at conduit fittings connecting between metallic and non-metallic raceways and to bond metal enclosures to conduit fittings with ground lugs.

E. Where conductors are run in parallel in multiple raceways, the grounding conductor shall be run in parallel. Each parallel equipment-grounding conductor shall be sized on the basis of the ampere rating of the overcurrent device protecting the circuit conductors in the raceway. When conductors are adjusted in size to compensate for voltage drop, grounding conductors, where required, shall be adjusted proportionately in size.

F. Ground conductors for branch circuit wiring shall be attached at each outlet to the back of the box using drilled and tapped holes and washer head screws, 6-32 or larger.
G. Each panelboard, switchboard, pull box or any other enclosure in which several ground wires are terminated shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

H. UFER Ground
1. In addition to all cold water and structural steel grounds provided to meet this specification, there shall be a main ground system of the UFER ground style.
2. The UFER ground electrodes shall be a minimum of two 20-feet lengths of #4/0 AWG bare stranded copper cable embedded horizontally in the cast in place concrete footing, extending in opposite directions in the footings. All portions of the ground electrodes shall be placed inside the concrete, between 2-inches and 4-inches from the earth surrounding the concrete.
3. The lengths of cable shall extend in opposite directions in the footings, with the center end of each cable terminated onto the main electrical service ground bus for the main electrical service equipment.
4. All wire cable connection terminations onto the ground bus shall be exothermic weld type.
5. The “UFER” grounding electrode, embedded in concrete, shall be exothermically welded to each steel reinforcing bar (rebar) and each steel anchor bolt located within 18-inches of the grounding electrode inside the concrete. Note: Reinforcing steel (rebar), in concrete foundations, attached with metal “tie-wraps” and in direct physical contact to other adjacent rebar that is in turn exothermic welded to the UFER grounding electrode, may be classified as attached to the UFER grounding electrode, and does not require additional exothermic weld connections to the UFER grounding electrode.

I. Provide a separate ground/bond insulated grounding electrode conductor, copper wire from the main electrical service ground bus to each of the following locations. The ground/bond conductor shall be sized to comply with Applicable Codes and as indicated on the Drawings, but in no case smaller than the following:
   1. Main service entrance equipment ground bus:
      a. Services smaller than 1200 ampere 1.5-inch conduit with 1#4/0.
      b. Services 1200 ampere and larger 2.5-inches conduit with 1#500MCM.
      c. Where a separate ground bus is not required, connect ground to electrical equipment metal housing
   2. Each telephone backboard and signal system backboard location, 1.25-inch conduit with 1#1.
   3. Metal cold water pipe located inside the building, 1.5-inch conduit with 1#4/0.
   4. Outdoor underground metal cold water pipe, make connection five feet from the building, 1.5-inch conduit with 1#4/0.
   5. Each service entrance ground bus and each separately derived ground rod system:
      a. Services smaller than 1200 ampere 1.5-inch conduit with 1#4/0.
      b. Services 1200 ampere and larger 2.5-inches conduit with 1#500MCM.
   6. Separate 1.25 inch conduit with 1#2 (AWG) bonding conductor to each interior metal pipe system located in the same building, including but not limited to, the following:
      a. Fire sprinkler system each stand pipe location (water based and non-water based).
      b. HVAC chilled water supply and return, at each pump location.
      c. Roof drains.
      d. Waste liquid disposal systems.
e. Metal gas pipe service entrance and service meters.
f. Hydraulic elevator hydraulic pipes.

3.03 CONDUIT

A. General

1. The sizes of the conduits for the various circuits shall be as indicated on the Drawings, but not less than the conduit size required by code for the size and quantity of conductors to be installed in the conduit.
2. Conduits shall be installed concealed from view. Install conduits concealed in walls, concealed below floors and concealed above ceilings, except as specifically noted otherwise.
   a. Conduits shall not be installed in concrete floors.
3. The following systems shall be considered as circuits 100 volts and less, all other circuits shall be considered to be over 100-volts (power circuits) unless specifically noted otherwise: Fire alarm, energy management control, telephone, public address, data, computer, television, intercom, intrusion alarm and nurse call.
4. Conduits shall be provided complete with conduit bends, conduit fittings, outlet boxes, pullboxes, junction boxes, conduit anchors/supports, grounding/bonding for a complete and operating conductor/wire raceway system.
5. Metal and nonmetal conduits shall be provided mechanically continuous between termination connection points. Metal conduit shall be provided electrically continuous between termination connection points.
6. Individual conduit paths and home runs shown on the Drawings shall be maintained as separate individual conduits for each homerun and path.
7. Conduits, conduit fittings and installation work occurring in classified hazardous materials locations shall comply with applicable code Class 1 Division 1 requirements, unless specifically noted otherwise.
8. Transitions between conduits constructed of different materials and occurring in above grade locations shall be allowed only at outlet boxes, junction boxes, pull boxes, and equipment enclosures unless specifically indicated otherwise. Provide outlet boxes and junction boxes.
9. Metal conduit terminating to nonmetal enclosures; terminating into metal enclosures with “concentric ring” knockouts; terminating into metal enclosures with knockout reducing washers, including but not limited to equipment housings, outlet boxes, junction boxes, pull boxes, cable trenches, manholes, shall be provided with a ground/bonding lug integrated with the conduit termination conductor fitting construction, by the Fitting Manufacturer. The lug shall provide for connection of a grounding/bonding conductor (insulated or uninsulated). The grounding lug shall be located on the fitting, inside the termination enclosure.
10. The type of conduit, type of conduit fittings, and type of conduit supports and method of conduit installation shall be suitable for the conditions of use and conditions of location of installation based on the Manufacturer’s recommendations; based on the Applicable Codes and based on the requirements of the Contract Documents.

B. RMC Installation Locations

RGS, IMC conduits and RGS, IMC fittings shall be installed in the following locations:
1. Embedded in floors, walls, ceilings, roofs, foundations, and footings constructed with concrete.
2. Embedded in walls and foundations constructed with brick and masonry.
3. Interior of buildings, within 9-feet of finish floor lines for exposed conduit locations.
4. Exterior of building for exposed conduit locations.
5. Damp or wet locations, exposed or concealed locations.
7. In hazardous materials areas and locations; below hazardous materials areas and locations; above hazardous materials areas and locations.
8. Exposed on utility service poles, for pole risers less than 9-feet above finish grade.
9. RMC conduit and RMC fittings may be installed in any location where EMT and FMC conduit is permitted to be installed.

C. PVC Coated RMC Installation Locations
PVC coated RMC conduit and PVC coated RMC fittings shall be installed in the following locations:
1. Underground conduit locations for elbows and bends with a radius of less than 36-times the conduit diameter.
2. Underground vertical risers extending above grade.
3. Entire length of underground conduits for the following circuits:
   a. Audio microphones
   b. Lighting dimming controls
4. Installed in contact with earth or corrosive materials.
5. Exposed in “cold” rooms and “refrigerated” rooms, rooms with a maintained temperature below 65 degrees Fahrenheit.

D. EMT Installation Locations
EMT conduit and EMT fittings may be installed in the following locations, for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”; only dry locations:
1. Concealed in hollow non masonry/non-concrete, metal stud frame and wood stud frame walls and floors.
2. Concealed above ceilings.
3. Exposed inside interior enclosed crawl spaces.
4. Exposed interior locations placed 9-feet or higher above finished floors (except as described in paragraph below at lower heights).
5. Exposed on walls and ceilings (any height) in the following dedicated function areas, interior enclosed room locations:
   a. Indoor enclosed electrical equipment rooms and closets.
   b. Indoor enclosed data and telecommunication terminal rooms and closets.
   c. Indoor enclosed HVAC equipment rooms and closets.
6. Any location where FMC is described to be installed, except as the final connection to rotating or vibrating equipment.

E. FMC Installation Locations
FMC conduit and FMC fittings may be installed in the following locations for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”; only dry, interior locations:
1. Concealed in hollow non-masonry metal stud frame and wood stud frame fully enclosed walls.
2. Concealed above fully enclosed ceiling spaces.
3. FMC conduit shall be installed in continuous lengths between termination points. FMC shall not be “spliced” or coupled directly to FMC or any other conduit type under any circumstance.

4. The maximum continuous length of FMC that shall be installed between termination end points is 15-feet. Circuits requiring continuous conduit lengths exceeding 15 feet between termination end points shall be installed using either RMC or EMT conduits. FMC lengths shorter than 16-inches are prohibited.

5. The minimum size FMC conduit shall be as shown on the Drawings but not be less than the following:
   a. FMC lengths of 6-feet or less, minimum FMC conduit size shall be 0.50-inch.
   b. FMC lengths exceeding 6-feet, minimum FMC conduit size shall be 1.0-inch.

F. LTFMC Installation Locations
LTFMC conduit and LTFMC fittings shall be installed in the following locations for circuit conductors operating below 600 volts to ground; locations containing only “non-hazardous materials”:
1. Final electrical connection to vibrating or rotating equipment; control and monitoring devices mounted on vibrating and rotating equipment including the following. Minimum conduit length shall not be less than 24-inches:
   a. Motor, engines, boilers, solenoids, and valves.
   b. Fixed mounted “shop” (manufacturing) production equipment.
   c. Fixed mounted food preparation equipment and “kitchen” equipment.
2. All locations where exposed flexible conduit connections are required, both indoor and outdoor.
3. Final connection to indoors electrical transformers. Minimum conduit length shall not be less than 24-inches; maximum conduit length shall not exceed 72-inches.
4. Do not install LTFMC located in environmental air plenums.

G. RNMC Installation Locations
RNMC conduit and RNMC fittings shall be installed in the following locations containing only “non-hazardous material”:
1. Underground, concealed below earth grade, unless specifically noted or specified otherwise.
2. Exposed on utility service poles, for pole risers at 9-feet or higher above finish grade, schedule 80 PVC only.
3. RNMC type “EB” conduit(s) shall be concrete encased along the entire length of the conduits for all installation locations.
4. Non-metal type raceways and RNMC type conduit shall not be installed inside buildings.

H. Combi-Duct Installation Locations
Combi-duct conduits shall be installed where shown on the Drawings. Combi-duct shall be installed underground (below grade) as follows:
1. Do not install exposed or inside buildings above grade.
2. Provide a 0.25-inch pull rope in each inner duct.
3. Radius and elbows shall be rigid non-metallic, PVC, Manufacturer factory fabricated, in lieu of PVC coated RMC conduit.
4. Inner ducts shall be supported by internal spacers inside the enclosing outer duct.
5. Provide end bell and three hole "snug-plugs" at each entrance end of Combi-duct into pullboxes, manholes, equipment cabinets stubups and Combi-duct terminations. Compression type “snug-plugs” shall provide watertight and airtight seal between inner and outer ducts and around future cables installed in inner duct.

I. Conduit Installation
   1. Conduit Supports
      a. Securely and rigidly support all raceways/conduits from the building structure. Raceways/Conduits shall be supported independent of all piping, air ducts, equipment ceiling hanger wires, and suspended ceiling grid systems. Secure conduit to structural element by means of UL listed and approved hangers, fasteners, “C” channels and pipe clamps.
      b. Provide conduit supports spaced along the length of the conduit as follows:
         1) RMC and EMT conduit, maximum not to exceed 96-inches on center; within 24-inches of each conduit bend and conduit termination location.
         2) FMC and LTFMC conduit, maximum not to exceed 24-inches on center; within 6-inches of each conduit bend and conduit termination location.
      c. Suspended conduit methods:
         1) Individual, suspended raceways/conduits separated by more than 12-inches from any other conduit and suspended from ceilings and roofs shall be supported as follows:
            a) Conduits smaller than 1.5-inches by means of hanger rods or hanger wires.
            b) Conduits 1.5-inches and larger by means of hanger rods.
            c) The conduit shall attach to the hangers with pipe clamps.
         2) Suspended raceways/conduits positioned within 24 inches of any other conduit shall be grouped and supported by hanger rods using trapeze type conduit support channels (“C” channels). Conduits shall individually attach to common channels side-by-side, with pipe clamps.
      d. Non-suspended conduit methods:
         1) Individual raceway/conduits placed against wall/ceiling/floors, placed inside hollow wall/ceiling construction or structure framing (i.e., “dry- wall” or plaster hollow wall construction), shall be secured by means of individual pipe clamps and fasteners attached to the framing studs or other structural members and the conduit/raceway.
         2) Provide common “C” channel supports for all multiple raceway/conduits placed against vertical or horizontal surfaces and positioned within 24-inches of other raceways/conduits. Attach channels to the framing studs or other structural members. Attach the conduits/raceway individually to common channels, side-by-side, with pipe clamps.
         3) The use of toggle bolts is prohibited.
      e. Conduit rising from floor for motor connection shall be independently supported if extending over 18-inch above floor. Support shall not be to a motor or ductwork, which may transmit vibrations.
      f. Provide conduit anchoring, conduit support and conduit bracing systems conforming to Earthquake Seismic Zone 4 requirements. The conduit support/anchoring system capacity shall include the weight of the conduits,
conduit fittings, conduit supports and conductors/wires/cables installed in the conduits plus a 300% safety factor. Submit shop-drawing details showing each typical conduit anchor, conduit support and conduit brace location. Submit structural calculations performed by and signed by a Professional Structural Engineer (P.E.) with a P.E. License, Registered in the State of California, U.S.A.

2. Conduit separation:
   a. Conduit installed underground or below building slab without full concrete encasement: Shall be separated from adjacent conduits of identical systems (i.e. signal to signal, data to data, power to power, control to control etc.) by a minimum of 3-inches. Conduits of non-identical systems (i.e. signal to power; data to power; power to control; signal to control, etc.) shall be separated by a minimum of 12-inches.
   b. Conduit installed underground with full concrete encasement; shall be separated from adjacent conduits of similar systems (100 volt and less) by a minimum of 2-inches; conduits for non-power systems (100 volts and less to ground) shall be separated by a minimum of 6-inches from power circuits (over 100 volts to ground); conduits for power circuits shall be separated from adjacent conduits of similar power systems (over 100 volts to ground) by a minimum of 3-inches.
   c. Separation of conduits entering termination points or crossing other conduits may be reduced as required within 60-inches of the termination or crossing points.
   d. Conduits containing Utility Company service circuits (i.e. electrical power, telephone, or cable television) shall be separated a minimum of 12-inches from all other utilities and conduits, with or without concrete encasement; metallic or non-metallic conduit, above grade or underground conduit locations.
   e. Conduits shall be separated from hot water piping, exhaust flues/chimneys, steam piping, boilers, furnaces, ovens by a minimum of 12-inches.

3. Conduit stubs:
   a. Branch circuit and telephone conduits turned up from floor at the following locations shall terminate each conduit in a flush conduit coupling at the floor and then extend into partition or to equipment. Refer to DISTRICT’S Representative’s Drawings for location of walls and partitions.
      1) Interior demountable partitions.
      2) Below, into or adjacent to equipment not installed directly adjoining to a wall.
      3) Up from below the floor into hollow stud frame walls.
   b. From each panel, and signal cabinet which is wall mounted, stub up from top of the panel/cabinet a minimum of three 1-inch conduits to the nearest accessible ceiling spaces or other accessible location. Where the floor below the panel is accessible or is a ceiling space, stub an additional three 1-inch conduits from the bottom of the panel into the accessible space below the panel. Cap conduits for future use.
   c. Conduits stubbed underground outside of building line for future use shall be terminated a minimum of five feet clear (whichever distance is greater) of building or adjacent concrete walks and AC paving. The stubout conduit shall be capped. Provide concrete monuments, 6-inches by 6-inches by 15-inches deep, buried flush with grade over the capped ends. The face of monument shall be furnished with 3-inch square brass plates
securely mounted and engraved with the number and size of conduits and type of service (i.e., "POWER", "TEL.", etc.).

d. Conduits stubbed into ceiling or floor spaces from outlets for telephone, video, computer/data or television shall be provided with an insulated throat bushing, on the end of each conduit stubout.

e. Conduit stubouts from outlet boxes and equipment located in hollow stud walls, into ceiling and floor spaces, shall be EMT or RMC conduit. The stubouts shall terminate into the ceiling and floor spaces with a conduit termination connector fitting.

f. Empty conduit stubs into building spaces and equipment shall be individually identified with an “ID-tag” located at each end of the conduit. The ID-tag shall state the origination point and termination point of the respective conduit (i.e., “from PNL-A/to Room #121”; “from outlet #24/to outlet #17 in Room #120”; etc.).

g. Provide a conduit termination fitting with insulated throat bushing and mechanical ground lugs at each conduit “stub-up” location.

4. Conduit concrete encasement:

a. Conduits which are run underground exterior to building slab shall be continuously concrete encased except, 15 and 20-ampere power branch circuit conduits underground do not require concrete encasement.

b. PVC rigid-non-metallic-type EB conduit, of any size and any location shall be continuously concrete encased the full length of the conduit installation, including under building slab.

c. Concrete for encasement of underground conduits shall be 2000-PSI 28-days cure strength with a mix of cement, sand, water and maximum of ¾-inch gravel. Concrete encasement of conduits shall be continuous without voids. The encasement shall extend 3-inches past the edges of all conduits on all sides of the circuit. Provide 10-pounds of red oxide cement coloring uniformly mixed with each cubic yard of concrete for conduit encasement.

d. Conduits located below or adjacent to structural foundations shall be separated from the foundation by a minimum of 12-inches. Conduits located below structural foundations shall be fully and continuously concrete backfilled and encased between the bottom of the foundation to the bottom of the conduits. The concrete shall be 4000 PSI 28 day cure strength instead of 2000-PSI concrete.

e. Conduits of any size and type (including 15 ampere and 20 ampere power branch circuits) located under roads, paved areas and “transit-system” right of way shall be concrete encased.

5. Underground conduits:

a. Three or more underground conduits larger than 1-inch in size and occupying the same trench shall be separated and supported on factory fabricated, non-metallic, duct/conduit support spacers. The spacers shall be modular, keyed interlocking type, "built-up" to accommodate quantity, size orientation and spacing of installed conduits. The spacers shall maintain a constant distance between adjacent conduit supports and hold conduits in place during trench backfill operations. Minimum support spacer installation interval along with length of the conduits shall be as follows:

1) Concrete encased conduits, not less than 8-feet on center.
2) Non-concrete encased conduits, not less than 5-feet on center.
b. Provide trenching, excavation, shoring and Backfilling required for the proper installation of underground conduits. Tops of backfill shall match finish grade.

c. Bottoms of trenches shall be cut parallel to “finish grade” elevation. Make trenches 12-inches wider than the greatest diameter of the conduit.

d. Back-filling Trenches for Conduits without Concrete Encasement Requirements

1) Conduits which are not required by the Contract Documents to be concrete encased and are located exterior to building slab, shall be set on a 3-inch bed of damp clean sand. Conduit trenches shall be backfilled to within 12-inches of finished grade with damp sand after installation of conduit is completed. Remainder of backfill shall be native soil.

2) Conduits located under a building which are not required by the Contract Documents to be concrete encased, shall be completely backfilled and compacted with clean damp sand to the same level as the building foundation pad.

3) Provide a continuous yellow 12-inches wide flat plastic tracer tape, located 12-inches above the conduits in the trench. The tracer tape shall be imprinted with “Warning-Electric Circuits” a minimum of 24-inches on center.

e. Backfilling trenches for conduits under paved areas:

1) In addition to the requirements of conduit concrete encasement, conduits under walkways, roads, parking lots, driveways, and buildings shall be cast in place concrete “slurry mix” backfill. The slurry mix shall cover each side and top of conduits and conduit concrete encasement. The slurry mix shall be continuous to the underside of the finish subgrade surface.

f. Backfilling trenches for conduits with concrete encasement requirements by the Contract Documents:

1) Trenches with all conduits concrete encased shall be backfilled with clean damp sand when located under building pads.

2) Trenches with all conduits concrete encased and not located under a building pad and not located under paved areas shall be backfilled with clean damp sand or native soil.

g. Backfill material:

1) Sand and native soil backfill of trenches shall be machine vibrated in 6-inch lifts to provide not less than 90% compaction of backfill.

2) Soil backfill shall have no stones, organic matter of aggregate greater than 3-inches.

3) Concrete and slurry mix (2000-PSI) shall be machine vibrated during installation to remove “air-voids”.

4) The slurry mix shall consist of concrete, clean rock, clean sand and clean water mixture. Maximum shrinking of slurry mix shall not exceed 5% wet to dry.

h. Do not backfill until District’s Representative has approved Installation and As-built Drawings are up to date. Promptly install conduits after excavation has been done, so as to keep the excavations open as short a time as possible. Excess soil from trenching shall be removed from the site.

i. Install underground conduit, except under buildings, not less than 24-inches below finished grade in non-traffic areas and 30-inches below finished grade in traffic areas, including roads and parking areas. Not less than 48-inches below finished grade under public/private transit system.
right of way and railroad right of way. Dimensions shall be measured to the top of the conduit.

j. Conduit crossing existing underground utilities shall cross below the bottom depth of the existing utilities. If the top portion of the existing utility depth below finish grade exceeds 72-inches and the specified separation and depths are maintained when crossing over the top of the existing underground utility, the conduit may cross above the existing underground utility.

k. Provide long radius horizontal bends (minimum radius of 36-times the conduit diameter) in underground conduits where the conduit is in excess of 100-feet long.

l. Conduits installed below grade and on grade below buildings, shall not be smaller than 0.75-inches. Conduits for circuits exceeding 600-volts shall not be smaller than 5.0-inches.

m. Underground conduits entering a building shall be sloped. The conduit direction of slope shall be away from the building, and shall prevent water in the conduit from “gravity draining” towards the building. The conduit slope “high point” shall originate from the building, out to the first exterior pullbox, manhole etc. exterior conduit termination “low point”. The minimum slope angle shall be a constant 8-inches (or greater) of fall for each 100-feet of conduit length.

n. Dewatering:

1) Provide pumping to remove, maintain and dispose of all water entering the excavation during the time the excavation is being prepared, for the conduit laying, during the laying of the conduit, and until the backfill at the conduit zone has been completed. These provisions shall apply on a continuous basis. Water shall be disposed of in a manner to prevent damage to adjacent property. Trench water shall not be drained through the construction. Groundwater shall not be allowed to rise around the pipe until joining compound has firmly set.

2) The DISTRICT’S Representative shall be notified 48 hours prior to commencement of dewatering.

6. Raceway/Conduits, which are installed at this time and left empty for future use, shall have 0.25-inch diameter polyvinyl rope left in place for future use. The pull rope shall be 500-pound minimum tensile strength. Provide a minimum of 5-feet of slack at each end of pull ropes.

7. Unless otherwise restricted by Structural Drawings and Specifications, the maximum size conduit permitted in concrete slab on-grade, walls, ceilings and roofs constructed of masonry or concrete shall not be greater than 20% of the concrete/masonry thickness. Conduits installed in these locations shall not cross.

a. Conduits shall not be installed in cast-in-place concrete floors.

8. Provide openings in building structures for conduit penetrations:

a. New construction shall be provided with conduit sleeves, to provide conduit penetrations.

b. Existing construction shall be drilled (core drill masonry and concrete) and provide conduit sleeves installed after drilling, to provide conduit penetrations.

c. Where the structure penetrations for underground conduits penetrating through foundations will not comply with the (restriction/penetration) shown in the Contract Documents, install the conduits below and clear of the foundation lowest point.
9. Conduit bends risers and offsets:
   a. The minimum bend radius of “factory or field” fabricated conduit bends shall not be less than the following. The bend radius shall be measured at the surface, inside radius of the conduit wall:
      1) FMC and LTFMC conduit - conduit minimum bend radius 12-times the conduit diameter.
      2) RMC and EMT conduit minimum bend radius - conduit for power circuits over 100 volts and less than 600 volts, 8-times conduit diameter. Conduit for power circuits over 600 volt, 12-times conduit diameter. Conduit for low voltage, signal and fiber optic circuits, 10-times conduit diameter.
      3) RNMC conduit - conduit minimum bend radius 36-times the conduit diameter. Under building reduce minimum bend radius to 10-times the conduit diameter. Conduit bends and offsets in RNMC with less than 36-times conduit diameter bend/offset radius, shall be RNMC PVC schedule 80 or PVC coated RGS.
      4) Conduits for Utility Company conductors. Conduit minimum bend radius shall comply with the respective Utility Company requirements.
   b. Bends and offsets in conduits shall be kept to an absolute minimum. The total summation of all bends and offsets permitted in a conduit segment, occurring between two conduit termination/connection end points, shall not exceed the following, including conduit fittings:
      1) RMC and EMT conduit - 360 angular degrees
      2) FMC and LTFMC conduit - 180 angular degrees
      3) RNMC conduit - 270 angular degrees
   c. Each field fabricated conduit offset, bend and elbow which are not the standard product of the Raceway/Conduit Manufacturer shall be mandrel tested. The test shall be conducted after the conduit installation is complete and prior to pulling-in any wire, in the same manner as for underground conduits.
   d. Factory manufactured angle connector conduit fittings shall be installed in exposed conduit locations only. Installation in locations normally concealed from view shall not be permitted. Not more than one factory manufactured angle connector shall be permitted in any length of conduit between conduit termination end points.
   e. RNMC conduit risers from below grade shall be PVC coated RGS. Conduit risers, bends or offsets entering into a building shall be PVC coated RGS.
   f. If three or more conduit-bends of the same conduit size and same conduit material type, installed, as part of the Contract Work, fail to comply with the required minimum conduit bend radius or conduit angular degree limits. The following corrective actions shall occur:
      1) The CONTRACTOR shall remove all the non-complying conduit bends and the respective wire in the conduit from the project site. Provide new conduit and wire, complying with the Contract Documents.
      2) Where the conduit bends similar to the non-complying conduit bends are installed concealed in walls, floors, above ceilings or below grade, the Contractor shall expose the conduit bends to allow visual observation.
      3) The CONTRACTOR shall remove the non-complying conduit bends and dispose of the Project Site. The CONTRACTOR shall provide
new conduit bends and conductors complying with the Contract Documents.

4) All the costs to correct the deficient material and work along with costs to repair the direct, indirect, incidental damages and Contract delays shall be the sole responsibility of the CONTRACTOR and shall be included in the bid price.

10. Expansion joint, deflection joint and seismic joint fittings.
   a. Provide a conduit expansion fitting for each conduit length and conduit type as follows (Note - The installation of specified combination expansion/deflection fittings at seismic joints shall satisfy this spacing requirement also):

<table>
<thead>
<tr>
<th>Conduit Type</th>
<th>Conduit</th>
<th>Fitting Length</th>
<th>Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) RMC and EMT</td>
<td>Exposed exterior locations</td>
<td>200-feet</td>
<td></td>
</tr>
<tr>
<td>2) RMC and EMT</td>
<td>Interior weather protected locations</td>
<td>00 feet</td>
<td></td>
</tr>
</tbody>
</table>

   b. Provide a conduit combination expansion/deflection fitting for each conduit, crossing the following elements:

   1) At each building or non-building structure seismic joint.
   2) At each building on non-building structure expansion joint.
   3) At each conduit penetration of a “sound-rated” wall, floor or ceiling.

11. Provide two locknuts and an insulated throat bushing at each metal conduit terminating at enclosures, including but not limited to outlet boxes, junction boxes, terminal cabinets, switchgear, transformers, switchboards, distribution panels and panelboards.

12. Provide metallic or plastic closure caps on all conduit ends during construction, until installation of conductors in the respective conduit.

13. Conduit run exposed, shall be run at right angles or parallel to the walls or structures. All changes in directions, either horizontally or vertically, shall be made with conduit outlet bodies as manufactured by Crouse Hinds, OZ or equal. Conduits run on exposed beams or trelliswork shall be painted to match surrounding surfaces.

14. Conduit exposed on roof:
   a. Conduits installed exposed on roofs shall be installed on conduit sleepers. Place the conduit sleepers a maximum 5-foot on center along the entire length of the conduit; under conduit expansion/deflection fittings; under each junction box and within 24-inches of each conduit bend.
   b. Provide a conduit support “C” channel continuous along the top length of the sleeper and rigidly bolted to the sleeper. Conduits shall be loosely fastened to each sleeper “C” channel with pipe clamps to allow for relative movement between the sleeper and conduit.
   c. Conduits shall not block or interfere with roof hatches, doors, ventilation openings, dampers, equipment access panels/doors, roof water drainage.
   d. Conduit sleepers shall be fabricated from “clear” solid redwood 4-inches by 4-inches (nominal) size. Sleeper length shall extend a minimum of 9-inches past the conduits attached to the sleeper, but in no case shall the length of the sleeper be less than 24-inches.
   e. Conduit sleepers shall be fabricated from “clear” solid redwood 4-inches by 4-inches (nominal) size. Sleeper length shall extend a minimum of 9-inches past the conduits attached to the sleeper, but in no case shall the length of the sleeper be less than 24-inches.
   f. Provide a pad under each sleeper; sleepers shall not be installed in direct contact with the roofing. Sleeper pads shall extend a minimum of 6 inches past each side of the sleeper. The sleeper pad shall be semirigid mineral surfaced composition board, not less than 0.375-inch thickness, bituminous impregnated, manufactured for application on the specific roofing material. Remove roofing “ballast” (gravel) under pad, prior to installation of sleeper pad. Do not puncture roof membrane.
g. Position the “length” of the conduit sleepers’ perpendicular to the roof slope, to prevent obstruction of roof drainage water flow. Where the conduit routing prevents placing the conduit sleeper parallel to the roof slope, provide two separate sleeper pads for the conduit sleeper, with a continuous 3-inches wide water drainage gap between the sleepers. Align the water drainage gap to allow unimpeded water travel along the roof slope drainage flow line between the pads.

h. Sleepers and sleeper pads shall be set in nonhardening mastic, a minimum of 0.25-inch thickness. Mastic shall be inorganic, nonhardening, and complying with ASTM-D1227. Mastic shall be applied with continuous uniform coverage, minimum 0.25-inch thickness, on all the surfaces of each conduit sleeper and on the sleeper pad contact surface with the roof.

15. Rigid steel conduit or electrical metallic tubing shall not be strapped or fastened to equipment subject to vibration or mounted on shock absorbing bases.

16. RMC conduit threads:
   b. The length of bare metal exposed during thread fabrication shall be completely covered by conduit couplings and fittings. Additionally, the thread length shall insure that conduit joints will reach “torque” tightness and become secure before conduit ends “butt” together and before conduit ends “butt” into the “shoulders” of other conduit fittings.
   c. Running threads or right/left handed threads shall not be used to connect RMC.

17. RNMC conduit:
   a. Joints and fittings shall be solvent welded to RNMC conduit. Joints and fittings shall be watertight and airtight after fabrication.

18. Tighten each conduit fittings and fitting appurtenance, to the “torque” (allowable tolerance ±5%) value recommended by the Fitting Manufacturer and applicable code. If three or more conduit fittings are found to not be in compliance with the Manufacturer’s “torque” (tightness) recommendations, the following corrective actions shall occur:
   a. The CONTRACTOR shall tighten “re-torque” the defective fittings and all similar conduit fittings installed as part of the Contract Documents in the presence of the District’s Representative.
   b. If the respective conduit fittings similar to the deficient “torque tightness” fittings are installed concealed in walls, floors, above ceilings or below grade, the CONTRACTOR shall expose the fitting, to allow retightening each similar conduit fitting to the Manufacturers recommended “torque” values.
   c. All the cost to repair the direct, indirect, incidental damages and Contract delays resulting from complying with these requirements shall be the sole responsibility of the CONTRACTOR and shall be included in the bid price.

19. Horizontal directional boring for underground conduit:
   a. Provide a directional guided horizontal “bore-hole” underground conduit installation where one or more of the following conduits occur:
      1) Continuous trenching excavation and backfill for conduit installation is not permitted by the Contract.
      2) Where continuous trenching excavation due to the existing surface and below grade conditions and restrictions, is not possible or practical to excavate a trench.
   b. Provide “path-tracing” of the underground bore head, from the surface, along the entire horizontal bore length. Path tracing shall use electronic
transmitters and receivers, continuously communicating the underground bore head locations and depth to the bore equipment operator. The directional boring system shall employ active tracking and directional position/steering control of the bore equipment drill head location. The active tracking system shall provide a portable receiver/transmitter unit for tracking the position of the moving drill head; a sensor “Sonde” unit on the drill head for tracking signals to the receiver/transmitter; and a drill head tracking data view display located at the boring equipment operator position to view the drill head position information sent from the portable receiver/transmitter. As manufactured by SPX-Radiodetection Company or similar products.

c. Provide vertical pilot excavations not more than 50-feet on center along the path of the bore-hole to intercept the horizontal bore-hole routing, provide excavations at the beginning and end terminals staging points of the horizontal bore-hole.

d. Provide full-depth “shoring” of the vertical pilot excavations. Remove the shoring, backfill, compact and repair the excavations when conduit installation is complete.

e. “Drilling-fluid” shall be used during “back-reaming” and “pullback”, pumped through the drill pipe to the bore drill head.

f. Directional guided horizontal drilling shall employ equipment specifically designed and manufactured for the process. The Equipment Manufacturer shall train bore equipment operating personal in the proper operation of said equipment.

g. Locate the position, size, depth and identify all underground “cross-bore” existing underground utilities, pipes, structures and conflicts along the entire bore path of each underground bore, prior to initiating directional boring work. Notify respective agency for each “cross bore” potential crossing. Comply with the recommendations of the Cross Bore Safety Association (CBSA).

h. Horizontal, directionally guided boring equipment, as manufactured by Ditch Witch; Vermeer Manufacturing; or Case Corporation.

J. Conduit Seals
1. Provide conduit seal fittings at each location where a conduit transitions or passes through the following areas and where indicated on the Drawings:
   a. Refrigerated areas.
   b. Temperature control rooms including warming rooms, steam rooms, saunas etc.
   c. Classified hazardous material areas.
   d. Water intrusion areas.

2. Provide conduit seals on each conduit entering a building from a below grade area located outside the building (i.e., basement, vault etc.) and connecting to the following types of equipment
   a. Transformers
   b. Panelboards
   c. Motor control centers
   d. Switchboards
   e. Switchgear
   f. Motors
   g. Terminal cabinets
   h. Terminal backboards
   i. Cable trenches
3. Conduit seals shall be installed in locations where the fitting is visible and accessible.

K. Nailing Shields
1. Provide “nail” shields where FMC conduit and conductors not installed in a conduit are installed through wood stud and wood frame construction. The nail shield shall provide a barrier resistant to “nailing” fasteners through the stud, and penetrating into the FMC and conductors.
2. The nail shields shall be flat nominal 1.5-inch by 3-inches, 14-gauge steel, and hot dip zinc galvanized with “nailing spurs”.
3. Provide nailing shields on the front face and rear face of each FMC penetration. The shield shall be centered on each penetration through the respective framing, stud framing blocking, and stud framing plates.

L. Conduit Bodies
1. Conduit bodies shall be installed in exposed conduit locations only or above accessible ceilings.
2. Conduit bodies shall be accessible for removing body cover and pulling wire through the conduit body.
3. Conduit bodies shall not be installed inside enclosed walls.

M. Preparation of Reuse of Existing Conduits
1. Prepare existing conduits shown to be reused as part of Contract Work as follows: Complete the required work prior to installing any conductors or cables in respective existing conduits.
   a. “Rod” out existing raceways to be used under this contact, with approved test and flexible mandrels to remove all obstructions to clear debris from inside conduits.
   b. Use test mandrels at least 12-inches long, 0.25-inch less than diameter of duct at center, tapering to 0.5-inch less than duct size at ends.
2. If test mandrels cannot be pulled through raceways, CONTRACTOR shall perform the following to clear the existing raceways:
   a. Force rigid or semi-rigid rods through the raceways to clear the obstructions from one to both ends of the raceway.
   b. Force a power driven rotating router device through the conduit from one or both ends of raceways. Device shall incorporate small diameter cutting blades. Repeat the “router” process in incremental stages to a cutting blade diameter approximately ⅛-inch smaller than the raceway inside diameter.
3. After clearing the raceway of obstructions, pull a test mandrel or brush through the raceway to clear the remaining debris from the raceway.

3.04 WIRE AND CABLE

A. Branch circuit and fixture joints for #10AWG and smaller wire shall be made with UL-approved connectors listed for 600 volts, approved for use with copper and/or aluminum wire. Connector to consist of a cone-shaped, expandable coil spring insert, insulated with a nylon shell and two wings placed opposite each other to serve as a built-in wrench or shall be molded one-piece as manufactured by 3M-"Scotchlok".
B. Branch circuit joints of #8AWG and larger shall be made with screw pressure connectors made of high strength structural aluminum alloy and UL-approved for use with both copper and/or aluminum wire as manufactured by Thomas & Betts. Joints shall be insulated with plastic splicing tape, tapered half-lapped and at least the thickness equivalent to 1.5-times the conductor insulation. Tapes shall be fresh and of quality equal to Scotch.

C. Use UL listed pulling compound for installation of conductors in conduits.

D. Correspond each circuit to the branch number indicated on the panel schedule shown on the Drawings except where departures are approved by the DISTRICT’S Representative.

E. All wiring, including low voltage, shall be installed in conduit.

F. Control wiring to conform to the wiring diagrams shown on the Mechanical Drawings and the Manufacturer's Wiring Diagrams.

G. All splices in exterior pull boxes and light poles shall be cast resins encapsulated.  
   1. Power conductor splices - 3M Scotchcast Series 82/85/90; Plymouth or equal.  
   2. Control and signal circuits 3M Scotchcast series 8981 through 8986, Plymouth or equal.

H. Neatly group and lace all wiring in panelboards, motor control centers and terminal cabinets with plastic ties at 3-inch on centers. Tag all spare conductors.

3.05 CHEMICAL GROUND ROD

A. General
   1. Install ground rod system in compliance with Manufacturer's instructions.
   2. Install rods vertically. Where subterranean hard rock conditions prevent vertical installation horizontal "L" shape ground rod shall be installed.
   3. Where ground rod is installed in an indoors dry location set ground box flush with finish floor. Where ground rod is installed outdoors set the top of the ground box four inches above finish grade.
   4. Do not remove sealing tape from ground rod holes until time of installation in ground.
   5. Separate ground rods from all other grounding electrodes and from each other by not less than 12-feet horizontal distance.

B. Excavation
   1. Vertical installation bore a 12-inches diameter vertical hole in the ground six inches deeper than ground rod length.
   2. Horizontal installations excavate a 12-inches wide trench, slope rod and trench to insure end cap of rod is 2-inches lower than the elbow.

C. Backfill
   1. Surround the entire rod with a minimum of 10 inches of bentonite clay mixed with water at six times volume to form a paste. Approximately 14-gallons for each 50-pounds of clay. Remove any excavation liners from the rod excavation area.
   2. Install ground box and complete backfill.

D. Connect grounding electrode conductor(s) to ground rod.
3.06 CABLE RACKS

A. General
   1. Provide cable racks in precast and cast-in place concrete pullboxes, manholes and cable trenches.

3.07 TESTING

A. Testing Conduit and Conduit Bends
   The CONTRACTOR shall demonstrate the usability of all underground raceways, and field fabricated conduit bends installed as part of this Contract.
   1. A round tapered segmented semi-rigid mandrel with a diameter approximately ¼-inch smaller than the diameter of the raceway, shall be pulled through each new raceway.
   2. The mandrel shall be pulled through after the raceway installation is completed. Conduits which stubout only, may have the mandrel pulled after the concrete encasement is completed, but prior to completing the backfill.
   3. DISTRICT’S Representative shall witness the raceway testing for usability. A Representative of the respective Utility Company shall witness the raceway testing where applicable.
   4. CONTRACTOR shall repair/replace any conduit and conduit bend provided under this Contract which will not readily pass the mandrel during this test.

B. Refer to Section 26 0500 Common Work Results for Electrical item 1.13 for Testing requirements.

END OF SECTION 26 0530
112316/223037
SECTION 26 0548
SOUND CONTROL

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Comply with pertinent provisions of Division 26.
B. Submit Product Data Sheets for vibration isolation devices.
C. Submit Detailed Shop Drawings including Dimensioned Plans, showing equipment vibration isolation anchoring.

PART 2 - PRODUCTS AND EXECUTION

2.01 QUIETNESS OF OPERATION

Before the work will be accepted as complete, quietness of operation, to a degree satisfactory to the ARCHITECT, shall be attained for apparatus, equipment, fixtures, etc., included under the electrical work. Provide isolation and vibration protection required.

2.02 VIBRATION ISOLATION FOR ELECTRICAL EQUIPMENT

A. Objective: It is the objective of this specification to provide the necessary design for the avoidance of excessive noise or vibration in the building due to the operation of machinery or transformers, and/or due to interconnected conduit.

B. CONTRACTOR Responsibility
   1. Provide a submittal to the ARCHITECT for review prior to any installation of his equipment, containing the following information:
      a. Catalog cuts and data sheets on specific vibration isolators to be utilized showing compliance with the Specification.
      b. An itemized list showing the items of equipment to be isolated, the isolator loading and deflection and isolator placement.
      c. Drawings showing methods for attachment of conduit to motors.
   2. Furnish and install the vibration isolation devices as specified herein.
   3. Do not install any equipment or conduit as specified in the schedule, which makes rigid contact with the "building" unless it is approved in this Specification, or by the ARCHITECT. "Building" includes slabs, beams, studs, walls, lath, etc.
4. Coordinate work with other trades to avoid rigid contact between equipment or conduit as specified in the schedule and the building. Inform other trades following his work, such as plastering, to avoid any contact that would reduce the vibration isolation.

5. Bring to the ARCHITECT'S attention, prior to installation, any conflicts with other trades which will result in unavoidable contact to the equipment or conduit as specified in the schedule, described herein due to adequate space, etc. Corrective work necessitated by conflicts after installation shall be at the responsible CONTRACTOR'S expense.

6. Bring to the ARCHITECT'S attention any discrepancies between the specifications and field conditions, changes required due to installation. Corrective work necessitated by discrepancies after installation shall be at the CONTRACTOR'S expense.

7. Obtain approval from the ARCHITECT of any installation to be covered on enclosed, prior to such closure.

8. Obtain written and/or oral instructions from the Vibration Isolation Manufacturer as to the proper installation and adjustment of vibration isolation devices.

9. Notify the ARCHITECT, prior to the general installation of vibration isolation devices, so that the ARCHITECT can instruct and demonstrate the technique of proper installation with the CONTRACTOR'S Foreman.

10. Correct, at no additional cost, all installations, which are deemed to be defective workmanship or materials by the ARCHITECT.

**2.03 VIBRATION ISOLATION TYPES**

**A. Isolator Description**

1. Isolate all transformers with Type MN molded neoprene units equipped with leveling bolts and design status deflection under load of 0.3-inch.

2. Isolate all switchgear connected directly to transformer with Type PN isolators. Limit loading to a static deflection of 0.06 inch. Choose the area of pad to match the load with the Manufacturer's recommended unit loading. An auxiliary steel plate may be required to distribute the load uniformly over the pad area.

**B. Equivalent Vibration Isolators**

1. | Type Description | A | B | C | D | E | F | G |
---|-----------------|---|---|---|---|---|---|---|
| Neoprene Mount |   |   |   |   |   |   |   |
| a) 0.2-inch max. deflection | N | FD | R | RV | CS | F | T-44 |
| b) 0.4-inch max. deflection | ND | FDD | RD | RFD | FU | RD | T-44 |
| PN Neoprene Pad | W | (1) | (2) | NR | R | (3) | 100W |

2. Notes | Manufacturer's Code |
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>(1) Elastogrip</td>
<td>A. Mason Industries</td>
</tr>
<tr>
<td>(2) Shearflex</td>
<td>B. Korfund</td>
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<tr>
<td>(3) Kinetic</td>
<td>C. Vibration Mounting</td>
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<tr>
<td></td>
<td>D. Amber/Booth</td>
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<td></td>
<td>E. Sausse</td>
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<tr>
<td></td>
<td>F. Consolidated Kinetics</td>
</tr>
<tr>
<td></td>
<td>G. Vibration Eliminator</td>
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</tbody>
</table>
2.04 CONDUIT INSTALLATION

A. Provide flexible conduit or an approved vibration isolation device between any transformer and the building structure.

B. Secure all electrical panels connected to transformers by flexible conduit to the floor. Do not contact stud or masonry partitions. Isolated panels from the floor as specified herein.

C. Provide flexible conduit connections to all connections to air conditioning, plumbing, etc., or any rotating or oscillating equipment requiring electrical motors. Base the length of flexible conduit required for each motor upon the requirements for a 360 degrees loop in the conduit between the electrical motor and electrical box.

D. As an alternative to the 360 degrees loop, a Neoprene or rubber bushing between the conduit and the electric motor to break the metal-to-metal contact may be used. Provide a flexible ground strap to complete the electrical ground.

2.05 DEVICE OUTLET BOXES (INSTALLED IN COMMON PARTY SEPARATION WALLS, IN CORRIDOR WALLS AND SERVICE WALLS)

Device outlet boxes installed in walls shall be sealed on the exterior back and sides of the boxes, including wall openings around the box, with a ⅛-inch minimum thickness resilient sound absorbing, sealant. The sealant shall be free of asbestos, temperature rated from -30°F to 200°F, self-adhesive to metal and plastics, as manufactured by Lowry and Associates Inc. Sun Valley, California or equal.
SECTION 26 0923

OCCUPANCY MOTION SENSORS

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
   2. General Provisions and Requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit data sheets on sensors, wiring diagrams, relays, transformers, junction and outlet boxes, and mounting accessories. Submit wiring diagrams. Submit Agency Certifications/Approvals.

B. Submit details of pendant-mounted sensor installation.

1.03 APPLICABLE STANDARDS (ADDITIONAL REQUIREMENTS)

A. General
   1. All ultrasonic sensors shall comply with the State of California Safety and Health Requirements. Decibel levels for ultrasonic sensors shall comply with the following criteria and the State of California Energy Commission for ultrasonic emissions:
      
      MAXIMUM DECIBEL LEVELS FOR ULTRASONIC EMISSIONS
      
      Mid-frequency of Sound Pressure | Minimum dB Level within Third Octave
      
      Third-Octave Bank (kHz) | Band (in dB reference 20 micropascals)
      
      Less than 20 | 80
      20 or more to less than 25 | 105
      25 or more to less than 31.5 | 110
      31.5 or more | 115

   2. The CONTRACTOR and Manufacturer shall certify in writing that all proposed and installed occupancy motion sensors comply with the Federal Environmental Protection Agency (EPA) and State of California Energy Commission criteria.

   3. Occupancy motion sensors shall be:
      a. UL listed and labeled.
PART 2 - PRODUCTS

2.01 MOTION SENSORS

A. General

1. Motion sensors and power supply shall be self-contained. The motion sensors shall be solid state low voltage devices designed specifically for energy conservation lighting control. Combined dual function ultrasonic and infrared motion sensing.
   a. Ultrasonic crystal controlled to within +/- 0.01% motion sensor technology.
   b. Passive infrared (PIR) motion sensor technology.

2. Occupancy motion sensor shall also include available ambient light sensor, in addition to the motion sensor. The ambient light sensor shall prevent the occupancy motion sensor from automatically turning "ON" the respective lighting when the ambient day-lighting intensity detected by photoelectric cell contained in the motion sensor exceeds a selected intensity. The ambient light sensor circuit shall not control the automatic off function. The ambient lighting intensity detection sensitivity shall be adjustable in the sensor, adjustment range not less than 15 through 140 ambient day-lighting footcandles.

3. Automatic-off: sensor shall automatically turn "OFF" lighting when there is no movement after the preset time delay interval. Lights shall remain "ON" with movement. There shall be a "dead band" time period after the unit turns itself off (because of lack of motion) during which a new motion will automatically turn lights on without the manual switch having to be activated.

4. Automatic-ON: Sensor shall automatically turn "ON" lighting when movement is detected in the monitored space. Lights shall remain on with movement. An internal control shall provide a mechanism to bypass the automatic-ON control feature and allow only automatic-OFF functions. Where manual ON/OFF lighting control switches are shown on the Drawings, in addition to the occupancy motion sensors in the same space, the manual controls shall override the automatic "ON" control feature of the occupancy motion sensor. Override of the automatic "OFF" feature shall not be affected by the respective manual switches.

5. Motion detection sensitivity, time delays to turn "ON" after activation and time delays to turn "OFF", shall be adjustable to ensure there will be no nuisance ON/OFF switching of the lights by the motion sensor while the room is occupied. Adjustable settings shall be tamper resistant, concealed behind an access protection cover.
   a. Fluorescent light fixtures with Instant Start or Rapid Start lamp ballast set the minimum lamp "ON" time at not less than 15-minutes. Program Start lamp ballast, set the minimum lamp "ON" time at not less than 5-minutes.

6. Automatic self-adjusting Adaptive-Learning for time delay and sensitivity variable conditions in the monitored space.

7. Fail-to-on, the failure of a sensor shall cause the occupancy motion sensor load relay contacts to activate, so the occupancy motion sensor function is automatically bypassed and lighting is turned-ON.

8. All occupancy motion sensors shall be provided with an indicator light to display when motion is being detected and the unit is operating correctly.

9. Non-volatile internal memory shall store and maintain in memory all occupancy motion sensor settings during any electric power failure.

10. Where multiple occupancy motion sensors are installed with overlapping monitoring spaces, the sensors shall not cause false triggering or malfunctions to adjacent occupancy motion sensors.
11. Occupancy motion sensors shall incorporate mechanical vibration-damping. The vibration-damping shall prevent normal building vibrations from causing “false” sensor operation.
12. As manufactured by WattStopper; or Leviton; or Hubbell; or Greargate.

B. Area Control Coverage
1. Space coverage of motion sensor transponder shall remain constant after sensitivity control has been set. No automatic reduction/increase in coverage nor sensitivity shall occur when air motion caused by air conditioning or heating fans are in operation nor when the occupancy motion sensor has turned off lighting due to not detecting any motion.
2. Occupancy motion sensors in spaces 300 square feet area or less may be a wall switch mounted unit.
   a. Wall switch sensors shall provide detection of motion at desk top, for up to 300 square feet,
      180-degree range within a volume dimension of up to approximately 20- feet by 15-feet by 10-feet high, extending from the wall mounting height of the unit to the finish floor.
   b. Wall switch occupancy motion sensors shall be a minimum load capacity of 500 watts 120V; 1000 watts 277V, but in no case shall the load rating be less than the lighting loads shown on the Drawings.
3. Motion sensors in spaces exceeding 300 square feet in size and where shown on the Drawing as mounted on the ceiling, shall be ceiling mounted. The sensor shall not protrude more than 1.6-inches below the ceiling line.
   a. Sensor area coverage shall be 360 degrees three dimensional diameter surrounding the sensor installation location.
   b. The sensor shall be rated to provide coverage of the space volume/room length/width/height shown in the contract documents. Provide additional ceiling mounted motion sensors to provide complete coverage of each area.
   c. Corridor/hallway sensor area coverage shall not be less than 80-feet linear feet extending from the sensor installation location. Sensor shall be bi-directional or uni-directional to provide complete area motion detection at the installation location shown on the Drawings.

2.02 CONTROL UNITS
A. General
1. Control unit shall be an integrated, self-contained unit consisting internally of load switching control relay(s); internal power supply and power supply transformer. The power supply shall be sufficient capacity to provide low-voltage power to a minimum of two motion sensors.
2. Occupancy motion sensors directly controlling line voltage electrical loads, the line voltage load relay contacts shall be “dry” type electrically isolated, with load ratings as follows:
   a. 15A – 120 volt single phase 60Hz AC.
   b. 15A – 277 volt single phase 60Hz AC.
3. Load relay contacts shall be rated to control load types up to the full ampere rating. Incandescent Tungsten lamps for lighting equipment. Rapid start and instant start and Program Start solid state electronic ballast (both low power factor and high power factor) for lighting equipment.
4. The quantity of individual internal load switching relays shall be not less than the quantity of individual “switchleg” circuits to be controlled shown on the Drawings.

B. Occupancy Management Control/Building Automation
   1. Provide each occupancy motion sensor control unit with auxiliary dedicated single pole double throw relay contacts operated by the motion sensors that shall be interfaced with Building Energy Management Control/Building Automation (EMCS/BAS) Energy Management and/or building security systems. Relay contacts serving security function shall activate when motion is detected, regardless of whether the respective room manual light switches are ON or OFF.

C. Occupancy Motion Sensors that Connect to Low Voltage Remote Control Relays (LVRCR) Systems.
   1. LVRCR systems and occupancy motion sensor shall be rated and certified by the Occupancy Sensor Manufacturer and the LVRCR Manufacturer for proper operation with the LVRCR control port inputs and the occupancy motion sensor control output interface relay contacts. Occupancy sensor normally open, normally closed, maintained control relay contact, momentary control relay contact, control operation sequences in coordination with the LVRCR requirements for automatic “ON and OFF” load control by the LVRCR.
   2. The occupancy motion sensor power supply input, voltage rating and current rating control interface should comply with LVRCR requirements.

2. OCCUPANCY MOTION SENSOR HOUSING ENCLOSURE

A. General
   1. Enclosures for occupancy motion sensor control units shall be pressed steel or high impact resistant nonflammable non-metallic enclosure. Enclosure finish color white. Semi-flush mounting installation, NEMA I “dead front” construction with mounting plates and barriers to provide separation between line voltage and low voltage wiring.

B. Mounting
   1. Flush mounting 4.67-inches square by 2.125-inches deep outlet junction box with extension ring and occupancy motion sensor cover mounting plate.
   2. Occupancy sensor shall be semi-flush mount into outlet box with tamper resistant attachment of the sensor and the outlet box.
   3. Motion sensor shall be approved for installation in environmental air plenum.

PART 3 – EXECUTION

3.01 MOTION SENSOR QUANTITIES AND TYPES

A. General
   1. The CONTRACTOR shall provide the quantity and types of motion sensors required for complete and proper volumetric coverage without gaps within the range of coverage(s) of controlled areas.
   2. Rooms shall be 90% to 100% volumetric coverage of the sensing coverage area, to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). Motion sensing detection coverage shall extend from the finish floor to not less than 48-inches above finish floor.
3. The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only rooms, which are to be provided with sensors. The CONTRACTOR shall provide additional sensors if required to properly cover the respective rooms.

4. Ceiling mounted sensors shall also be pendant-mounted in rooms in which the controlled lighting fixtures are chain, cable or pendant suspension mounted. The mounting height of the sensor shall be approximately 6-inches below the bottom of the light fixtures to be controlled.

5. Wall mounted sensors shall be installed at a height not higher than the bottom of the respective ceiling lighting fixtures. For Wall switches with integrated manual switch for “ON” or “OFF” applications, mounting height shall not exceed 42-inches above finish floor.

6. Occupancy sensors may be affected by various conditions in the room. Make adjustments, change the location and/or type of occupancy motion sensor to obtain proper operation in each specific room location.

7. Install occupancy motion sensors a minimum of 72-inches horizontal distance from environmental air supply/return registers, fans and moving objects.

3.02 SETUP AND TESTING

A. Commissioning (Additional Requirements)
   1. Setup, testing, startup and Commissioning shall be performed by Factory Technician(s) trained, certified and authorized by the Equipment Manufacturer. Final commissioning shall be performed after installation and connections are complete.
   2. Provide system programming and setup of all control sequences for lighting control system.
   3. Adjust sensitively, time-delay, location and orientation of each occupancy motion sensor; test each sensor/control unit all in accordance with the Manufacturer’s recommendations. Be certain that no obstructions block proper sensor coverage of detection areas and limit sensor pickup zone to the respective room.
   4. Test all control system functions after the installation and connections are complete and the system has been energized. Verify each control sequence of operation and each device to be controlled are operating correctly.
   5. Verify interconnections and controls with the:
      a. Lighting control systems.
      b. Security/intrusion detection systems.
   6. Record and document each sensor setup and program setting.
   7. Submit written report (six copies) to District’s Representative certifying commissioning has been performed; all respective systems are operating correctly and documenting all software setup and each device settings.
   8. Refer to General Commissioning Section 01 9113 for additional requirements.

3.03 WIRING (ADDITIONAL REQUIREMENTS).

A. General
   1. The Drawings do not indicate the quantity of control wires required between various control points. The CONTRACTOR shall provide the quantity and type of control wire required for proper system operation, as recommended by the System Manufacturer. Install all control circuits in conduit.
2. Control wire shall be copper #18AWG minimum, twisted pairs, PVC insulated for control voltage, Color Coded to match relay and switch wiring “pigtail” Color Codes.

3. Network communications wires shall be ANSI/EIA/TIA-568B, 100-OHM, 4-pair shielded twisted pairs STP, Category-5E.

4. Where multiple control wires are installed in a signal conduit or route to a single location provide multi-conductor control cables with outer jacket. Control wires for control of relay controllers which shall be separate twisted shielded 4-wire PVC insulated conductors, with a ground wire and outer jacket for each controller to prevent “RF” inference.

5. Control wire shall be increased in wire gauge size as required to ensure proper system operation and voltage drop over the installation distance shown on the Drawings between equipment and control device locations.

6. Occupancy motions sensor control power shall be powered from line voltage "hot" non-switched, lighting branch circuit. Alternately, control power may be obtained directly from the respective lighting control panel (if available). Provide two additional #12 (AWG) “hot-circuit” and neutral unswitched conductor in conduit homeruns and branch circuits.

7. All wiring shall be installed in conduit.
SECTION 26 0943

LIGHTING CONTROL SYSTEM

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. NA

1.02 SUMMARY

A. The lighting control system specified in this Section shall provide time-based, sensor-based (both occupancy and daylight), and manual lighting control.

B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)

C. All system devices shall be networked together enabling digital communication and shall be individually addressable.

D. The System Architecture shall be capable of enabling stand-alone groups (rooms) of devices to function in some default capacity even if network connectivity to the greater system is lost.

E. The System Architecture shall facilitate remote operation via a computer connection.

F. The system shall not require any centrally hardwired switching equipment.

G. The System shall be capable of Wireless, Wired, or Hybrid Wireless/Wired Architectures.

1.03 DEFINITIONS

A. NA

1.04 SUBMITTALS

A. Product Datasheets (general device descriptions, dimensions, wiring details, nomenclature).

B. Riser Diagrams – typical per room type (detailed Drawings showing device interconnectivity of devices).

C. Other Diagrams – as needed for special operation or interaction with other system(s)

D. Example Contractor Startup/Commissioning Worksheet – must be completed prior to factory start-up.

E. Hardware and Software Operation Manuals

F. Other operational descriptions as needed
1.05 QUALITY ASSURANCE
   A. All steps in sensor manufacturing process shall occur in the USA; including population of all electronic components on circuit boards, soldering, programming, wiring, and housing.
   B. All components and the manufacturing facility where product was manufactured must be ROHS compliant.
   C. In high humidity or cold environments, the sensors shall be conformably coated and rated for condensing humidity and -40 degree Fahrenheit (and Celsius) operation.
   D. All applicable products must be UL / CUL Listed or other acceptable National Testing Organization.

1.06 COORDINATION
   A. Coordinate lighting control components to form an integrated interconnection of compatible components.
   B. Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs.
   C. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable Local and National Codes.

1.07 WARRANTY
   A. All devices in lighting control system shall have a 5 year warranty.

PART 2 – PRODUCTS

2.01 MANUFACTURERS
   A. This Specification is based on the nLight® Network Control System from Sensor Switch, an Acuity Brands Company (800-727-7483, www.sensorswitch.com).

2.02 SYSTEM REQUIREMENTS
   A. System shall have an architecture that is based upon three main concepts; 1) Intelligent lighting control devices; 2) Standalone lighting control zones; 3) Network backbone for remote or time based operation.
   B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.
   C. System must interface directly with intelligent LED luminaires such that only CAT-5 cabling is required to interconnect luminaires with control components such as sensors and switches (see Networked LED Luminaire section).
D. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and possess RJ-45 style connectors.

E. Lighting Control Zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.

G. Lighting Control Zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

H. Individual Lighting Zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.

I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.

J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

K. System shall have one or more primary wall mounted network control “gateway” devices that are capable of accessing and controlling connected system devices and linking into an Ethernet LAN.

L. System shall use “bridge” devices that route communication and distribute power for up to eight directly connected lighting zones together for purposes of decreasing system wiring requirements.

M. System shall be capable of wirelessly connecting a lighting zone to a WiFi (802.11n) wireless data network for purposes of eliminating the “bridge” devices and all cabling that connects zones to bridge devices.

N. WiFi enabled devices shall be able to detect when WiFi Network is down and revert to a user directed default state.

O. WiFi enabled devices shall be capable of current monitoring

P. WiFi enabled devices shall utilize WPA2 AES encryption

Q. WiFi enabled devices shall be able to connect to 802.11b/g/n WiFi Networks

R. WiFi enabled devices shall have at least one local RJ-45 port for communicating with nonWiFi enabled system devices

S. System shall have a web-based software management program that enables remote system control, status monitoring, and creation of lighting control profiles.
T. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

U. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or WiFi backbone.

V. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.

1. Auto-On / Auto-Off (via occupancy sensors)
   - Zones with occupancy sensors automatically turn lights on when occupant is detected.
   - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
   - Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.

2. Manual-On / Auto-Off (also called Semi-Automatic)
   - Pushing a switch will turn lights on.
   - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.

   - Pushing a switch will turn lights on.
   - After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
   - Sequence can be reset via scheduled (ex. daily each morning) events

5. Auto-to-Override On
   - Zones with occupancy sensors automatically turn lights on when occupant is detected.
   - Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
   - Sequence can be reset via scheduled (ex. daily each morning) events

   - Pushing a switch will turn lights on.
   - Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
   - Sequence can be reset via scheduled (ex. daily each morning) events

7. Auto On / Predictive Off
   - Zones with occupancy sensors automatically turn lights on when occupant is detected.
   - Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
   - If switch is pressed, lights turn off and a short “exit timer” begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
8. Multi-Level Operation (multiple lighting levels per manual button press)
   • Operating mode designed specifically for bi-level applications
   • Enables the user to cycle through the up to four potential on/off lighting states using only a single button.
   • Eliminates user confusion as to which of two buttons controls which load
   • Three different transition sequences are available in order to comply with energy codes or user preference)
   • Mode available as a setting on all nLight devices that have single manual on/off switch (ex. nWSX, nPODM, nPODM-DX).
   • Depending on the sequence selected, every button push steps through relays states according to below table
   • In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present.

<table>
<thead>
<tr>
<th>Sequence State #</th>
<th>Alternating Sequence</th>
<th>Full On Sequence</th>
<th>3 Step On Sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relay 1</td>
<td>Relay 2</td>
<td>Relay 1</td>
</tr>
<tr>
<td>1</td>
<td>On</td>
<td>Off</td>
<td>On</td>
</tr>
<tr>
<td>2</td>
<td>Off</td>
<td>On</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>On</td>
</tr>
<tr>
<td>4*</td>
<td>Off</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>

(*step only present for devices without separate off button)

W. A taskbar style desktop application shall be available for personal lighting control.

X. An application that runs on “smart” handheld devices (such as an Apple® IPhone®) shall be available for personal lighting control.

Y. Control software shall enable logging of system performance data and presenting useful information in a web-based graphical format and downloadable to .CSV files.

Z. Control software shall enable integration with a BMS via BACnet IP.

AA. System shall provide the option of having pre-terminated plenum rated CAT-5 cabling supplied with hardware.

2.03 INDIVIDUAL DEVICE SPECIFICATIONS

A. Control Module (Gateway)
   1. Control module shall be a device that facilitates communication and time-based control of downstream network devices and linking into an Ethernet.
   2. Devices shall have a user interface that is capable of wall mounting, powered by low voltage, and have a touch screen.
   3. Control device shall have three RJ-45 ports for connection to other backbone devices (bridges) or directly to lighting control devices.
   4. Device shall automatically detect all devices downstream of it.
5. Device shall have a standard and astronomical internal time clock.
6. Device shall have one RJ-45 10/100 BaseT Ethernet connection.
7. Device shall have a USB port.
8. Each control gateway device shall be capable of linking 1500 devices to the management software.
9. Device shall be capable of using a dedicated or DHCP assigned IP address.
10. Network Control Gateway device shall be the following Sensor Switch model Series: nGWY2.

B. Networked System Occupancy Sensors
1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize Passive Infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.
6. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one (1) 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W at 120 VAC, 1200 W at 277 VAC, 1500 W at 347 VAC, and ¼ HP motor. Relays shall be dry contacts.
7. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
10. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue.
12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
13. Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 cabling.
14. Sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements.
15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
16. Wall switch sensors must meet NEC grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
17. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
18. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray).
19. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls.
20. Wall switch sensors shall be the following Sensor Switch model numbers, with device color and optional features as specified:
   - nWSD or nWSX (PIR, 1 Relay)
   - nWSD PDT or nWSX PDT (Dual Tech, 1 Relay)
   - nWSD NL (PIR with Night Light, 1 Relay)
   - nWSD PDT NL (Dual Tech with Night Light, 1 Relay)
   - nWSX NL LV (PIR with Night Light, No Relay)
   - nWSD PDT NL LV (Dual Tech with Night Light, No Relay)
   - nWSD LV or nWSX LV (PIR, No Relay, Raise/Lower Dim Ctrl)
   - nWSD PDT LV or nWSX PDT LV (Dual Tech with Night Light, No Relay, Raise/Lower Dim Ctrl)
21. Network system shall have sensors that can be embedded into luminaire such that only the lens shows on luminaire face.
22. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection.
23. Embedded sensors shall have an optional photocell.
24. Embedded sensors shall be the following Sensor Switch model numbers:
   - nES 7 (PIR, No Relay)
   - nES 7 ADCX (PIR with Photocell, No Relay)
   - nES PDT 7 (Dual Technology, No Relay)
   - nES PDT 7 ADCX (Dual Technology with Photocell, No Relay)
25. Network system shall also have ceiling, fixture, recessed, and corner mounted sensors available.
26. Fixture mount sensors shall be capable of powering themselves via a line power feed.
27. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
28. Sensors with dimming can control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).
29. Sensors shall be the following Sensor Switch model numbers, with device options as specified:

<table>
<thead>
<tr>
<th>Model # Series</th>
<th>Occupancy Poles</th>
<th># of Relays</th>
<th>Lens Type</th>
<th>Detection Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>nCM(B) 9</td>
<td>1</td>
<td>-</td>
<td>Standard</td>
<td>PIR</td>
</tr>
<tr>
<td>nCM(B) 9 2P</td>
<td>2</td>
<td>-</td>
<td>Standard</td>
<td>PIR</td>
</tr>
<tr>
<td>nCMR(B) 9</td>
<td>1</td>
<td>1</td>
<td>Standard</td>
<td>PIR</td>
</tr>
</tbody>
</table>
Note: Recessed mount versions of the above ceiling (fixture) mount versions also shall be available (e.g. nCMR(B) 9 => nRMR 9).

30. System shall have WiFi enabled fixture mountable sensors available.
31. Embedded sensors shall have an optional photocell and 0-10 VDC dimming output.
32. WiFi enable sensors shall be one of the Sensor Switch model numbers:
   nCMRB 6 WIFI (PIR, with Relay)
   nCMRB 10 WIFI (PIR, with Relay)
   nCMRB 50 WIFI (PIR, with Relay)
   nCMRB 9 WIFI (PIR, with Relay)

C. Networked System Daylight (Photocell and or Dimming) Sensors
1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor’s set-point and deadband shall be automatically calibrated through the sensor’s microprocessor by initiating an "Automatic Set-
3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of Class 2 current (typically 40 or more ballasts).
5. Photocell and dimming sensors shall be equipped with an automatic override for 100 hour burn-in of lamps. This feature must be available at any time for lamp replacements. (Note: This function should be performed prior to any dimming of the lamps including the “auto set-point” setting).
6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an “offset” from the primary zone.
8. Line voltage versions of the above described photocell and combination photocell/ dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall be 800 W at 120 VAC, 1200 W at 277 VAC, 1500 W at 347 VAC, and ¼ HP motor load. Relays shall be dry contacts.
9. Sensor shall be the following Sensor Switch model numbers, with device options as specified:
   - nCM(B) PC (on/off)
   - nCM(B) ADC (dimming)
   - nCM(B) PC ADC (on/off, 0-10 VDC dimming)
   - nCMR(B) PC (on/off, single relay)
   - nCMR(B) PC ADC (on/off, 0-10 VDC dimming, single relay)
   Note: Recessed mount versions of the above ceiling (fixture) mount versions also shall be available (e.g. nCMR(B) PC => nRMR PC)
10. Network system shall have dimming photocells that can be embedded into luminaire such that only the lens shows on luminaire face.
11. Embedded sensors shall be the following Sensor Switch model number:
    - nES ADCX (Dimming Photocell)

D. Networked System Power (Relay) Packs
1. Power Pack shall incorporate one or more Class 1 relays and contribute low voltage power to the rest of the system. Secondary Packs shall incorporate the relay(s), shall have an optional 2nd relay, 0-10 VDC dimming output, or line voltage dimming output, but shall not be required to contribute system power. Power Supplies shall provide system power only, but are not required to switch line voltage circuit. Auxiliary Relay Packs shall switch low voltage circuits only.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
3. All devices shall have two RJ-45 ports.
4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
5. Power Pack shall securely mount to junction location through a threaded ½ inch chase nipple or be capable of being secured within a luminaire ballast channel. Plastic clips into junction box shall not be accepted. All Class 1 wiring shall pass through chase nipple into adjacent junction box without any exposure of wire leads. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
6. When required by Local Code, Power Pack must install inside standard electrical enclosure and provide UL recognized support to junction box. All Class 1 wiring is to pass through chase nipple into adjacent junction box without any exposure of wire leads.

7. Power Packs and Power Supplies shall be available that are WiFi enabled.

8. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.

9. Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.

10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.

11. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120 VAC incandescent lighting loads or 120/277 VAC line voltage dimmable fluorescent ballasts (2-wire and 3-wire versions).

12. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.

13. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.

14. Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.

15. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.

16. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.

17. Specific Secondary Packs shall be available that control louver/damper motors for skylights.

18. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

19. Power (Relay) Packs and Supplies shall be the following Sensor Switch model Series:

   - nPP16 (Power Pack with 16A relay)
   - nPP16 WIFI (Power Pack with 16A relay, WIFI enabled)
   - nEPP5 D (Power Pack with 5A relay and 0-10VDC dimming output)
   - nSP16 (Secondary Pack with 16A relay)
   - nSP5 2P (Secondary Pack with two 5A relays)
   - nSP5 D (Secondary Pack with 5A relay and 0-10VDC dimming output)
   - nPP16 ER (UL924 Listed Secondary Pack with 16A relay for switching emergency power circuits)
   - nSP5 D ER (UL924 Listed Secondary Pack with 5A relay and 0-10VDC dimming output for switching emergency power circuits)
   - nSP5 PCD 2W (Secondary Pack with 5A relay and incandescent dimming or 2-wire line voltage fluorescent dimming output)
   - nSP5 PCD 3W (Secondary Pack with 5A relay and 3-wire line voltage fluorescent dimming output)
   - nSP5 PCD MLV (Secondary Pack with 5A relay and magnetic low voltage dimming output)
   - nSP5 PCD ELV 120 (Secondary Pack with 4A relay and electronic low voltage dimming output)
   - nSP5 480 (Secondary Pack with 5A relay for switching 208/240/480 VAC loads)
   - nSP5 2P LVR (Louver/Damper Control Pack)
   - nSHADE (Pulse On/Off Control Pack)
E. Networked System Relay and Dimming Panels.
1. Panel shall incorporate up to four normally closed latching relays capable of switching 120/277 VAC or up to two Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection.
8. Power (Relay) Packs and Supplies shall be the following Sensor Switch model numbers:
   nPANEL 4 (Panel with four 120/277 VAC relays and four 0-10 VDC dimming outputs)
   nPANEL 2 480 (Panel with two dual phase relays (208/240/480 VAC) and two 0-10 VDC dimming outputs).

F. Networked Auxiliary Input / Output (I/O) Devices
1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½-inch knockout.
2. Devices shall have two RJ-45 ports.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically forty or more ballasts).
5. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.
6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output.
7. Specific I/O devices shall sense state of low voltage outdoor photocells.
8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
9. Specific I/O devices shall sense.
10. Auxiliary Input/Output Devices shall be the following Sensor Switch model numbers:
    nI0 D (I/O device with 0-10 dimming output)
    nI0 1S or nI0 RLX (I/O device with contact closure or 0-10VDC dimming input)
    nI0 NLI (Input device for detecting state of low voltage outdoor photocell; sold in nI0 PC KIT only)
    nI0 X (Interface device for communicating with RS-232 enabled AV Touch Screens)
G. Networked LED Luminaires
   1. Networked LED luminaire shall have a mechanically integrated control device.
   2. Networked LED luminaire shall have two RJ-45 ports.
   3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers).
   4. Networked LED luminaire shall provide low voltage power to other networked control devices.
   5. System shall be able to turn on/off LED luminaire without using a relay.
   6. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
   7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hours).
   8. LED Luminaires shall be the following Lithonia model families:
      RTLED
      TLED
      VLED
      ACLED
      AL LED
      WLED
      STLED
      MINO

H. Networked System Wall Switches and Dimmers
   1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
   2. Devices shall be available with zero or one integrated Class 1 switching relay.
   3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
   4. All sensors shall have two RJ-45 ports.
   5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
   6. Devices shall be available in four colors (Ivory, White, Light Almond, and Gray).
   7. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically forty or more ballasts).
   8. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
   9. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
  10. Devices with mechanical push-buttons shall be made available with custom button labeling.
  11. Devices with a single on button shall be capable of selecting all possible lighting combinations for a bi-level lighting zone such that the user confusion as to which of two buttons (as is present in multi-button scenarios) controls which load is eliminated.
  12. Wall switches and dimmers shall be the following Sensor Switch model numbers, with device options as specified:
      nPOD (single on/off, capacitive touch, audible user feedback)
      nPOD 2P (dual on/off, capacitive touch, audible user feedback)
      nPODR (single on/off, one relay, capacitive touch, audible user feedback)
      nPODM (single on/off, push-buttons, LED user feedback)
      nPODM 2P (dual on/off, push-buttons, LED user feedback)
I. Networked System Graphic Wall Station
1. Device shall have a 3.5-inches full color touch screen for selecting up to eight programmable lighting control presets or acting as up to sixteen on/off/ dim control switches.
2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
3. Device shall enable user supplied .jpg screen saver image to be uploaded.
4. Device shall surface mount to single-gang switch box
5. Device shall have a micro-USB style connector for local computer connectivity.
6. Device shall have two RJ-45 ports for communication
7. Device shall be the following Sensor Switch model number:
   nPOD GFX

J. Networked System Scene Controllers
1. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
2. Device shall recess into single-gang switch box and fit a standard GFI opening.
3. Devices shall provide LED user feedback.
4. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
5. All sensors shall have two RJ-45 ports.
6. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.
7. Device shall be capable of selecting a lighting profile be run by the system’s upstream Gateway so as to implement selected lighting profile across multiple zones (and not just its local zone).
8. Device shall have LEDs indicating current selection.
9. Scene Selector device shall be the following Sensor Switch model number:
   nPOD 2S (2 Scene, push-button)
   nPOD 4S (4 Scene, push-button)
   nPOD 4S DX (4 Scene, push-button, On/Off/Raise/Lower)
   nPOD 4L DX (4 Adjustable Presets, push-button, On/Off/Raise/Lower)

K. Communication Bridges
1. Device shall surface mount to a standard 4-inches x 4-inches square junction box.
2. Device shall have 8 RJ-45 ports.
3. Device shall be capable of aggregating communication from multiple lighting control zones for purposes of minimizing backbone wiring requirements back to Control Gateway.
4. Device shall be powered with Class 2 low voltage supplied locally via a directly wired power supply or delivered via a CAT-5 cabled connection.
5. Device shall be careful of redistributing power from its local supply and connect lighting control zones with excess power to lighting control zones with
insufficient local power. This Architecture also enables loss of power to a particular area to be less impactful on network lighting control system.

6. Communication Bridge devices shall be the following Sensor Switch model numbers:
nBRG 8 (8 Ports)

2.04 LIGHTING CONTROL PROFILES

A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.

B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.

C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.

E. All lighting control profiles shall be stored on the network control gateway device and on the software’s host server.

F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.

G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.

H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.

I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.05 MANAGEMENT SOFTWARE

A. Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software.

B. The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, current PIR Status, current Microphonics Status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).

C. The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
D. A printable network inventory report shall be available via the software.

E. A printable report detailing all system profiles shall be available via the software.

F. Software shall require all users to login with a User Name and Password.

G. Software shall provide at least three permission levels for users.

H. All sensitive stored information and privileged communication by the software shall be encrypted.

I. All device firmware and system software updates must be available for automatic download and installation via the internet.

J. Software shall be capable of managing systems interconnected via a WAN (wide area network).

2.06 BMS COMPATIBILITY

A. System shall provide a BACnet IP gateway as a downloadable software plug-in to its management software. No additional hardware shall be required.

B. BACnet IP gateway software shall communicate information gathered by networked system to other building management systems.

C. BACnet IP gateway software shall translate and forward lighting relay and other select control commands from BMS system to networked control devices.

2.07 SYSTEM ENERGY ANALYSIS AND REPORTING SOFTWARE

A. System shall be capable of reporting lighting system events and performance data back to the management software for display and analysis.

B. Intuitive graphical screens shall be displayed in order to facilitate simple viewing of system energy performance.

C. An “Energy Scorecard” shall be display that shows calculated energy savings in dollars, KWHr, or CO$_2$.

D. Software shall calculate the allocation of energy savings to different control measures (occupancy sensors, photocells, manual switching, etc.).

E. Energy savings data shall be calculated for the system as a whole or for individual zones.

F. A time scaled graph showing all relay transitions shall be presented.

G. A time scaled graph showing a zones occupancy time delay shall be presented

H. A time scaled graph showing the total light level shall be presented.

I. User shall be able to customize the baseline run-time hours for a space.

J. User shall be able to customize up to four (4) time-of-day billing rates and schedules.

K. Data shall be made available via a .CSV file
2.08 START-UP AND SUPPORT FEATURES

A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.

B. All lighting control zones shall be able to function according to default settings once adequate power is applied and before any system software is installed.

C. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.

D. All system devices shall be capable of being given user defined names.

E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.

F. All sensor devices shall have the ability to detect improper communication wiring and blink it’s LED in a specific cadence as to alert installation/startup personnel.

END OF SECTION 26 0943
112316/223037
SECTION 26 2416

BRANCH CIRCUIT PANELBOARDS AND TERMINAL CABINETS

PART 1 – GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Provide Manufacturers Catalog Data for Panels, Cabinets, and Circuit Breakers.

B. Provide Shop Drawing showing Panel Circuit arrangements, size, voltage, ampacity, overcurrent protective devices, etc.

C. Provide nameplate engraving schedule.

D. Short Circuit, Coordination and ARC-FLASH
   1. Perform and submit engineered settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and settings to provide the selective coordination within the limits of the specified equipment, per the latest applicable standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH Calculations as part of the Coordination Analysis recommendations.
   2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six copies.
   3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
      b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
      d. CEC/NEC
   4. Electrical equipment including switchgear, switchboards, electrical panels, and control panels, transformers, disconnects, etc., shall each be labeled by the Manufacturer with "Electrical-ARC-Flash" warning signs. The signs shall explain a hazard to personnel may exist if the equipment is worked on while
energized or operated by personnel, to wear the correct Protective Equipment/clothing (PPE) when working “Live”, or operating “Live” equipment and circuits.

1.03 SEISMIC EARTHQUAKE AND WIND LOADING WITHSTAND, TESTING AND CERTIFICATION. (ADDITIONAL REQUIREMENTS)

A. General
1. The complete panels and terminal cabinet assemblies; including circuit protection devices, meter, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested.
   a. Wind loading all outdoor equipment locations.
   b. Earthquake Seismic Zone-4 and CBC/IBC Seismic withstand all indoor and all outdoor equipment locations.
2. Shall withstand, survive and maintain continuous non-interrupted energized operation during the seismic event occurrences and wind event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation. Acceptance test seismic qualification shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.
4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
   a. 100MPH – West Coast States USA and Hawaii.
   b. 150MPH – East Coast States USA, Gulf Coast States USA and Alaska State.
   c. 90MPH – all other USA locations.
5. Seismic Test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and Reports shall be Certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

B. Refer to General Commissioning Section 01 9113 for additional requirements.

PART 2 - PRODUCTS

2.01 PANELBOARDS AND DISTRIBUTION PANELS

A. Shall be flush or surface mounting as indicated with group-mount circuit protection devices as shown on panel schedule, hinged lockable doors, index cardholders and proper bussing.
1. Panelboards shall comply with the latest versions:
   a. NEMA – PB1.
   b. UL – 50 and 67.
   c. CEC/NEC.
   d. ASTM-B187.
2. Where indicated on the Drawings shall be furnished with subfeed breakers and/or additional conductor lugs, split bussing, contactors, time switches, relays, etc., as required.
   a. Branch circuit panels up through 42-circuits shall be single section, to accommodate all of the circuits and components.
b. Distribution panels shall be single section or multi-section, to accommodate all of the circuits and components.

3. Panels shall be “Service-Entrance” equipment rated when the panel main incoming supply feeder originates from one of the following:
   a. Originates outdoors exterior of the building in which the respective panel is located.
   b. Originates from an electrical supply source not located in the same building as the respective panel.

B. Housing and Painting, Panels and Terminal Cabinets
   1. Shall be finished with one coat of rust inhibitor zinc chromate and coat of primer sealer after a thorough cleaning.
   2. Finish color paint as selected by DISTRICT’s Representative where exposed to public view (e.g., corridors, covered passages, offices, etc.). Prime coated panelboard shall be painted to match surroundings after installation in public areas.
   3. Manufacturer’s standard color in electrical rooms/closets, janitors, HVAC and storage rooms.
   4. Shall be fabricated of sheet steel of the following minimum gauges:
      a. Full height hinged, locking door. Trim #12 gauge steel; enclosure - code gauge steel.
      b. Panels installed in indoor dedicated electrical equipment rooms and dedicated electrical equipment closets, omit full height hinged locking panel door. Dead front cover behind omitted panel door shall remain.
   5. NEMA-1 Metal Housing, for indoor locations.
   6. NEMA-3R Metal Housing, tamper resistant, for outdoor locations.
   7. Furnish all panels and terminal cabinets with the Manufacturers flush locks and keys except where indicated otherwise herein. Keys and locks shall be interchangeable for all panels. Provide two latches and two locks for door heights exceeding 36-inches.
   8. Fasten the trim to panel and terminal cabinets by means of concealed, bolted or screwed fasteners accessible only when the door is open.

C. Panels 208/120 volt, three phase, 4-wire, S/N or 120/240 volt, single phase, 3-wire, S/N.
   Branch Circuit Panel as manufactured by:
   1. Cutler Hammer “Pow-R-Line 1 or 2” Series
   2. General Electric “A” Series
   3. Square D “NF/NQ” Series
   4. Siemens “P1/P2” Series

D. Distribution Panels as manufactured by:
   1. Cutler Hammer “Power-R-Line 3 or 4” Series
   2. General Electric “Spectra” Series
   3. Square D “I-Line” Series
   4. Siemens “P4/P5” Series

E. Top and bottom gutter space shall not be less than 6-inches high. Provide 6-inches additional gutter space in all panels where double lugs are required, or where cable ampere size exceeds bus ampere size. Provide 12-inches additional gutter space in all panels for aluminum feeders where used.
F. Panel Dimensions.
   1. Panels with buss sizes 50 ampere thru 400 ampere
      a. Shall be 20-inches wide. Surface or flush mounting as indicated.
      b. Recess mounted type shall have a 20-inches wide (maximum) recess metal enclosure with overlapping edge trim plate cover extending 1-inch on all sides of enclosure.
      c. Depth shall be 5.75-inches nominal. Height of panel as required for devices.
   2. Panels with buss sizes greater than 400 ampere
      a. Narrow panels 24-inches (maximum) wide by 6.5-inches (maximum) deep units. Wide panels 25-inches to 44-inches (maximum) wide by 8-inches to 15-inches (maximum) deep units. Nominal 90-inch panel height.
      b. The wider units shall be used only at locations where the narrow unit is not available with the quantity or size of large-ampere frame branch/subfeed circuit protective devices shown on the panel schedules, or where the main breaker size exceeds the narrow panel maximum.
      c. Distribution panels shall be floor standing and also supported from behind the panels at walls.

G. Distribution panels and branch circuit panels maximum load rating
   1. Panelboards and Distribution Panels exceeding 800-ampere load rating shall not be permitted.
   2. Provide Distribution Switchboards instead of Distribution Panels for bus load and circuit load ratings exceeding 800 ampere.

H. Panel Auxiliary Cabinets
   1. Panelboards shown on the Drawings with relays, time clocks or other control devices shall have a separate auxiliary metal barrier compartment mounted above panel.
   2. Panelboards with circuits controlled by low voltage remote control relays shall be provided with separate auxiliary cabinets to contain the relays, adjacent to the panelboard.
   3. Provide auxiliary cabinets with separate hinged locking door to match panelboard.
   4. Provide mounting subbase in cabinet for control devices and wiring terminal strips.

I. Panels shall have a circuit index cardholder removable type, with clear plastic cover. Index card shall have circuit numbers imprinted to match circuit breaker numbers.
   1. The panel identification nameplate shall describe the respective panel name and voltage, corresponding to the Contract Documents.
   2. The electrical power source, name and location of each panel supply-feeder and supply equipment name shall also be identified and described on the respective panel nameplate.

J. TVSS - Transient Voltage Surge Suppressor
   1. Provide each of the following branch circuit panel and distribution panel types with a TVSS and RF filtering:
      a. 208/120 volt - single phase and/or three phase.
      b. 120/240 volt - single phase.
      c. 480/277 volt - single phase and/or three phase.
      d. All distribution panels.
2. The TVSS shall be installed inside the respective panel housing and shall be factory connected to each main phase, ground and neutral bus inside the panel.

3. The TVSS monitor/annunciator indicators shall be visible only when the panel access door is in the open position.

4. Provide a 20-ampere 3-pole (2-pole for single-phase panels) branch circuit protection device in each panel for TVSS connection.

5. The TVSS device and panel shall be UL labeled and listed for combined use. See related Specification Sections for additional TVSS requirements.

K. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (ADDITIONAL REQUIREMENTS)

1. The complete panel/panelboard assembly; including circuit protection devices, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested for wind loading and Earthquake Seismic Zone-4 withstand.

2. Shall withstand, survive and maintain continuous non-interrupted energized operation (running) during the seismic event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.

3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation.

4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading as follows:
   a. 100MPH – West Coast States USA and Hawaii.
   b. 150MPH – East Coast States USA, Gulf Coast States USA and Alaska State.
   c. 90MPH – all other USA locations.

5. Acceptance test seismic qualification of proposed panels and panelboards shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) seismic event motion, certified and approved by the AHJ.

6. Seismic test shall be performed by a third party independent test laboratory. Wind analysis and seismic Testing and reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

2.02 SHORT CIRCUIT RATING

A. Circuit protective devices and bussing as indicated on the Drawings. All devices and bussing shall have a short circuit fault withstand and interrupting capacity not less than the maximum available fault current at the panel and as indicated on the Drawings, plus a 25% additional capacity (safety margin). However, in no case shall the short circuit fault interrupting and withstand capacity be less than the following symmetrical short circuit.

<table>
<thead>
<tr>
<th>C/B and/or Bus Rating</th>
<th>Circuit Voltage</th>
<th>Short Circuit Amp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 400A and less</td>
<td>240V and below</td>
<td>10,000A</td>
</tr>
<tr>
<td>2. 400A and less</td>
<td>over 240V and below 600V</td>
<td>14,000A</td>
</tr>
<tr>
<td>3. Over 400A &amp; 800A &amp; below240V and below</td>
<td>42,000A</td>
<td></td>
</tr>
<tr>
<td>4. Over 400A &amp; 800A &amp; belowover240V and below 600V</td>
<td>30,000A</td>
<td></td>
</tr>
</tbody>
</table>
B. Panel short circuit fault rating
   1. General
      a. Provide a “fully rated” for short circuit fault interrupt and full load ampere main circuit breaker in each branch circuit panel and/or each distribution panel. Provide the main circuit breaker whether or not a main circuit breaker is shown otherwise on the Drawings, Schedules or Diagrams. The “utility-source” plus the “motor-load” transient contributions shall be used to establish the available fault duty values, unless indicated otherwise on the Drawings.
      b. The panel main circuit breaker full load ampere capacity rating shall equal the respective panel main bus ampere rating.
      c. The panel assembly, buss and circuit protection devices bolted fault short circuit withstand and bolted fault short circuit interrupt ratings shall not be less than 125% greater (including a 25% safety margin) than the available utility-source symmetrical and asymmetrical bolted fault short circuit current when “series combined rated” with the panel main circuit breaker.
      d. The main circuit breaker rated “bolted-fault” short circuit fault interrupt and withstand short circuit rating shall not be less than 125% (including a 25% safety margin) of the upstream main service entrance “bolted-fault” available (symmetrical and asymmetrical) short circuit current.
   2. Distribution Panelboards
      a. Distribution panel, main circuit breaker, all feeder circuit breakers, and all branch circuit breakers shall be “fully-rated” (plus safety margin) for the available bolted fault short circuit current (including safety margin).
      b. Shall provide time/current-tripping coordination with downstream equipment and upstream equipment.
   3. Non-emergency branch circuit panelboards 400-ampere buss and smaller; Non-emergency branch circuit panelboards 400-ampere trip main circuit breaker and smaller.
      a. The branch circuit panel main circuit breaker shall be “fully-rated” (plus safety margin) Current Limiting Circuit Breaker type (CLCB). Shall provide time/current- tripping coordination with upstream equipment.
      b. The branch circuit panel main circuit breaker shall be “series-rated” with the panel downstream branch circuit devices and panel bussing. “The series-rating” shall provide short circuit bolted fault current withstand protection and short circuit bolted fault interrupt rating protection during a downstream 3-phase line-to-line and/or single-phase line-to-ground short circuit bolted faults.
      c. Typical for branch circuit panelboards connected to normal-power (non-emergency) power circuits.
   4. Emergency branch circuit panelboards 400-ampere bus and smaller; Emergency branch circuit panelboards 400-ampere trip main circuit breaker and smaller.
      a. The branch circuit panel main circuit breaker shall be short circuit bolted fault “fully-rated” (plus safety margin) Non-Current Limiting circuit breaker type (non-CLCB).
      b. The panel bussing shall also be short circuit bolted fault “fully-rated”.
      c. All of the branch circuit panel, branch circuit breakers shall be “fully-rated” non-fused Current Limiting Circuit Breaker Type (CLCB). Shall provide short circuit bolted fault interrupt rating. Coordinated time/current and instantaneous tripping with the upstream circuit protection devices.
      d. Typical for branch circuit panelboards connected to emergency power circuits.
2.03 PANEL CIRCUIT BREAKERS, CIRCUIT PROTECTION DEVICES

A. Circuit Breakers General, for Distribution Panels and Panelboards
   1. NEMA-AB1 and AB3, comply with latest revision.
   2. UL-1087, UL-489 and IEC-60.947.2 rated devices, comply with latest revision.
   3. 5Hz AC closing and 3Hz AC trip and clear.
   4. Main circuit breakers for distribution panels exceeding 400 ampere and larger;
      a. Shall be Insulated Case Circuit Breaker type ICCB.
   5. Main circuit breakers for branch circuit panelboards 400 ampere buss and smaller;
      a. Shall be Current Limiting Circuit Breaker type-CLCB for non-emergency panelboards.
      b. Shall be Molded Case Circuit Breaker type-MCCB for emergency panelboards.
   6. Branch circuit breakers and feeder circuit breakers smaller than 100-ampere trip shall be Molded Case Circuit Breakers type-MCCB and/or Current Limiting Circuit Breakers type-CLCB.
   7. All circuit breakers 100 ampere and larger trip shall employ sensors and solid state digital electronic automatic trip system. Short-time and long-time time/current curve shaping field adjustable functions and adjustable instantaneous trip. Typical for Molded Case Circuit Breaker type-MCCB, Insulated Case Circuit Breaker type-ICCB and Current Limiting Circuit Breaker type-CLCB.
   8. Refer to Specification Section 26 2410 and/or 26 1105 for additional circuit breaker requirements.

B. Manufacturer
   1. Circuit breakers as manufactured by the following companies only are acceptable:
      a. Cutler Hammer
      b. General Electric Co.
      c. Square D Co.
      d. Siemens

C. Configuration
   1. Circuit breakers shall be arranged in the panels so that the breakers of the proper trip settings and numbers correspond to the numbering in the panel schedules on the Drawings.
   2. Circuit numbers of breakers shall be black-on-white micarta tabs or other previously approved method. Circuit number tabs, which can readily be changed from front of panel, will not be accepted. Circuit number tabs shall not be attached to or be a part of the breaker.
   3. Panelboard circuit protection devices shall be bolt on type for connection to panel bus. Removable and installable without disturbing adjacent devices.
   4. Provide conductor wire terminations (lugs) on each circuit protection device for incoming main feeder, branch circuits and outgoing feeder circuits. Dual rated copper/aluminum and compatible with the respective conductor size, type, and quantity.
   5. Where 2-pole or 3-pole breakers occur in the panels, they shall be common trip units. Single pole breakers with tie-bar between handles will not be accepted.
   6. Branch circuit panels shall be field convertible for bottom entry main incoming feeder or top entry main incoming feeder.
7. Each panel section, the feeder and branch circuit protection devices (3-phase and/or 1-phase) shall be “twin-mount”, side-by-side double row construction for the following circuit sizes:
   a. 480/277 volt, 60-ampere circuit size and smaller.
   b. 240 volt – 208/120 volt, 100 ampere circuit size and smaller.

D. Lock-Off and Lock-On
1. All circuit breakers shall be pad-lockable in the “off” position.
2. Where branch circuit breakers supply the power to motors and signal systems, the breakers shall also be furnished with lockout clips, mounted in the “on” position. The breakers shall be able to trip automatically with lockout clips in place.
3. Provide lock-on clips on branch circuit breakers supplying fire alarm equipment and fire alarm panels. Provide identification of the dedicated “fire alarm” circuit function and operation. Color-code the circuit breakers to comply with AHJ requirements.
4. Locking facilities shall be riveted or mechanically attached to the circuit breaker (submit sample for approval. Other means of attachment shall not be accepted without prior written approval of the District's Representative.

E. ARC Fault Interrupter Circuit Breaker (AFCI-C/B)
1. AFCI-C/B provides automatic circuit interruption upon detection of any of these conditions: overload, short circuit fault and electric branch circuit arcing protection.
2. The AFCI-C/B shall detect intermittent “arching” type electrical faults, and provide automatic circuit interruption (tripping).
3. Provide “test-pushbutton” on each C/B for manual AFCI-C/B Testing.
4. Single pole, 120-volt, 60Hz AC UL listed and labeled for installation in panelboard, #14 - #8AWG solid/stranded AL/CU load conductor.

F. Switch and Fuse Feeder Protective Devices for Distribution Panels
1. Locations where the Drawings show distribution panels employing switch-fuse circuit protection devices.
2. Fusible Switches: Quick-make, quick-break type with rejection clips for use with Class “R” fuses Current Limiting Fuses (CLF). Switches with ratings up to and including 100 ampere at 240 volts shall be twins mounted. Switches rated through 60 ampere and 480 volts shall be twins mounted. Provisions for padlocking in the “on” and/or “off” positions. Switches shall be removable from front of panel without disturbing adjacent units or panel bus structure.
3. Fuses shall be time delay current limiting types, UL Class RK-1 unless otherwise indicated on the Drawings. Provide one spare set of fuses of each size and type in each Distribution Panel.
4. Provide auxiliary contact on switch for remote status (on-off) signaling and monitoring. Provide conductor lugs to accept conductor temperature rating, sizes and quantities shown on Drawings.
5. Switch and fuse devices shall be permitted only in distribution panels and only where specifically indicated on the Drawings for feeders.

2.04 PANEL BUSSING

A. Bus Material
1. Bussing shall be rectangular cross section tin-plated copper or alternately silver or tin-plated aluminum.
2. Bussing shall be non-tapped, full length of the enclosure.
B. Ground Bus
1. Each panel shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall have a separate lug for each ground conductor. No more than one conductor shall be installed per lug.

C. Provisions
1. Provide space and all hardware and bus mounting attachments for future devices as indicated on the Drawings.

D. Neutral Bus
1. The ampere rating of the neutral bus of panels and distribution panels shall be a minimum of 100% greater ampere capacity than the ampere rating of the corresponding phase bus, where the panel is indicated to be provided with an "oversize-neutral" or "200%" neutral on the Drawings.

2.05 TERMINAL AND AUXILIARY CABINETS

A. Cabinets
1. Fabricated of code gauge sheet steel for flush mounting (except where noted as surface) of size indicated on the Drawings, and complete with hinged lockable doors, provide the quantity of 2-way feed through conductor terminals required for termination of all conductors, plus 15% spares of each type.
2. Cabinet locks to operate from same key used for panelboards. The trim to cabinets shall be fastened by means of concealed bolted or screwed fasteners accessible behind door into cabinets. All cabinets shall have ¾-inch plywood backing, finished with fireproof intumescent primer and finish coat paint. Provide equipment ground bus in each cabinet.
3. Cabinets shall be finished with one coat of zinc chromate and one coat of primer sealer after a thorough cleaning. Where exposed to public view (e.g., corridors, covered passages, offices, etc.) finish color paint to match surrounding and Manufacturer's standard gray color in switchboard, janitors, heater and storage rooms.
4. Provide grounded metal barriers inside cabinet to isolate and separate line voltage and low voltage from each other inside the cabinet.

B. Cabinet Dimensions.
1. Unless indicated otherwise on Drawings.
   a. Shall be 20-inches wide. Surface or flush mounting as indicated.
   b. Recess mounted type shall have a 20-inches wide (maximum) recess metal enclosure with overlapping edge trim plate cover extending 1-inch on all sides of enclosure.
2. Depth shall be 5.75-inches nominal. Height of cabinet as required for devices, plus 25% spare unused interior space for future use, but not less than 36-inches high.

C. Terminals
1. Non-digital analog circuits; line and low voltage modular signal systems, 15-ampere dual row with isolation barriers, screw-down terminals insulated strips, heavy duty.
   a. As manufactured by Molex, or ITT-Cannon, or General Electric.
2. Digital circuits; low voltage signal systems, ANSI/ EIA/TIA Category-6, 110-Block or 66-Block gas-tight punch down style, heavy duty.
   a. As manufactured by: Leviton, or Ortronics, or AMP.
Identification (Additional Requirements)
1. Provide engraved nameplate on each cabinet indicating its designation and system (i.e., “Life Safety System - Panel 2LS”, etc.).
2. Identify each terminal landing with unique circuit number and provide corresponding alphanumeric text-index card inside panel access door

PART 3 - EXECUTION

3.01 MOUNTING

A. Flush Mounted Panelboards and Terminal Cabinets shall be securely fastened to at least two studs or structural members. Trim shall be flush with finished surface.
1. Panels and cabinets installed flush (recess or semi-recess) into fire rated or smoke rated walls. The wall recess shall be fully wrapped inside the recess with fire/smoke rated materials. The wrap-materials shall provide the same fire and/or smoke protection rating as the respective wall.

B. Surface Mounted Panels and Terminal Cabinets shall be secured to walls by means of preformed galvanized steel channels securely fastened to at least two studs or structural members.

C. Panelboards and Terminal Cabinets shall be installed to insure the top circuit protective device (including top compartment control devices) are not more than 6-feet-6-inches above finish floor in front of the panel and the bottom device is a minimum of 12-inches above the floor. Manufacturer shall specifically indicate on Shop Drawing submittals each panel where these conditions cannot be met.

3.02 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. Provide a red and white Bakelite nameplate with ½-inch high letters in each 277/480 volt panel fastened to face of dead-front plate, to read: “DANGER 480 (or as applicable) VOLTS KEEP OUT AUTHORIZED PERSONNEL ONLY”.

B. Manufacturer shall stencil the panel/cabinet number identification on the inside of door to correspond with the designation on the Drawings.

C. Identification plates and numbers shall be attached with screws or twist lock fasteners. Adhesive attachment of any kind shall not be used.

3.03 SPARE CONDUITS (ADDITIONAL REQUIREMENTS)

Provide three 1-inch conduit only stubs from each panel and terminal cabinet into accessible ceiling space. Where floor level below panel or terminal cabinet is accessible, also provide an additional three 1-inch conduit only stubs into accessible floor space.
SECTION 26 2419
MOTOR CONTROL EQUIPMENT

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for, and incidental to, performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Provide Schematic "Ladder-Type" logic control wiring diagrams and "point-to-point" control wiring diagrams showing the control system for HVAC equipment and other electrical equipment.

B. Provide Nameplate Engraving Schedule.

C. Submit full-scale time/current transparencies on log/log paper for all fuses, circuit breakers, ground fault system devices, and relays.

D. SHORT CIRCUIT, COORDINATION AND ARC-FLASH
   1. Perform and submit engineered settings for each equipment location, fuse and adjustable circuit breaker device, showing the correct time and current settings to provide the coordination within the limits of the specified equipment, per the latest applicable Standards of IEEE and ANSI. Provide electrical system short circuit fault analysis, both 3-phase line-to-line and 1-phase line-to-ground calculations as part of the Coordination Analysis recommendations. Provide Electric ARC-FLASH calculations as part of the Coordination Analysis recommendations.
   2. The information shall be submitted in both tabular form and on time current log-log graph paper, with an Engineering Narrative. Written narrative describing data, assumptions, analysis of results and prioritized recommendations, six copies.
   3. The goal is to minimize an unexpected but necessary electrical system outage and personnel exposure to the smallest extent possible within the fault occurrence location, using the specified Contract Equipment. Shall comply with, but not limited to:
      b. IEEE-399, Recommended Practice for Industrial and Commercial Power System Analysis.
      d. CEC/NEC
   4. Electrical equipment including switchgear, switchboards, electric panels and control panels, motor control centers, combination motor starters, transformers, disconnects, etc., shall each be labeled by the Manufacturer with “Electrical-ARC-Flash” warning signs. The signs shall explain a hazard to personnel may
exist if the equipment is worked on while energized or operated by personnel while energized. The sign shall instruct personnel to wear the correct Protective Equipment/clothing (PPE) when working “Live”, or operating “Live” electrical equipment and circuits.

PART 2 - PRODUCTS

2.01 GENERAL

A. Division 240000 HVAC/Plumbing
   Refer to Division 26 0000 Mechanical and Plumbing Contract Documents and Shop Drawings for additional electrical work and material requirements.
   1. Provide all control devices including timeswitches, relays, auxiliary contacts, voltage transformers, and interlocks.
   2. Provide all raceways, conduit wire, circuits, outlets, and interconnections of starters as required for HVAC and Plumbing systems.

B. Special Considerations
   1. Mount all auxiliary relays and timeswitches in an isolated compartment inside motor control equipment unless otherwise indicated.
   2. Whether or not shown on Mechanical and Plumbing Contract Documents and/or control schedules, where motors are controlled by external devices (i.e., thermostats, relays, float or pressure switches, etc.) or interlocked with other motors, provide each magnetic motor starter with a "Hand-Off-Auto" selector switch in starter cover. Other magnetic motor starters provide a "Start-Stop" push-button station in starter cover.
   3. Motor starters, motor controllers and circuit feeder tap devices for motor circuits shall be rated and labeled for control of all electric motor design types A, B, C, D, and E pursuant to the requirements of the NEC

C. Seismic Earthquake and Wind Loading Withstand, Testing and Certification (ADDITIONAL REQUIREMENTS)
   1. The complete motor control equipment assembly; including circuit protection devices, motor controllers, housings/enclosures, accessories, supports/anchors etc., shall be designed, manufactured and tested.
      a. Wind loading for outdoor locations.
      b. Earthquake Seismic Zone-4 withstand and CBC/IBC Seismic withstand all indoor and all outdoor equipment locations.
   2. Shall withstand, survive and maintain continuous non-interrupted energized operation (running) during the seismic event occurrences. Continued normal energized operation after the wind event and seismic event occurrences have abated.
   3. Shall include demonstrations of successful operation and run test after completion of seismic event shake-table simulation.
   4. Provide three dimensional finite element analysis demonstrating anchorage and operational withstand of wind loading not less than as follows and as required by AHJ:
      a. 100MPH-West Coast States USA and Hawaii.
      b. 150MPH-East Coast States USA, Gulf Coast States USA and Alaska State.
      c. 90MPH-all other USA locations.
   5. Acceptance Test Seismic Qualification of proposed motor control equipment shall employ triple axis shake-table simulation of the Required Response Spectrum (RRS) Seismic Event Motion, Certified and Approved by the AHJ.
6. Seismic test shall be performed by a third party independent Test Laboratory. Wind Analysis and Seismic Testing and Reports shall be certified, signed and “stamped” by PE Professional Engineer licensed and in good standing in the State, Civil Engineer or Structural Engineer.

D. Motor Control Equipment as manufactured by:
   1. General Electric; or Square D; or Cutler-Hammer; or Allen-Bradley; or Siemens.

2.02 MANUAL MOTOR STARTERS

A. Provide flush or surface mounting manual motor starters with number of poles and size of thermal overload heaters as required for the motor being controlled (equipped with overload heaters, one for each motor lead). Back boxes shall be supplied with all flush mounting starters, whether they are toggle type requiring only a 4-inch square outlet box or the larger type requiring a special box. Provide cover designed to accept the particular unit.

B. Unless otherwise noted on the Drawings, all manual starters for single phase motors, smaller than 1 h.p. shall be the compact toggle type. Manual starters for all single phase motors, 1 to 5 h.p. and all three phase motors up to 5 h.p. shall be the heavy-duty type.

C. Where manual motor starter is shown with pilot light, the pilot light shall be installed in a separate outlet box adjacent to the starter outlet with engraved nameplate to indicate function of pilot light. Pilot lights shall be push-to-test style.

2.03 MOTOR STARTERS - 50/60HZ AC INDUCTION ELECTRIC MOTORS

A. General
   1. Motor starters shall be horsepower rated for the motor connected to the starter, air insulated, with NEMA rating.
   2. Motor starter coils and controls shall be designed to operate on the control voltage indicated on the control diagrams and specifications. The motor starters shall reliably pick-up and seal-in at 80% through 110% of their coil control voltage.
   3. Under voltage release for motor starter coil circuit shall automatically drop motor starter off the line when the line voltage drops below normal operating voltage. Under voltage release shall be field adjustable 80% to 95% of nominal voltage with field adjustable dropout delay 0.1 to 3 seconds minimum for starters larger than NEMA Size 1. The under voltage release shall reset automatically when line voltage level returns to normal. The reset time delay shall be a 0.1 to 60-second field adjustable time range for starters larger than NEMA Size 1.
   4. Each motor starter control circuit shall be independently fused.
   5. Three phase motor starters controlling three phase motors, five horsepower and larger shall provide integral motor single phasing protection. The starter shall automatically "open", turn off electrical power to the connected motor in the event of the loss of one or more circuit phases, lock out and require manual resetting of the single phase protection to restart the magnetic motor starter. Provide single-phase annunciator. Provide adjustable time delay, minimum range 0.1 to 3 seconds for initiating single phase shut down.
6. Starter units shall be equipped with individual control power transformers (grounded type) with secondary and primary control power fuses. One secondary lead shall be grounded in the unit.
   a. The unit disconnect shall be equipped with a normally open contact to isolate the control circuit from the source when the controller disconnect is open.
   b. The control power transformer VA load rating shall include the motor starter, additional internal and external control devices connected to the motor starter, to insure control power voltage drop does not exceed 5% of nominal rating.

7. Starter units shall be equipped with three motor overload elements, one for each phase, with automatic lockout, external overload indicating flag/pilot light and manual reset external push-button. Trip rating characteristics of the overload elements shall be as recommended by Motor Manufacturer.
   a. Motor overload protection relays shall be bi-metal (non-melting) "heater-element" type or solid-state type, for motor starters NEMA Size 1 and smaller.
   b. Motor overload protection relays for motor starters larger than NEMA Size 1 shall be solid-state type.

8. Pilot light indicators shall be provided with "Push-to-Test" feature. Provide a capacitor in parallel with the starters stop-start control relay circuit, to permit the motor starter control circuit to "drop-out" (turn-off) and prevent "capacitive-holding" (capacitive coupling) on control circuits with "long" (excessive distance) control circuit wiring.

9. Each starter shall be equipped with a minimum of one normally open and one normally closed auxiliary spare contact. Provide additional auxiliary control contacts for interlocking with system control circuits as indicated on the Drawings and Specifications. Auxiliary contacts shall be field convertible for normally open or normally closed operation. Contacts shall be rated not less than 10 amps at 120 volt 60Hz, AC, but in no case shall the auxiliary contacts be rated for less ampere or lower voltage than the connected control circuit.

10. Motor starters larger than NEMA Size 1, provide a running time meter 0 to 99999 hours minimum range, and an operations counter 0 to 9999 meter minimum operations start count range. Meters shall be field resettable with maintained memory during power outages of any length.

11. Minimum starter size shall be NEMA 1, but in no case less than indicated on the Drawings or Specifications.

12. Verify the exact motor connection requirements; motor locked rotor/full load current, NEMA Code letter and voltage characteristics with the supplier of each motor. Motor starters shall comply with the identified requirements.

13. Each starter shall be equipped with "Hand-off-Auto" switch or stop-start push-button as required.

14. An auxiliary relay contact for remote alarm annunciation shall provide common trouble annunciation for any of the starter automatic protection systems. The alarm contact shall automatically reset when the starter is reset.

15. Provide each motor starter main "start" control relay or starter coil as applicable, with a magnetic coil auxiliary control "pilot" relay. The contacts of the auxiliary control relay shall directly control the starting, running and stopping control voltage of the motor starter main control coil circuit. The coil of the auxiliary relay shall condition and match the voltage and in rush of each motor starter to the requirements of the incoming control circuit.
16. Provide a transient surge suppressor for each motor starter coil, to limit voltage transients induced by the motor starter coil operation and to protect the motor starting circuit from voltage transients.

17. Motor starters connected to engine generator emergency power supply source (either direct connection or connection through an automatic transfer switch) shall each be provided with a field adjustable (0.1 - 180 seconds) "start" (on delay) time delay, to provide "staggered" sequenced starting of the connected motor load.

B. Full Voltage Non Reversing (FVNR), Unless Noted Otherwise
   1. Across the line full voltage magnetic electromechanical motor starter.
   2. Provide FVNR motor starter for motor sizes through fifty horsepower (241 to 600 volt) and through thirty horsepower (240 volt and under) where the motor is connected to normal power utility source, unless noted otherwise on Drawings.

C. Two Speed Motor Starters
   1. The two speed motor starters shall be compatible with the connected motor and shall provide automatic two speed control of separate high speed and low speed motor winding or consequent pole two speed motors as applicable. The starters shall be constant horsepower, constant torque or variable torque as applicable for the motor connected to the starter.
   2. Low speed compelling control shall compel the motor starter to always start the motor on low speed before switching to high speed. Compelling control shall be manual switch selectable as either "in" or "out" (bypass) of the motor control circuits.

D. Reduced Voltage Non-Reversing (RVNR)
   1. General
      a. The reduced voltage starter shall reduce both motor starting current and motor starting torque.
      b. Reduced voltage starters shall be closed transition types.
      c. Provide RVNR motor starters for motors larger than thirty horsepower (240 volt and below) and larger than fifty horsepower (over 240 volts), reduced voltage type (Where the motor starter circuit is connected to engine generator emergency power source for motors larger than five horsepower, provide each respective motor with RVNR reduced voltage motor starters).
      d. Starters shall provide field adjustable time periods for acceleration (reduced voltage) and transition (transfer to full voltage) modes, with failure to transfer lockouts and pilot light annunciators. Adjustable time range shall be 0.1 to 15 seconds.
      e. Duty cycle - NEMA rated medium duty, starters shall provide for not less than one 15-second duration starter operation in each 4-minute interval for a 1-hour period, followed by a cool down rest period of 2-hours before the duty cycle is repeated. Provide automatic temperature lockout to prevent exceeding starter duty cycle.
      f. Reduced voltage non-reversing RVNR Motor starters shall be types described in the following paragraphs.
   2. Autotransformer type reduced voltage starter
      a. Auto transformers on each phase with field adjustable transformer voltage taps for 50%, 65%, and 80% motor terminal starting voltages.
      b. Magnetic electromechanical motor contactor type.
2.04 COMBINATION MOTOR STARTERS

A. General
   1. Combination motor starters shall consist of a feeder tap device, motor starter and enclosure. Voltage and amperage rating as indicated on Drawings.
   2. Combination motor starter shall not be less than NEMA Size 1, but in no case less than indicated on the Drawings.
   3. Unit shall be self-contained floor standing, wall mounted NEMA 1 enclosures or as indicated on the Drawings. Constructed, Tested and Listed in accordance with NEMA, ANSI and UL standards.
   4. Combination motor starters as manufactured by General Electric, Westinghouse, Square D, Cutler Hammer or equal.
   5. Provide incoming line and outgoing load terminations, size and capacity to match connections shown.

B. Construction
   1. NEMA styles metal enclosed, with full height hinged access door. 12-gauge welded frame members and 14 gauge panel members. All parts shall be removable and accessible from the front for ease of maintenance and rearrangement.
   2. Provide removable lifting points and permanent anchor mounting points on the enclosure.
   3. Hinged doors shall be mounted with removable pin hinges and secured with quarter turn indicating fasteners. A door interlock with manual defeat override shall prevent access to unit interior when the feeder tap device is in the "on" position.
   4. Each metal surface shall be phosphatizing prime rust inhibitor painted and baked Enamel Finish Painted Manufacturer's standard color.

C. Combination Motor Starter Short Circuit Coordination Protection
   1. The combination motor starter shall be constructed and tested to comply with the following requirements.
   2. Type 1 Coordination:
      Under short circuit conditions the contactor/motor starter shall cause no danger to persons or installation. Continued re-use shall be permitted after service, repair or replacement of parts.
   3. Type 2 Coordination:
      a. Under short circuit conditions the contactor/motor starter shall cause no danger to persons or installation. Continued re-use shall be permitted without requiring any service, repair or replacement of parts.
      b. Motor starters shall also comply with International Electromechanical Committee (IEC) Type-2 short circuit protection, as recommended by the Manufacturer's published protection tables and as Certified by UL.

D. Energy Efficient Motor Protection
   1. Where a combination motor starter is connected to a high efficiency motor, provide one of the following modifications to the starters or circuit disconnects. The modification shall prevent unnecessary tripping from locked rotor high inrush motor starting current:
      a. Circuit breaker or MCP short circuit protection - Provide circuit breaker/ MCP with adjustable magnetic current trip for high inrush motor starting current, or adjustable time delay trip for high magnetic current motor inrush damping.
b. Switch and fuse motor short circuit protection - Provide fuses with sufficient inherent time delay to allow passage of high magnetic current inrush motor starting current.

PART 3 - EXECUTION

3.01 INDIVIDUAL COMBINATION MOTOR STARTERS

A. Install motor control equipment in accordance with Manufacturer’s written instructions and applicable portions of NEMA "Standards of Installations" for switchboards and motor control centers and individual motor starters.

3.02 IDENTIFICATION

A. Provide a red and white bakelite nameplate with ½-inch high letters fastened to face of dead-front plate, to read: "DANGER 480 (actual volts) VOLTS, KEEP OUT, AUTHORIZED PERSONNEL ONLY".

B. Manufacturer shall stencil the panel number and name of the connected motor circuit on each device and equipment section to correspond to identification on the drawing.

C. Identification plates and numbers shall be attached with screws or twist lock fasteners. Adhesive attachment of any kind as the only method of attachment shall not be used.

3.03 SETTINGS AND ADJUSTMENTS

A. Program and set control function sequences, time delays, and protective device settings for correct system operation.

B. Test all timing, control sequences and motor rotation direction for proper operation. Correct deficiencies and retest until proper operation is confirmed.

C. Refer to General Commissioning Section 01 9113 for additional requirements.

END OF SECTION 26 2419
112316/223037
SECTION 26 5000

LIGHTING FIXTURES

PART 1 - GENERAL

1.01 SCOPE

A. Work Included:
   All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specification Sections and Drawings for related work required to be included as work under Division 26.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. General
   1. Submit certification letter from Manufacturers of Lamps and Ballasts and Power/Driver Supplies, (or alternately, Manufacturer's published catalog data) stating/showing the specific lamp, ballast, or power/driver supply combination comply with Manufacturer recommendation and approval for the combined use, shown on the Drawings.
   2. Provide complete Manufacturers catalog data information for each light fixture (luminaire), ballast, power/driver supplies, lamps, materials, auxiliary equipment/devices, finishes and photometrics.

B. Performance Certification
   2. Submit Manufacturer's letter of certification for each fixture type, confirming the proposed combination of specific lamp, ballast, power/driver supply and auxiliary components for each light fixture (luminaire) type will function together correctly and perform in compliance with the requirements of the Contract Documents as follows:
      "The proposed drivers, (where, applicable), lamp sockets and fixture have been tested as an assembly. The proposed fixture products assemblies are certified by the Manufacturer to function within the required temperature, lumen output, electrical characteristics and operational life described in the Contract documents".

C. Light Fixture Samples
   1. If requested by the DISTRICT'S Representative, provide a sample of each fixture proposed as a substitution for a specified fixture. Sample fixture shall be complete with specified lamps, 3-wire grounding "SO" cord and plug for 120-volt 60Hz, AC plug-in operation. Sample fixtures shall be delivered to the DISTRICT'S Representative's Office for review, the samples shall be picked up within 10-working days after review comments have been received; any samples left beyond this time will be discarded by the DISTRICT'S Representative. Decision of DISTRICT'S Representative regarding acceptability of any lighting fixture is final.
1.03 QUALITY ASSURANCE (ADDITIONAL REQUIREMENTS)

A. Work and Materials shall be in full accordance with the latest rules and regulations as follows. The following publications shall be included in the Contract Document requirements. If a conflict occurs between the following publications and any other part of the Contract Documents, the requirements describing the more restrictive provisions shall become the applicable Contract definition:

1. UL – Underwriters’ Laboratory:
   a. UL – 8750 and 1598C: Light Emitting Diode – LED Equipment for use in Lighting Products and Replacements

2. NEMA – National Electrical Manufacturers Association:
   a. NEMA – LE4: Recessed Luminaries Ceiling Compatibility
   b. NEMA – SSL #1, #3 and #6: Electronic Drivers for LED; LED and Incandescent Lamp Replacement
   c. NEMA – LSD #44, #45, #49 and #51: SSL - Solid State Lighting

3. United States Federal Government:
   a. FCC – Part 18: EMI and RFI emissions limitations.
   b. EPA: Energy conservation publications and waste disposal regulations.

4. ETL and C.B.M. certified and approved.

5. Electrical installation standards, National Electrical Contractors’ Association:
   a. NEIS/NECA and IESNA – 500: Recommended Practice for Installing Indoor Commercial Lighting Systems.
   b. NEIS/NECA and IESNA – 501: Recommended Practice for Installing Exterior Lighting Systems
   c. NEIS/NECA and IESNA - 502: Recommended Practice for Installing Industrial Lighting Systems.

6. Illuminating Engineering Society – IES (IESNA):
   a. IES – LM41: Photometric and Reporting.
   b. IES – 587: Transient Surge Protection.
   d. IES – LM80: Testing for Lifetime of LED.

7. ANSI-American National Standards Institute:
   a. ANSI – C81
   b. ANSI – C82
   c. ANSI – C62.41: Transient Withstand
   d. ANSI – C78: Lamps


PART 2 - PRODUCTS

2.01 GENERAL

A. Complete Fixture
   1. Provide light fixtures complete including lamps, drivers, housings, ceiling and wall trim "rings" for each ceiling type, mounting and adapter support brackets, diffusers/lenses and outlet boxes.
   2. Include an allowance of $300.00 to provide a light fixture for each lighting fixture outlet shown on Drawings without a fixture type designation.

B. Specific Fixture Requirements and Fixture Schedule Information
   1. The catalog numbers included in the description of the various types of lighting fixtures shall be considered to establish the type or class of the fixture with a particular Manufacturer only. The fixture length, number of lamps and lamp
types, component materials, accessories, mounting type, ceiling, wall and
install adapters, operation voltage, and all other components required to fulfill
the total description of the fixture based on all Drawing information, branch
Circuits, Voltages, Specification information, and shall be included in the
Contract Requirements regardless of whether or not the catalog number
specifically includes these components.

2. Lighting fixtures shall be the types as indicated in Fixture Schedule on the
Drawings and as described in the Specifications.

3. All fixtures of the same fixture type shall be the same Manufacturer and of
identical finish and appearance, unless indicated otherwise on Drawings.

C. Manufacturer Certification of Operation

1. Lamps and lamp ballasts and power supplies (drivers) shall be recommended
and certified by the respective Manufacturer(s), to be "matched" to operate
correctly together, within the published characteristics, for efficacy, lamp
starting, operating life hours, lumen output, power factor, power input,
operating line ampere, sound intensity, and temperature.

2.02 POWER SUPPLIES (DRIVER-POWER SUPPLIES FOR LED-SOLID STATE LAMPS)

A. General

1. All ballast, power supplies, lighting fixtures assemblies and components shall
be ANSI, ETL approved C.B.M. Certified and UL labeled.

2. Ballasts shall comply with FCC Part 18 Class-A and NEMA limits as to EMI or
RFI and not interferes with normal operation of electrical or electronic data
processing equipment.

3. Open circuit voltage, starting voltage, crest voltage and lamp-operating voltage
shall comply with requirements of the respective Manufacturer of the installed
lamps.

4. Lamp ballasts, power supplies and transformers shall be for use with the
specific lamps provided as part of the Contract.

5. Shall be suitable for use with automatic occupancy motion sensing type
switching "on-off" control systems, with multiple "on-off" cycles per hour, on a
24-hours a day basis. Operation shall be without loss of performance in
operating characteristics described in the Contract Documents.

6. Fusing

a. Shall be independently fused on the incoming line side within the fixture
compartment.

b. Alternately the Ballast Manufacturer may install the equipment fuse inside
the ballast/power supply.

c. Provide a label next to ballast cover reading: "Ballast (Power Supply) is
fused, check fuse prior to relamping". Provide an additional quantity of
10% spare fuses and deliver to DISTRICT’S Representative.

7. Ballast sound rating Class-A or better. Where sound-rating classification is not
published, the ballast sound rating shall be the best of product manufactured.
Ballasts, which are judged by the DISTRICT’S Representative to be
excessively noisy, shall be removed and replaced at the CONTRACTOR’S
expense with low noise ballasts.

8. Electronic solid-state ballasts and power supplies shall be the product of
Manufacturer that has been producing electronic ballasts/power supplies for a
minimum of five consecutive years prior to the date of the Contract.

9. Shall be designed and supplied to operate on the incoming line voltage system
circuits to which the respective light fixtures are connected.
10. Shall not contain any PCB (polychlorinated biphenyl).

11. Power factor shall be not less than 0.90, starting and operating. The input starting transient line input ampere should never exceed lamp normal operating ampere by more than 10%.

12. Ballast and power supply disconnect:
   a. Lighting Fixture Manufacturer factory installed and prewired inside each light fixture, for lamp-ballast or lamp-driver power supply.
   b. Shall comply with UL-2459 and CEC/NEC. Shall disconnect (load-break) energized or de-energized ballast/driver from respective line voltage circuit and dimming circuit. UL-94V-0 flame retardant.
   c. Hot pluggable, multi-pole, insulated connectors, with strain relief and finger-safe squeeze-to-release latching function.
   d. Suitable for available voltage and ampere dimming and non-dimming lamp-ballasts and lamp-power supplies.

13. Ballast and power supplies as manufactured by General Electric, Advance, Philips, Universal, Sylvania/Osram or equal.

2.03 LIGHT FIXTURES (LUMINAIREs)

A. General
   1. Lighting fixtures shall have all parts, ballasts, sockets, support attachments, trim flanges and fittings necessary to complete and properly install the fixture at the indicated installation locations. All fixtures shall be provided with lamps of size and type specified.

2. Ceiling and/or wall surface mounted lighting fixtures shall not have any exposed chase nipples or conduit knockouts visible to view within fixture housing. Lighting fixtures mounted in continuous rows shall have chase nipples or conduit knockouts between lighting fixture housing, but shall not have visible chase nipples/conduit knockouts on the visible ends of the continuous row of lighting fixtures.

3. Where fixture color is indicated to be selected by the ARCHITECT and/or DISTRICT’S Representative, provide two color chip samples for each color for review.

4. Recessed fixtures with attached junction box shall be provided with a junction box permanently attached to the plaster ring so that the junction box is accessible through the fixture opening when the fixture is removed. Connection between fixture and pull box shall be flexible metal conduit with not less than 16 AWG "AF" or "CF" type fixture rated copper wires, high temperature wire insulation for not less than 600 volts AC. The flexible conduit shall be sufficient length, so that when the fixture is removed, the pullbox is readily accessible.

5. Recessed fixtures shall be Underwriters’ Laboratory approved for recessed installation with plaster frame and attached pull box. Lamp enclosure, reflectors and finish wiring shall not be installed until plastering is completed. Exposed finish trim shall not be installed until finish painting of the adjacent surface is completed.

6. The fixture shall bear Underwriters’ Laboratory label of approval for the wattage and installation indicated.

7. Light fixtures installed outdoors, in damp or wet locations shall be UL labeled for said location as "damp-location" and "wet-location" for the respective installation location.

8. Fixtures in contact with thermal/building insulation shall be UL listed and rated for direct contact installation in thermal insulation systems.
9. Lamp auxiliary support brackets shall be heat-resistant, non-dielectric. Alternatively, metal auxiliary lamp support brackets shall be electrically isolated from the fixture, to prevent glass decomposition.

10. Lighting fixtures installed in masonry and/or concrete construction. The fixture housing shall be rated for "concrete-pour" installation location.

11. Provide a permanent label inside each light fixture stating the following relamping information. Not less than 0.125-inch high black alphanumeric characters on white background.

"Replacement lamp(s) installed in this light fixture must comply with the following criteria:

*: CRI *: Lamp Watts
*: CCT-K *: Lamp Lumens

Only lamp rated * type lamp ballast shall be installed in this fixture."

*Insert the value required for the specific lamp required by the Contract Documents for each light fixture.

B. Lens and Diffusers

1. Acrylic plastic or Plexiglas for the light fixture diffusers or fixture lenses shall be 100% virgin material.

2. Thickness of not less than 0.125-inch, as measured at the "THINIST" portion on the diffuser or lens. However, thickness shall be increased to sufficient construction and camber to prevent the lens and diffusers from having any noticeable sag over the entire normal life of the installation.

3. Diffusers shall be formed from cast sheet by a vacuum and/or pressure technique.

4. Lighting fixtures containing lamps with dichroic reflectors and light fixtures with non-dichroic lens/diffuser shall be rated for high temperature lamp operations resulting from lamp heat redirected (reflected) back into the fixture.

2.04 SOLID STATE LIGHTING (SSL), LIGHT EMITTING DIODES (LED) LAMPS, POWER SUPPLIES, AND LIGHT FIXTURES (ADDITIONAL REQUIREMENTS)

A. General

1. Solid State LED light source (lamps), related control equipment (driver-power supply), and luminaire (light fixture) optics for light output distribution.

2. Shall comply with the US-DOE Energy Star Program for SSL-LED. Submit documentation with Shop Drawings.


4. SSL chromaticity shall comply with latest revision NEMA and ANSI – C78.377. Submit documentation with Shop Drawings.

5. Submit with Shop Drawings two samples of each light fixture type employing SSL, with prewired 120 volt, 60Hz AC “SO” cord and plug-in cap.

B. LED Lamps

1. Lamp lumen output and overall efficiency shall be based on the LED lamps installed in specified fixture and ambient operating temperature.

2. Lamp Color Rendition Index (CRI) shall equal or exceed CRI – 80, unless noted otherwise on Drawings.

3. Lamp color output shall be 4000-degree K (± 100K), unless noted otherwise on Drawings.

4. CRI and lamp color temperature shall be same for all light fixtures of the same fixture type.
C. LED Power Supply (driver)
   1. Combination of power supply and SSL – lamp shall be tested and certified by respective Manufacturers for performance and proper operation.
   2. Provide dimming type driver where indicated on Drawings. Driver and dimming equipment shall be Tested and Certified by respective Manufacturers for performance and proper operation.

D. Self-Contained LED Lamp and Driver, Integral “Screw-Base” and/or “Pin-Connect”, replacement assembly for incandescent lamps.
   1. Shall be dimmable. Dimmer and lamp shall be certified by respective Manufacturers for compatible correct operation with each other.
   2. Optical system and operating temperature thermal performance shall be compatible with light fixture.

2.05 EMERGENCY BALLAST LIGHTING AND EMERGENCY DRIVER LIGHTING

A. General
   1. Self-contained emergency ballast and power supply (driver) containing batteries, battery charger, solid-state electronic control and lamp/ballast/driver operation, contained within a metal case, red finish case color.
   2. UL–924, listed Emergency Lighting and Power Equipment, for installation inside and/or attached to lighting fixtures.
   3. The emergency battery supply unit(s) shall be provided inside each respective emergency light fixture by the Fixture Manufacturer.
   4. Normal operating temperature range from 0-degrees Centigrade up to operating ambient temperature inside respective lighting fixture, but not less than 50-degrees Centigrade.
   5. Provide a permanent label inside each emergency light fixture stating as follows, not less than 0.125-inch high black alphanumeric characters on a white background:
      "Warning – this fixture provides more than one electric power source. Disconnect both normal and emergency sources including battery sources prior to opening fixture. Written permanent records documenting regular (every 30 days) emergency lighting function testing results shall be kept on file by the DISTRICT."
   6. UL and Manufacturer rated to supply the lamp and ballast/driver (power-supply) combination occurring in the respective light fixture, both dimming-type and non-dimming type light fixtures.
   7. As manufactured by Bodine Inc. or IOTA-Engineering Inc.

B. Operation
   1. Emergency mode
      When external AC electrical power fails, the emergency unit shall immediately and automatically switch to emergency mode. Maintain emergency lamp(s) illumination, while operating from the internal battery/electronics during the power failure for not less than 90-minutes continuous duration.
   2. Normal Mode
      When AC electrical power is restored, automatically switch lamp(s) operation to external AC operation and begin battery-charging mode.
3. Battery Recharge Mode
The battery charger shall automatically fully recharge discharged batteries in less than 24-hours, and prevent overcharging of the batteries, while maintaining a "float-charge" on the batteries.

4. The emergency battery unit shall operate not less than two lamps in multi-lamp light fixtures and one lamp in single lamp light fixtures. When operating in emergency mode and battery power, the lamp lumen output of each lamp shall be not less than 40% of the lamp normal full lumen output rating of the lamp operation on normal power. The lamp-lumen output shall be 100% of the lamp normal full lumen output rating when operating in normal mode.

5. The emergency ballast shall provide cold-strike start and hot-restrike operation of the fixture lamp(s).

6. Periodic automatic, internal self-test, simulating normal power loss and actual operation of emergency lamps on internal battery power. Auto self-test shall occur not more than 30-day intervals. Audible and visual trouble alarm display, with manual alarm reset/silence, for problems identified by autotest functions.

C. Electrical Characteristics
1. Emergency equipment shall operate on the same input AC voltage as the normally "hot" branch circuit supplying the respective light fixture. Maximum line input load shall not exceed 15% more than normal fixture electrical load.

2. The emergency equipment shall be compatible for correct operation with the specific lamp/ballast/driver combination contained in the respective light fixture.

3. The emergency equipment shall be compatible with switched (on-off), non-switched (continuously on) and dimmer controlled lighting fixtures/circuits.

D. Components
1. Sealed nickel cadmium batteries, maintenance-free, rated for continuous operation in high ambient temperature, with 7 to 10 year operational life expectancy.

2. When standing on the floor below the fixture the emergency ballast test/monitor control panel shall be visible and readily accessible when the fixture is installed. The control panel shall provide:
   a. Charging indicator visual annunciator to display the charger and battery status.
   b. Momentary test switch/pushbutton to manually simulate power failure test.

PART 3 - EXECUTION

3.01 LIGHT FIXTURE INSTALLATION

A. General
1. The CONTRACTOR shall verify actual ceiling and wall construction types as defined on the Architectural Drawings and furnish all lighting fixtures with the correct mounting devices, trim rings, brackets whether or not such variations are indicated by fixture catalog number. The CONTRACTOR shall verify depth of all recessed lighting fixtures with Architectural Drawings prior to ordering fixtures. Any discrepancies that would cause recessed lighting fixtures not to fit into ceiling shall be reported to the DISTRICT’S Representative prior to release of order to the Supplier of the fixtures.

2. On acoustical tile ceilings, fixture outlets shall be accurately located in the center, at the intersection of the four corners or at the center of the joints of two tiles.
3. The CONTRACTOR shall aim the exterior adjustable lighting fixtures after dark in the presence of, and at a time convenient to the DISTRICT’S Representative.

4. Fixtures shall be ordered and furnished to operate correctly on the branch circuit voltage connected to the respective fixture as shown on the Site Plan and Floor Plan Electrical Drawings. The voltages shown on the fixture schedule are for generic fixture information only.

5. Install and connect lighting fixtures to the circuits and control sequences indicated on the Drawings and to comply with respective Manufacturer’s instructions/recommendations.

6. Lighting fixtures in building interstitial spaces, in mechanical plumbing and electrical spaces/rooms, are shown in their approximate locations. Do not install lighting outlets or light fixtures until the mechanical, plumbing and electrical equipment/pipes/ductwork are installed; then adjust and install lighting in revised clear (non-interfering) locations to provide best even-illumination. Coordinate the locations with all other trades prior to lighting installation.

B. Lighting Fixtures Installed in Ceiling Support Grids - Suspended Lay-in "T-bar" and Concealed Spline Ceilings.

1. Provide two seismic clips at opposite ends of each recessed light fixture, the clip shall connect to the ceiling grid main runners and the light fixture. The light fixture with seismic clips and ceiling grid runner connections shall resist a horizontal seismic force equal to the total weight of the light fixture assembly.

2. Each light fixture weighing 40-pounds or less and where the respective ceiling grid system is "heavy duty" type, shall be suspended directly from the ceiling grid or shall be suspended independent of the ceiling grid support system as approved by the AHJ. Each light fixture weighing more than 40-pounds or where the ceiling grid system is not a "heavy duty" type shall be supported independent of the ceiling grid and independent of ceiling grid support system.

3. Each light fixture supported independent of the ceiling grid system shall be supported with a minimum of four taut independent support wires, one wire at each fixture corner.

4. Each light fixture supported directly from the ceiling grid or ceiling grid support system shall be additionally connected with a minimum of two independent slack safety support wires. One wire at each opposite diagonal fixture corner. Each 3-feet by 3-feet and larger light fixture shall be supported in the same manner, except provide a minimum of independent slack safety wires, one at each fixture corner.

5. Light fixtures surface mounted to a suspended ceiling shall be installed with a 1½-inch steel – "C" channel which spans across and above a minimum of two parallel main ceiling grid "runners" and concealed above the ceiling. Each channel or angle member shall be provided with a minimum of two threaded studs for attaching to the fixture housing through the lay-in ceiling tile. Two steel "C" channel members shall be installed for each 4-feet (or smaller) fixture. Install the channels within 6-inches of each end of the light fixture to span a minimum of two ceiling grid parallel main runners. Provide two seismic clips connecting the ceiling grid main runners to each steel – "C" channel. Provide a not less than two taut independent support wires connecting to each channel. Bolt the light fixtures to the threaded studs on the channels or angles, to support the light fixture tight to the ceiling surface.
C. Fixture Supports
1. The support wires for light fixture support shall be 12-gauge steel (minimum). The wires including their building and light fixture attachments shall provide support capacity of not less than four times the weight of the light fixture assembly. Provide additional light fixture support wires and building anchors to meet these requirements, as part of the Contract. The support wires shall be anchored to the building structural elements above the ceiling.
2. Pendant mounting fixtures shall be supplied with swivel hangers. Fixtures shall swing in any direction a minimum of 45 degrees of gravity, position. Fixtures shall have special stem lengths to give the mounting height indicated on the Drawings. Stem to be single continuous piece without coupling, and to be finished the same color as the canopy and the fixture, unless otherwise noted. The CONTRACTOR shall check all lock nuts and set screws to rigidly secure the swivel socket to the stem, and the stem to the outlet box. Fixtures shall be plumb and vertical. Where obstructions occur restricting 45-degrees free-swing of fixtures, the fixtures shall be "guy" wired to prevent fixtures from striking obstructions. The DISTRICT'S Representative shall approve method of guying. Swinging fixtures shall have an additional safety hanger cable attached to the structure and the fixture at each support, with the capacity of supporting four times the vertical weight of the light fixture assembly.
3. Suspended fixtures weighing in excess of 40-pounds shall be supported independently of the fixture outlet box. Provide "air craft" (minimum 12 gauge) steel hanger cable for suspended fixtures route cable concealed or in pendant where possible. Each cable attachments shall support four times the weight of the fixture assembly. Securely attach the cable to the building structure.
4. Surface mounted fixtures installed on drywall or plaster ceilings and weighing less than 40-pounds may be supported from outlet box. Provide structural supports above drywall or plaster ceilings for installation of fixtures weighing more than 40-pounds and secure fixture to structural supports. The use of toggle bolts is prohibited.

C. Recessed Lighting Fixtures - Fire Rated Building Surfaces
1. Lighting fixtures recessed in ceiling or wall which has a fire resistive rating of 1-hour or more shall be enclosed in a fully enclosed backbox (except over fixture lens/diffuser). The material used to fabricate the "enclosed backbox" shall have a fire rating equal to that of the respective ceiling or wall.
2. The space from the fixture to the box enclosure shall be a minimum of 3-inches.
3. The backbox shall be concealed behind the fire rated ceiling and wall finish surface. The light fixture shall be provided with lamp ballast rated for (normal light output) operation in a "high" ambient temperature.

3.02 LENS AND DIFFUSERS

Lens, diffusers, internal reflectors shall be completely cleaned of all dust, dirt and fingerprints after the installation of the light fixtures and lamps, and after all trades have completed work and prior to occupancy of the facility by the DISTRICT.
3.03 COMMISSIONING LIGHTING FIXTURES (ADDITIONAL REQUIREMENTS)

A. General

1. Verify correct lighting control configurations and operation in each room.
2. Simulate normal source power failure by "opening" (turn off) building main service disconnect and verify connections and operation of each emergency lighting fixture.
3. Confirm "EXIT" sign directional arrows are visible in each "EXIT" sign.
4. Verify light fixture support-hangers, ceiling grid clips and seismic restraints comply with the Contract Documents.
5. Remove protective shipping/installation shields on fixtures. Verify fixtures and lamps are clean and free of construction debris. Clean light fixtures found to be contaminated or dirty.
6. Setup, program, and function test lighting control systems to perform each of the indicated control functions, area/room zones and sequences.
7. Provide "aiming", directional adjustment of light fixtures, both indoor and outdoor. Aiming shall comply with Manufacturer's aiming diagrams, and as directed by District's Representative.

B. Sample Spot-Check in each room the following lighting fixture information:

1. Lamp type and performance data.
2. Ballast type and performance data.
3. Combined lamp/ballast certification of performance and compatibility by respective Manufacturer.
4. Verify instructional signage is placed inside each lighting fixture in compliance with Contract Documents.

END OF SECTION 26 5000
112316/223037
SECTION 27 2000

ELECTRONIC NETWORK SYSTEMS INFRASTRUCTURE

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26.
   2. General provisions and requirements for electrical work.

B. Provide Electronic Network Systems Infrastructure for the following systems:
   1. Computer Data Networks
   2. Telephone and Intercom Voice Communications
   3. Other special systems described in the Contract documents.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Drawings Submittals
   1. Drawings shall be submitted on reproducible sepias and Autocad® Version 2.2 (or later revision) data files on CD/DVD-ROM disk, WINDOWS®-XP or Version-7 or Version-8 format.
   2. Submit redrawn Building Floor Plan for each building area, same scale as the Contract Drawing.
   3. Plans shall show walls, doors, windows, furniture, infrastructure, outlets and network systems equipment locations. Show point-to-point interconnecting cables, pathways, conduit, conduit sizes, circuit types, along with circuit identification names, numbers and quantities between all components.
   4. Provide scaled Elevation Drawings of each equipment rack, terminal blocks, terminal backboard and terminal room/closet showing location and arrangement of each equipment component, outlet and cable training provisions, with estimated weight of each complete assembly.
   5. Submit block wiring diagrams showing major system components, outlets, equipment racks, terminal blocks, signal loss with interconnecting circuit conductors, splices, portable patch cords and connectors. Riser type diagram shall be provided if the building has more than one floor level, with information shown on riser diagram corresponding for each respective floor.

B. Submit Manufacturer's standard catalog data for each component. The submittal shall be arranged in the order of the Specification and shall list the Specification paragraph number, the name, the proposed model and Manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure. The Manufacturer's data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of items. The data sheet shall completely describe the proposed item. Where modification to the equipment is necessary to meet the operational requirements of the Contract Documents, the brochure shall include complete Mechanical and
Electrical Shop Drawings, detailing the modification. The brochure shall include a listing of the outlet rough-in requirements for every device and equipment item. The applicable symbol which illustrates that rough-in item on the job plans shall be drawn on the proposal, opposite the description of the rough-in to facilitate locating the data by Field Personnel. Submit elevation and dimensional information.

C. Performance Calculation:
1. Provide engineered calculations showing the Passive Cable System Signal Attenuation losses of the proposed installed system. The intent is not to require calculations for every system segment, port and outlet. The intent is to require engineered calculations for proposed typical worst case port to port; head end to farthest distance outlet and patch port to outlet signal attenuations.
2. Provide calculations for a minimum of 50 complete channel/circuit paths. The calculations shall include attenuation insertion losses for each system component including individually itemized cable-fiber/wire; outlet, termination, connector, electronic component (if any), coupler and patch cord along the entire path from the head end equipment to the end use outlet.
3. The calculations shall serve as the basis for verifying the system performance with the system testing specified in the Contract Documents.

D. Provide proposed nameplate and outlet identification/color coding system. Indicate proposed identification naming sequence and methods, itemized for review.

E. Submit Manufacturer Certified Test Reports showing test documentation for the proposed material that the material meets or exceeds the performance standards defined in the Contract Documents. The testing and results shall reflect worst case performance based on a minimum of ten samples. Tests shall be certified by a Nationally Recognized Independent Test Lab (i.e., ETL, UL, etc.). The Manufacturer shall certify in writing the material has been manufactured and tested to comply with the requirements defined in the Contract Documents.

F. Submit three samples of each of the following, fully assembled with 24-inches of cable type connected:
1. Copper wire outlet and connector, with each type of specified inserts.
2. Copper cables and patch cords, each type.
3. Fiber optic cables and patch cord each type.
4. Mechanical splice - fiber optic.
5. Fusion splice - fiber optic.
6. Fiber optic outlet and connector each type.
7. Fiber optic cable connector each type of termination, with interconnection coupler.
8. Patch panel each type.
9. Coverplate each type.

1.03 APPLICABLE STANDARDS

A. Individual component Production/Manufacturer Testing and Labeling.
1. The equipment shall be UL listed, labeled, and approved for the application shown in the Contract Documents.
2. ETL (USA) each network systems infrastructure component. Third party testing, documentation and certification for performance compliance of each component with the UL, ANSI, TIA and EIA applicable Standards specified in the Contract Documents.
B. The complete system material, equipment, testing, installation, workmanship and installed performance shall comply with the mandatory requirements and the guideline/recommendation requirements of the following latest published version, supplements, latest revision including Addendums and TSB. Both the mandatory and advisory criteria shall be included as requirements of the Contract Documents:

1. TIA-526 Optical Power and loss measurements – multimode and single mode fiber.
2. ANSI/TIA/EIA-568C Commercial Building Telecommunications Standards.
3. ANSI/TIA/EIA-569B – Commercial Building Standards for Telecommunications Pathways.
5. ANSI/TIA/EIA-598B Optical Fiber Cabling Color-Coding.
7. ANSI/TIA/EIA-607 Commercial Buildings Grounding and Bonding Requirements for Telecommunications.
9. ISO/IEC 11801
10. National Electrical Code (NEC) and California Electrical Code (CEC) including Articles 770 and 800 with ETL verified testing and local code jurisdictions.
11. NECA/NEIS, National Electrical Contractors Association, National Electrical Installation Standards:
   a. 301 – Standard for Installation and Testing for Fiber Optic.
   b. 568-Standard for Installing Building Telecommunications Bonding and Grounding.
   c. 607-Telecommunications
12. Manufacturer's recommendations for the respective equipment.

C. Network Performance

1. The entire completed Electronic Network Systems Infrastructure shall be tested and provide electronic data/network and telephone/voice multi-channel communications latest revisions, standards and addendums for the following protocols:
   a. IEEE 802.3/ETHERNET latest revisions.
2. Twisted pairs copper wire (100 meter path length unless indicated otherwise)
   a. 10Mbps 10Base-T, 100Mbps 100Base-Tx;
   b. 1000Mbps (1Gbps) 1000 Base-Tx;
   c. 10,000 Mbps (10Gbps) 10Gb Base-Tx.
   d. IEEE-802.3 for Power Over Ethernet (POE) and Power Over Ethernet-Plus (POE Plus).
3. Fiber optic, 550 meter communications pathway distance, OM4 standard multimode and OS2 single-mode.
   a. 10Mbps 10Base-F1, 100Mbps 100Base-FX,
   b. 1000Mbps 1000Base-Lx-Sx
   c. 10,000 Mbps (10Gbps) for fiber optics
   d. Single Mode path length performance increase requirement to 3000 meters.
4. IEEE 802.5/TOKEN RING.
5. APPLETALK (Phone-net).
6. FDDI - Distributed data interface on fiber or copper wire, 100Mbps.
7. 100VG – Any LAN
8. TIA/EIA serial and Bi-directional RS-232 and RS-485, including Star-Hub repeaters.
9. ANSI - TPPMD 55Mbps, 155Mbps and 622Mbps Asynchronous Transfer Mode - ATM.

D. The Complete Telephone/Voice Infrastructure System shall be suitable for the telephone/voice analog and digital communications and VOIP protocols. The system shall be compatible with the telephone/voice equipment installed as part of the Contract.

F. Installation of All Infrastructure Equipment, Devices, Splices, Terminations, Cables, Outlets, etc. shall comply with Manufacturer's recommendations.

1.04 EQUIPMENT QUALIFICATIONS

A. Equipment
1. The Supplier of the equipment shall be the Factory Authorized Distributor and service facility for the brands of equipment and material provided.
2. Network systems infrastructure equipment and materials shall all be the product of one of the individual same Manufacturers as follows. Typical unless specifically described otherwise:
   - Belden – 10GX Series; or CommScope-Systimax X10D Series;
   - or AMP/Tyco – NetConnect Series;
   - or Ortronics/Legrand – NetClear Series;
   - or Siemon – ConvergeIT Series.

B. Installation Certification
1. Work and material for cables, cable terminations, outlets and related components for infrastructure systems shall be performed by Certified Installers. The Installer shall be certified by the respective Product Manufacturers.
2. The Manufacturers of the indicated work and material, shall provide an Installer education/training and certification program for the supplied products.
3. The Installers performing the Contract Work for the indicated products, shall have attended and successfully completed each of the respective Manufacturer's installation training education programs for the specified products.
4. Submit six copies of the Manufacturer's Certifications for each installer performing the work. The submittal shall be approved by the OWNER'S Representative prior to initiating any related Contract Work.
5. Contract material installed and work performed by Installers not complying with these requirements shall be removed. Removal of work and material not in compliance with these requirements shall done at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions. New material and work required to replace the non-complying removed work and material shall be provided at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions.

C. Extended Material and Performance Warranties
1. In addition to the warranty requirements described elsewhere in the Contract Documents, provide the following extended material and performance warranties. The warranty period shall be for not less than 15-years from the Contract Notice of Completion.
2. Warranty scope includes materials and performance for network cables and terminations, network workstation plug-in outlets, and patch panel plug-in outlets, cable splices and connectors.

3. Repair or replace the defective material with new material at the Project premise, to comply with the performance standards outlined in the Contract Documents during the warranty period.

4. Submit seven copies of proposed warranty statements, with Shop Drawing submittals.

1.05 ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Terminology</th>
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<tbody>
<tr>
<td>ACR</td>
<td>Attenuation to Cross Talk.</td>
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<tr>
<td>AHJ</td>
<td>Authority Having Jurisdiction.</td>
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<tr>
<td>Backbone</td>
<td>Circuit interconnections between MDF and IDF patch panel locations.</td>
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<tr>
<td>dB</td>
<td>Decibel.</td>
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<tr>
<td>dBm</td>
<td>Decibel referenced to a milliwatt.</td>
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<tr>
<td>Demarc</td>
<td>Demarcation location where operational control change occurs or ownership change occurs.</td>
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<tr>
<td>ft</td>
<td>Feet.</td>
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<tr>
<td>GHz</td>
<td>Gigahertz.</td>
</tr>
<tr>
<td>Gbps</td>
<td>Gigabits per second.</td>
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<tr>
<td>Horizontal Connection</td>
<td>Circuit interconnections between individual workstation outlet and/or horizontal wiring equipment rack patch panel.</td>
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<tr>
<td>IDF</td>
<td>Intermediate Distribution Frame (horizontal or vertical cross connect) for an individual building area/ floor.</td>
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<tr>
<td>km</td>
<td>Kilometer-1km.</td>
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<tr>
<td>kPSI</td>
<td>1000 pounds per square inch.</td>
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<tr>
<td>m</td>
<td>Meter = 39.37 inches.</td>
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<tr>
<td>Mbps</td>
<td>Megabits per second.</td>
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<tr>
<td>MDF</td>
<td>Main Distribution Frame (central/main cross connect) for multi-building site or for a single individual building.</td>
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<td>MHz</td>
<td>Megahertz.</td>
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<tr>
<td>MIC</td>
<td>Micrometer</td>
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<tr>
<td>mm</td>
<td>Millimeter = 10⁻³ meter.</td>
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<td>NEXT</td>
<td>Near end cross talk.</td>
</tr>
<tr>
<td>nm</td>
<td>Nanometer = 10⁻⁹ meter.</td>
</tr>
<tr>
<td>pF</td>
<td>Picofarad = 10⁻¹² farad.</td>
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<tr>
<td>Provide</td>
<td>Furnish, install and connect.</td>
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<tr>
<td>RTDE</td>
<td>Equipment rack mount fiber optic termination distribution enclosure, with fiber optic patch panel.</td>
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<tr>
<td>RMSE</td>
<td>Equipment rack mount fiber optic enclosure, splice only (without patch panel).</td>
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<tr>
<td>STP</td>
<td>Shielded individual twisted pairs copper wire.</td>
</tr>
<tr>
<td>ScTP</td>
<td>Shield Screened Twisted Pairs copper wire.</td>
</tr>
</tbody>
</table>
Trunking-Cable ........................................... Individually insulated twisted pair copper wire cable, consisting of 24-pair or more of conductors inside a common cable jacket. Terminate and connect to common terminal-block location at each end of the trunking-cable.

Micrometer = 10^-6 meter.

Universal Splice Enclosure.

Unshielded twisted pairs copper wire.

Voice communications Over Internet Protocol.

WideBand Gigabit Networking Alliance.

Spaces remote from the MDF/IDF terminal location room/closet, where user equipment interacts and connects with the electronic systems infrastructure equipment connection outlet device.

Wall Mount fiber optic cable Interface Cabinet.

1.06 MATERIALS AND METHODS

A. Material and Labor not complying with the Contract Documents shall be removed by the CONTRACTOR from the Project Site. Material and labor complying the Contract Documents shall be provided.

B. All the cost to remove deficient work and material, provide work and material complying with the Contract Documents and the direct, indirect, incidental damages and Contract delays resulting from complying with these requirements shall be the sole responsibility of the CONTRACTOR and shall be included in the bid price.

C. System Performance Requirements

1. The work, performance and type of materials provided as part of the Contract shall comply with the following ANSI/TIA/EIA-568C and related standards for all Electronics Network Systems Infrastructure work and materials described in the specifications and shown the Drawings:
   a. Computer/data network systems: Category-6A
   b. Telephone/intercom voice systems: Category-6A
   c. Broadband transmission radio frequency for television, digital or analog cable television, digital satellite system, broadcast quality Coaxial-RG6 (QUAD SHIELDING).
   d. Trunking-cable, analog circuits copper wire twisted pairs: Category-5E.

2. The Electronic Network Systems Infrastructure system shall be based on “star topology”; for MDF to IDF backbone connections and workstation outlet to MDF/IDF horizontal connections.

PART 2 - PRODUCTS

2.01 FIBER OPTICS CABLES

A. General

1. Operating temperature range - 20 degrees centigrade through +60 degrees centigrade. Cables shall be flame retarding.

2. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access
floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled “Limited Combustible Cable” (LC or LCC) and shall comply with the latest published revision of all of the following additional requirements.

a. Limited combustible “FHC-25/50” per UL-2424.

b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, fiber optic “FHC-25/50-CMP and/or OFNP/OFCP”.

c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited-combustible.

d. NFPA-5000; defines combustible material including wire and cable.

e. NFPA-75 computer rooms and electronic equipment room.

f. NFPA-13; spaces containing “limited combustible loading”.

3. Cables shall qualify as 100% recyclable materials disposal, RoHS regulation complaint.

4. All fibers in a multi-fiber cable shall be fully operational within the performance characteristics specified prior to and after the cable is installed. The use of spare fibers in the cable to compensate for defective fibers is not permitted. Defective cables shall be removed and replaced with fully functional cables at no additional cost to the Contract.

5. Cables shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with specified requirements. ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

6. Each fiber shall be individually identified with factory color-coding or factory imprinted label. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number, along with Agency listing identification.

7. Fiber optic cable shall be a product of the same Manufacturer, including portable patch cables.

8. Cables installed in raceways or conduits below grade, through in-grade manholes or pullboxes shall be rated for installation in water/wet locations.

9. Provide overall outer jacket enclosing all fibers inside jacket. Cables containing less than seven fiber strands shall be provided with a color coded outer jacket (red or orange).

10. Multimode (62.5/125)

a. Fiber optic cables optical fibers, (62.5/125) graded index multimode optical glass fibers, 62.5 micron fiber core and 125 micron fiber cladding, 0.275 numerical aperture. Optical fibers shall be 100 kpsi proof tested, with maximum 0.7 micron flaw size for dual operation at 850nm and 1300nm wave lengths.

b. Minimum bandwidth:

   @ 850nm - wave length  160MHz per km length
   @ 1300nm - wave length  500MHz per km length

c. Maximum attenuation:

   @ 850nm-wave length  3.4 dB @ 1km length
   @ 1300nm-wave length  1.0 dB @ 1km length

d. Laser-optimized "OM2" optical multi-mode standards.

11. Multimode (50/125)

a. 50/125 fiber optic cables optical fibers, graded index multimode optical glass fibers, 50.0-micron fiber core and 125-micron fiber cladding, 0.2 numerical aperture. Optical fibers shall be 100 kPSI proof tested, with maximum 0.7 micron flaw size for dual operation at 850nm and 1300nm wave lengths.
b. Minimum bandwidth:
   @ 850nm-wave length  3500Mhz per km length
   @ 1300nm-wave length  500Mhz per km length

c. Maximum attenuation:
   @ 850nm-wave length  3.0db @ 1km length
   @ 1300nm-wave length  1.0db @ 1km length

d. Laser-optimized "OM4" optical multi-mode standards.

12. Single mode:
   a. Fiber optic cables optical fibers, (8.3/125) single mode optical glass fibers,
      8.3-micron core fiber and 125-micron fiber cladding, 0.11 numerical
      aperture. Optical fibers shall be 100-kPSI proof tested, with maximum 0.7-
      micron flaw size. For operation at 1310nm and 1550nm wave lengths.
   b. Maximum attenuation:
      @ 1310nm- wave length  0.5 dB @ 1km length
      @ 1550nm- wave length  0.4 dB @ 1km length
   c. Maximum dispersion
      @ 1310nm- wave length  2.8 ps/nm km length
      @ 1550nm- wave length  18.0 ps/nm km length
   d. Laser-optimized "OS1"/"OS2" optical single mode standards.

B. Loose Tube Gel-filled Cables
   1. Multiple, loose tube buffer tubes, gel-filled. Each buffer tube shall contain the
      same quantity of optical fibers, but not more than twelve optical fibers in each
      buffer tube.
   2. Buffer tubes shall be cabled around a central dielectric strength member. The
      central strength member shall be centered along the length of the cable.
   3. Aramid yarn, non-optical, strength fibers shall extend continuously along the
      length of the cable.
   4. The cable interstitial spaces shall be flooded to inhibit water migration, with
      non-flammable water blocking gel.
   5. Each optical fiber shall be individually UV cured acrylate coated, 250-micron
      diameter coating over fiber cladding.
   6. A seamless black polyethylene outer layer jacket shall envelope the entire
      cable.
   7. The cable shall be fungus resistant, UV resistant, and moisture resistant for
      installation indoors with or without an enclosed raceway and outdoors in
      underground enclosed raceway/conduit and manholes/pullboxes continuously
      flooded with water.

C. Indoor/Outdoor Cables
   1. The cable shall be fungus resistant, UV resistant, moisture resistant for
      installation indoors with or without an enclosed raceway and outdoors in
      underground enclosed raceway/conduit and manholes/pullboxes continuously
      flooded with water, and in conduits exposed to the sun.
   2. Each optical fiber shall be primary coated with 500 micron uniform acrylate tight
      buffered and with elastomeric uniform 900-micron diameter tight buffered,
      secondary coating. Aramid yarn strength member elements shall be tensioned
      and symmetrically and uniformly distributed around the fibers, along the length
      of the cable.
   3. An overall cable jacket uniformly extruded directly around and mechanically
      interlocked with the optical fibers/strength members. The extruded jacket shall
      form internal helical cusped ridges that interlock with the optical fibers and
strength members. The interlocking jacket shall not allow cable fibers to move axially within the cable jacket.

4. Cables containing more than 24-optical fibers shall be constructed with sub-cable fiber bundles. Each sub-cable bundle shall contain equal quantities of optical fibers, with a separate PVC jacket around each sub-cable. Sub-cable and sub-cable jacket construction shall match the overall cable requirements and jacket requirements.

5. The cable shall be UL listed and comply with NEC and NFPA requirements for each installation location shown in the Contract Documents. ETL tested and certified to comply with or exceed specified requirements.
   a. NEC – OFNR (Vertical Riser Type Locations) OFNP (UL FHC-25/50 LC Plenum Type Locations and locations where not continuously enclosed inside conduits for entire cable length).
   b. NEC – OFNG (Where continuously enclosed inside conduits for entire cable length).

D. Tight Buffered Cables
   1. Each optical fiber shall be coated, 900-micron diameter uniform coating, with uniform tight buffering over the coating, uniform dielectric strength member surrounding the buffering coating and an overall jacket around each optical fiber assembly.
   2. Individual multiple optical fiber assemblies shall be symmetrically arranged around a central dielectric strength member. The central strength member shall be centered along the length of the cable.
   3. A dielectric strength member shall surround the fiber assemblies.
   4. An outer dielectric jacket shall envelope the entire cable.
   5. The cable shall be UL listed and comply with NEC and NFPA requirements for each installation location shown in the Contract Documents. ETL tested and certified to comply with or exceed specified requirements.
      a. NEC - OFNP (UL FHC-25/50 LC Plenum type locations and locations where not continuously enclosed inside conduits for entire cable length).

2.02 COPPER WIRE CABLES (TWISTED PAIRS)

A. General
   1. Conductors shall be copper wire, individually insulated and color coded, with multiple conductors arrange in twisted pairs.
   2. An overall non-conductive jacket shall encase the copper wires and any shielding (where shielding is specified) shall also be encased by the jacket.
   3. Cables shall be UL listed, complying with NEC National Electrical Code, National Fire Protection Agency and NFPA requirements for each installation location shown. ETL tested and certified to comply with or exceed specified requirements.
      a. NEC – MPP/CMP, FHC-25/50 (Plenum type locations and locations where not continuously enclosed inside conduit).
      b. NEC – MPR/CMR (Vertical riser type locations).
      c. ANSI/TIA/EIA-568C; including related standards, amendments and TSB.
   4. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled "limited
combustible cable” (LC or LCC) and shall comply with the latest published revision of all of the following additional requirements.

a. Limited combustible “FHC-25/50” per UL-2424.

b. NEC/CEC;CMP, additional listing/labeling where the install location is an environmental air plenum, copper wire “FHC-25/50-CMP”.

c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited-combustible.

d. NFPA-5000; defines combustible material including wire and cable.

e. NFPA-75 computer rooms and electronic equipment room.
f. NFPA-13; spaces containing “limited combustible loading”.

5. Cables shall qualify as 100% recyclable materials disposal, RoHS regulations complaint.

6. Cables installed in air plenums, air-handling spaces and cables installed without raceway or conduit shall also be UL listed and labeled for installation in air plenums.

7. Cables installed in raceways or in conduits below grade, or through in-grade manholes and pullboxes, shall be rated for installation in water/wet locations.

8. The outer cable jacket shall be imprinted with date, Manufacturer’s model and catalog number and Agency (AHJ) listing identification.

9. Copper wire Electronic Network Systems Infrastructure cable shall be a product of the same Manufacturer, including portable patch cables.

10. The outer jacket of cables with less than nine pair of conductors shall be color-coded. The jacket color shall be different for each system type; multimedia; telephone/voice; computer/data network; and fiber cable jackets.

11. 300-volt RMS insulation material for each data conductor shall be the same material; shall be the same electrical characteristics and shall be the same dielectric constant, for all data conductors contained within the respective common cable jacket, along the entire installed length of the cable. Data cables employing differing insulation materials for individual data conductors contained within a common cable jacket are not acceptable and shall not be provided.

12. Propagation and “Skew” Rate

a. Skew rate (nominal velocity of propagation delay) between any twisted pair in a combination of four twisted pair conductors grouped in the same cable, shall not exceed 35-nano seconds between any wire pair contained in the conductor group, and as required by the cable Category rating, over a cable length of 328-feet (100 meters), for all frequencies up to the cable maximum frequency rating.

b. Nominal velocity of propagation, exceeding 70% of the speed of light.

13. Large capacity feeder cables and trunking-cables

a. Copper wire cables with more than 24-twisted pairs of conductors shall be constructed with 25-pair binder groups of conductors. The cable binder groups shall be enclosed in colored binders and assembled to form a single cable. The twisted pair/binder groups shall be enclosed with multi-layer dielectric protective sheaths underneath a cable jacket enclosing the entire cable assembly. A corrugated metal 100% shield shall be provided under the cable jacket enclosing all conductors.

b. Cables shall be wet location rated and listed for installation in conduit, where the conduit is in a wet environment and/or high-temperature environment, including:
   - Underground conduit.
   - Inside manholes and pull boxes.
   - Outdoor conduit exposed to weather and/or sunlight.
c. ANSI/TIA/EIA Category rating of cable assembly shall be Category-5E, trunking-cable.

B. Category-5E Computer/Data Enhanced Cables – UTP
1. Category-5E cables shall be tested and shall pass ANSI/TIA/EIA test recommendations for Category-5E.
2. Operational characteristics:
   a. Wire size 24AWG solid copper (24AWG stranded copper for portable patch cables)
   b. Quantity of twisted pairs As indicated but in no case less than four (4) twisted pairs
   c. Impedance 100 OHM ± 15%, 3-100MHz
   d. Maximum Signal Attenuation
      Per 300 feet 18dB @ 8MHz
      (100 meters) 20dB @ 10MHz
   e. Mutual Maximum Capacitance of Any Pair 14pf/feet
   f. Worst Pair "NEXT" Loss Per/328-feet (100 meters)
      62dB @ 1Mhz
      53dB @ 4Mhz
      48dB @ 8Mhz
      47dB @ 10
      44dB @ 16Mhz
      42dB @ 20Mhz
      41dB @ 25Mhz
      40dB @ 31.25Mhz
      35dB @ 62.5MHz
      32dB @ 100Mhz

3. ScTP, all the wires in the cable shall be enclosed in a common, 100% metallic foil shield with copper "drain" wire, shield and drain wire located under the cable jacket.

C. Category-6A Computer/Data Enhanced Cables – [ScTP] [UTP]
1. Category-6A cables shall be tested and shall pass the ANSI/TIA/EIA test recommendations for Category-6A.
2. Operation Characteristics:
   a. Wire size 23AWG solid copper (23AWG stranded copper for portable patch cables)
   b. Quantity of twisted pairs As indicated but in no case less than 4-twisted pairs
   c. Impedance 100 OHM ± 15%, 1-500Mhz
   d. Maximum Signal Attenuation
      Per 328-feet 2.1dB @ 1Mhz
      (100 meters) 3.8dB @ 4Mhz
      5.9dB @ 10Mhz
      7.5dB @ 16Mhz
      8.4dB @ 20Mhz
      10.5dB @ 31.25Mhz


2.03 COPPER WIRE CABLES (COAXIAL)

A. General

1. An overall non-conductive jacket shall encase the copper wires and shielding.

2. Cables shall be UL listed, complying with NEC National Electrical Code, National Fire Protection Agency and NFPA requirements for each installation location shown. ETL tested and certified to comply with or exceed specified requirements. In addition to the UL listing requirements for Copper wire Cable twisted pair, coaxial cable shall additionally be UL listed and labeled for each install location.
   a. NEC - CATVP (Plenum type locations and locations where not continuously enclosed inside conduit).
   b. NEC - CATVR (Vertical riser type locations).
   c. NEC - CATV (Locations where continuously enclosed inside conduit).
   d. ANSI/TIA/EIA-568C; including related standards, amendments and TSB.

3. Electronic network systems infrastructure cables that are not installed inside conduit raceways. Electronic network systems infrastructure cables that are installed in concealed spaces including plenums and non-plenums; access floors, ceiling spaces, walls, floor, etc., and/or installed without continuous raceways. The cable insulation and jacket shall be listed and labeled “Limited Combustible Cable” (LC or LCC) and shall comply with the latest published revision of all of the following additional requirements.
   a. Limited combustible “FHC-25/50” per UL-2424.
   b. NEC/CEC; CMP, additional listing/labeling where the install location is an environmental air plenum, “FHC-25/50-CMP”.
   c. NFPA-90A; ceiling cavity plenums, wall cavity spaces and raised floor cavity plenums, limited-combustible.

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e. Mutual Maximum Capacitance of Any Pair 4.4nF/100m

f. Worst Pair "NEXT" Loss Per/328-feet (100 meters)

15.0dB @ 62.5Mhz
19.1dB @ 100Mhz
27.6dB @ 200Mhz
31.1dB @ 250Mhz
34.3dB @ 300Mhz
40.1dB @ 400Mhz
45.3dB @ 500Mhz

67.0dB @ 1Mhz
67.0dB @ 4Mhz
67.0dB @ 10Mhz
67.0dB @ 16Mhz
67.0dB @ 20Mhz
67.0dB @ 31.25Mhz
65.6dB @ 62.5Mhz
42.3dB @ 100Mhz
58.0dB @ 200Mhz
56.5dB @ 250Mhz
55.3dB @ 300Mhz
53.5dB @ 400Mhz
52.0dB @ 500Mhz

3. ScTP, all the wires in the cable shall be enclosed in a common, 100% metallic foil shield with copper "drain" wire, shield and drain wire located under the cable jacket.
d. NFPA-5000; defines combustible material including wire and cable.
e. NFPA-75 computer rooms and electronic equipment room.
f. NFPA-13; spaces containing “limited combustible loading”.

4. Cables shall qualify as 100% recyclable materials disposal, RoHS regulation complaint.
5. The outer cable jacket shall be imprinted with date, Manufacturer’s model and catalog number and agency (AHJ) listing identification.
6. Cables installed in air plenums, air-handling spaces and cables installed without raceway or conduit shall be UL listed and labeled for installation in air plenums.
7. Cables installed in raceways or conduits below grade, through in-grade manholes and pullboxes shall be rated for installation in water/wet locations.
8. Copper wire Electronic Network Systems Infrastructure cable shall be product of the same Manufacturer, including portable patch cables.

B. RG6 Coaxial Cables
1. ANSI/TIA/EIA-568C cables. RG-6, Quad-Shield cables, shall be tested and shall pass ANSI/TIA/EIA test recommendations for the cable type. Rated for both analog and digital RF signal circuits.

2. Operational characteristics:
   a. Single center conductor size 18AWG stranded or solid bare copper.
   b. Velocity of propagation not less than 82%.
   c. Impedance 75-OHM.
   d. Maximum signal attenuation per 100-feet.
      ▪ Baseband Video 0.26dB @ 1MHz
      ▪ Upstream Digital Cable 0.76dB @ 10MHz
      ▪ TV ch. 2 1.46dB @ 50MHz
      ▪ FM Radio 2.05dB @ 100MHz
      ▪ TV Ch. 12 2.83dB @ 200MHz
      ▪ CATV Ch. 54 4.05dB @ 400MHz
      ▪ CATV Ch. 109 5.60dB @ 700MHz
      ▪ CATV Ch. 142 6.23dB @ 900MHz
      ▪ DBS 6.59dB @ 1000MHz
      ▪ DBS 7.50dB @ 1200MHz
      ▪ DBS 8.04dB @ 1450MHz
      ▪ PCS Cell Phones 8.50dB @ 1800MHz
      ▪ Wireless Cable 9.00dB @ 2200MHz
      ▪ High Frequency 13.7dB @ 3000-4500MHz
   e. Capacitance 16.2 pf/feet
   f. ASTM-D4566, 5 thru 4500MHz Return Loss Headroom (RLH) not less than 20dB.
   g. 100% sweep tested 5MHz thru 4500MHz

3. Four alternating layers of metal foil shielding and brass braiding shielding, 100% metallic shielding below the jacket and symmetrically enclosing the individual layers of dielectric insulation surrounding the center conductors.

2.04 FIBER OPTIC FIBER SPLICES

A. General
1. Fiber optic cable splices shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA–568C including related Standards, Amendments and TSB.
2. Fiber optic splices shall be the product of the same Manufacturer.

B. Mechanical Splice
1. Mechanically splice each fiber with a splice suitable for use with the type of fiber optic fibers. Re-enterable and reusable splice. Splice shall be recommended as compatible with the optical fibers by the Manufacturer. Splice shall not require the use of adhesives. Splice shall provide integral strain relief.

2. Performance requirements after installation:
   a. Operating temperature range minus 20-degrees centigrade through plus 60-degrees centigrade.
   b. Loss variation over temperature range, 0.05dB or less at specified wave lengths.
   c. Insertion loss, 0.3dB or less at specified cable wave lengths.
   d. Reflection (return loss), -40dB at specified cable wavelengths.

C. Fusion Splicing
1. Fusion splicing shall be performed with equipment providing the following features:
   a. Cleaving and cleaning optical fiber.
   b. Integral splice optimization verification system with local injection and detection.
   c. Projection screen optics and fiber core alignment system.
   d. Fiber cleaning/stripping.
   e. Cleaning fiber ends and fusing of fiber together with an electric arc.

2. Fusion splice insertion loss as measured at the completion of the splice shall be less than 0.1dB at specified cable wave lengths.

2.05 FIBER OPTIC FIBER CONNECTORS AND INTERCONNECTION COUPLERS

A. General
1. The connectors and interconnection couplers shall be compatible, maintain the same performance Category rating and be compatible with the corresponding fiber optic cable type attached to the connectors.
2. Fiber optic cable connectors and interconnection couplers shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements. Connectors and couplers shall comply with ANSI/TIA/EIA-568C, related Standards, Amendments, TSB, and TIA/EIA-Fiber Optic Connector Intermateability Standard (FOCIS) documentation.
3. Fiber optic connectors and couplers shall be the product of the same Manufacturer.
4. Shall be UL listed and comply with UL94V-0.
5. Color code connectors for fiber optic cables to match the respective fiber optic strand/jacket color.

B. Fiber Optic Fiber Connectors
1. LC – Small Form Factor (SFF) termination connector
   a. Ceramic oxide 1.25mm ferrule. Mechanical durability not less than 500-mating cycles. Insertion loss of mated connector shall be less than 0.3dB at specified wavelengths.
   b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match the connector installation application. Provide duct cover cap for each connector.
c. Locking type to automatically align mating fibers in the fiber cable and prevent accidental rotation and pullout.

2. ST type bayonet termination connector
   a. Ceramic aluminum oxide 2.5mm ferrule, multi-cure ultra violet or heat cured epoxy bonded, for multimode or single mode to match cable fiber. Insertion loss of each mated connector shall be less than 0.3dB at specified wavelengths.
   b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match the connector installation application. Provide dust cover cap for each connector.
   c. Locking type, to automatically align fiber cable and prevent accidental pullout.

3. SC – Square/Subscriber termination connector
   a. Ceramic oxide 2.5mm ferrule. Insertion loss of mated connectors shall be less than 0.3dB at specified wavelength.
   b. Strain relief boot, long boot type unless indicated otherwise, short or angled boot type to match connector installation application. Provide dust cover cap for each connector.
   c. Push-pull snap and lock type to automatically align mating fibers in the fiber cable and prevent accidental pullout.

4. "FSD" fixed shroud duplex type termination connector

C. FIBER OPTIC FIBER INTERCONNECTION COUPLERS
   1. Interconnection couplers shall be "like-to-like" compatible, and shall provide "plug-in" coupling of two fiber optic cable connectors terminated with fiber optic fibers front-to-rear "in-line" together. The coupler shall provide interlocking, automatic optical self-alignment of two mating fiber optic connectors.
   2. The centerline to centerline spacing of the interconnection couplers shall allow removal and insertion of portable patch cords, fiber cable connectors for both "single" and "duplex" type fiber adapter connectors without interfering with adjacent connectors.
   3. Patch panel mounted interconnections couplers shall be factory pre-mounted to a modular nominal 0.09-inch thick metal panel, couplers aligned and anchored on the plate.
      a. The metal panel shall be predrilled for standard EIA mounting in high-density 19-inch wide metal patch panel frames.
   4. Interconnection couplers in workstation outlets shall be installed in outlet boxes with cover plates.
   5. Provide removable dust caps for the front side of each coupler.

2.06 COPPER WIRE OUTLET CONNECTORS

A. General
   1. Connectors shall comply with FCC part-68 Subpart F for gold plating.
   2. Connectors shall be UL listed and shall comply with UL94V-0.
   3. Provide a removable blank dust cover for each plug-in outlet insert. The dust cover shall protect the insert from contamination until a workstation or patch cord is "plugged" into the outlet.
   4. Copper wire outlet connectors shall be color coded to distinguish telephone/voice separately from computer/data. The outlet cover plate shall be engraved to identify telephone/voice, computer/data and other infrastructure outlets separately.
5. Copper wire outlet connectors shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

6. Copper wire outlet connectors shall be the product of the same Manufacturer.

B. Universal Outlet Connector (for twisted pair Copper Wire Premise/Workstation Wiring and copper wire patch panels).

1. General
   a. Connections for twisted pairs copper conductors shall provide a universal outlet connector between the building premise copper wire, and plug-in workstation locations. Patch panel/equipment plug-in connectors. The connector components shall assemble with "snap-in" spring loaded retainers to prevent dislocation during insertion or removal of external plug-in devices.
   b. The contacts shall be gold plated with a 250 insertion/withdrawal cycle rating.
   c. Unless specifically noted otherwise the universal outlet connector shall comply with ANSI/TIA/EIA-568C; related Standards, Amendments and TSB.
   d. Operational characteristics shall match or exceed and shall be compatible with the respective twisted pair’s cable.
   e. A metal ground shield with EMI/RFI metal ground clip shall be provided where shielded cable is connected to the universal outlet connector for each universal outlet connector assembly.
   f. Each universal outlet connector shall consist of three major components.
      1) Universal edge connector assembly.
      2) Plug-in adapter inserts.
      3) Connector housing.
   g. Provide snap-in blank removable insert covers for connector installed without plug-in adapter inserts.

2. Universal edge connector:
   a. Insulated assembly shall connect to the premise copper wire. The connectors shall be multiple plug type connector contacts, one contact (total of eight contacts) for each individual premise wire connection interconnected to the individual wire terminations.
   b. Connector shall provide insertion of individual insulated copper wire, gas tight, 110-style punch down/displacement termination, for 22-26 AWG insulated premise wire.
   c. The edge connector assembly shall provide termination of eight separate wire conductors, twisted or untwisted pairs, solid or stranded, shielded or unshielded, with color codes and numbered identification of each contact. Integral cable/conductor strain relief to prevent pullout of terminated premise wire conductors.

3. Plug-in adapter inserts:
   a. Plug-in adapter inserts shall be internally factory connected to the universal edge connector assembly to adapt the universal connector to the specific outlet type configuration (i.e. "RJ" style computer/data, telephone/voice, (multimedia) modular jacks, etc.).
   b. Inserts shall be certified for shielded or unshielded wire, to match premise wire type connected to the universal edge connector.
c. Inserts shall provide correct pin-to-pin connections, electrical and mechanical matching characteristics for the specific equipment connected to the respective outlet.

d. Inserts for different infrastructures shall be color coded with different colors from each other, for system identifications.

e. Plug-in adapter insert type:
   1) Computer/data network systems:
      a) ANSI/TIA/EIA-568C, female modular jack 8-position/contact "RJ-45" style.
   2) Telephone/intercom voice systems:
      a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45 style.
   3) Multimedia audio/video tv (baseband only):
      a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45 style.
      b) Each multimedia audio/video outlet location provides a Balun to match the circuit impedance of the premise wiring to the multimedia outlet signal type.
   4) Intrusion detection/access control systems:
      a) ANSI/TIA/EIA-568C female modular jack 8-position/contact RJ-45 style.
      b) Each intrusion detection system outlet location provides a Balun to match the circuit impedance of the premise wiring to the intrusion system outlet signal type.

4. Connector housing:
   a. Connector housing shall contain the universal edge connector assembly and the plug-in adapter inserts in a rigid assembly. Connector housing shall provide integral cable strain relief for the premise wiring connection.
   b. The connector housing shall mount to a metal panel, metal device cover plate or plastic device cover plate with spring loaded snap-in retainers. Nominal depth of connector housing behind the mounting panel and/or device cover plate shall not exceed 1.625-inch including premise wiring termination depth requirements.

C. Coaxial Cable Connectors
   1. General
      a. BNC type connectors, for coaxial cable premise/workstation wiring and coaxial cable patch panel equipment.
      b. Unless noted otherwise, the BNC connectors shall comply with ANSI/TIA/EIA-568C and related Standards, Addendums and TSB.
      c. Brass body and male contact. Beryllium copper or bronze female contact. Bayonet coupling with threaded or cam-locking mating connection.
   2. Operational characteristics shall match or exceed and shall be compatible with the respective coaxial cable. 75-OHM, operational frequency range 0-4500MHz.

2.07 FIBER OPTIC FIBER DISTRIBUTION ENCLOSURES

A. General
   1. Fiber optic fiber distribution enclosures shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA–568C including related Standards, Amendments and TSB.
2. Fiber optic fiber distribution enclosures shall be the product of the same Manufacturer.

B. Equipment Rack Mount Fiber Optic Termination Distribution Enclosure - RTDE
   1. The RTDE enclosure shall mount in an EIA standard 19-inch wide enclosed or open frame equipment rack assembly. The RTDE enclosure shall be metal, painted finish, Manufacturer's standard color.
   2. The RTDE shall provide the following self-contained functions internal to the RTDE assembly.
      a. Fiber cable termination.
      b. Fiber cable "pig-tail" splicing.
      c. Fiber cable patch panel.
      d. Fiber cable management, training and strain relief.
      e. Individual fiber and patching port identification numbers, color-coding of incoming trunk and outgoing distribution fiber ports.
      f. Plug-in fiber optic interconnection couplers for port to port patching with portable fiber optic patch cords.
   3. Fiber splice drawers:
      a. Horizontal sliding metal drawers adjustable to approximately 30-degree angle when fully open, and removable for easy access. Each drawer shall contain two fiber optic splice trays with tray holders.
      b. Drawers shall stack vertically one above the other in the RTDE and allow sufficient slack in all fiber cables for removal of the drawer and splice trays.
      c. Provide one sliding drawer and two splice tray assemblies for each group (24-individual fibers or fewer fibers per group) of fiber optic fibers terminated in the equipment rack, but in no case provide not fewer than two sliding drawers with splice tray assemblies in each RTDE.
   4. Fiber cable patch panel
      a. Metal panel shall provide a patch port for each fiber consisting of metal panel mounted fiber optic interconnection couplers for each fiber optic fiber indicated to be terminated at the RTDE.
      b. The fiber optic fiber interconnection coupler shall be provided to match and be compatible with the fiber cable connectors. Quantity shall match quantity of terminated fibers, unless indicated otherwise on the equipment rack schedules.
      c. Nominal panel thickness 0.09 inches.
      d. Provide a minimum of sixteen unused spaces for additional couplers in the patch panel.
   5. Nominal height of the RTDE shall not be exceeded, as follows:
      | Quantity of Patch Ports | Quantity of Splice Drawers | Nominal Height |
      |-------------------------|---------------------------|--------------|
      | 24                      | 2                         | 11-inches    |
      | 48                      | 2                         | 11-inches    |
      | 72                      | 3                         | 14-inches    |
      | 144                     | 6                         | 28-inches    |

C. Equipment Rack Mount Fiber Optic, Splice only (for use only where fiber patch panel is not required) enclosure - RMSE
   1. The RMSE enclosure shall mount in an EIA standard 19 inch wide enclosed or open frame rack assembly. The enclosure shall be metal, painted finish, Manufacturer's standard color.
2. The RMSE shall provide the following self-contained functions internal to the RMSE assembly:
   a. Fiber cable splicing for "thru splicing" of fiber optic cables where the cables do not terminate in the equipment rack.
   b. Fiber cable management, training and strain relief.
3. Fiber splice drawers
   a. Horizontal sliding metal drawers adjustable to approximately 30-degree angle when fully open and removable for easy access. Each drawer shall contain two fiber optic splice trays with splice tray holders.
   b. Drawers shall stack vertically one above the other in the RMSE and allow sufficient slack in all fiber cables for removal of the drawers and splice trays.
   c. Provide one sliding drawer and two fiber optic splice tray assemblies for each group (24-individual fibers or fewer fibers per group) for fibers optic fiber routed through but not terminated in the equipment rack, but in any condition provide not fewer than two sliding drawers with splice tray assemblies in each RMSE.
4. Nominal height of the RMSE shall not be exceeded, as follows:

<table>
<thead>
<tr>
<th>Thru Splices</th>
<th>Splice Drawers</th>
<th>Nominal Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>2</td>
<td>4-inches</td>
</tr>
<tr>
<td>48</td>
<td>2</td>
<td>4-inches</td>
</tr>
<tr>
<td>72</td>
<td>4</td>
<td>8-inches</td>
</tr>
<tr>
<td>96</td>
<td>4</td>
<td>8-inches</td>
</tr>
</tbody>
</table>

2.08 COPPER WIRE PATCH PANELS

A. General
1. Copper wire patch panels shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
2. Copper wire patch panels shall be the product of the same Manufacturer.

B. Equipment Rack Mounted Patch Panel
1. Standard EIA 19-inch wide metal panel, Manufacturers standard color. Prepunched for copper wire outlet connectors. Panel shall mount on a EIA standard 19 inch wide enclosed or open frame equipment rack assembly. Nominal 24-copper wire outlet connectors in a horizontal row, quantity of rows as required for total quantity of connectors. Provide not less than two spare empty rows for future copper wire outlet connectors.
2. The patch panel shall provide the following self-contained functions.
   a. Copper wire cable termination including conductor/ shield termination and strain relief.
   b. Plug-in copper wire outlet connectors for port to port patching with copper wire portable patch cords.
3. Patch panel height shall be based on the quantity of copper wire outlet connectors described plus the specified space for future outlets and shall not exceed the following dimension height:

<table>
<thead>
<tr>
<th>Outlet Quantity</th>
<th>Nominal Patch Panel Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-24</td>
<td>3.5 inches</td>
</tr>
<tr>
<td>25-48</td>
<td>7 inches</td>
</tr>
<tr>
<td>49-72</td>
<td>10.5 inches</td>
</tr>
</tbody>
</table>
4. Horizontally mounted, cable support metal bracket shall be provided for each 24-outlet/connector groupings. The brackets shall be bolted to the equipment rack located at the backside of the patch panel; the brackets shall support and provide strain relief for each incoming copper wire cable connecting to the patch panel.

5. The copper wire connector installed in the patch panel shall be the same configuration, Manufacturer and type as the corresponding copper wire connector provided in the remote workstation outlet locations connecting to the respective patch panel outlet, unless indicated otherwise.

6. Each multimedia, audio/video/TV multimedia and intrusion detection/access control outlet. Provide a Balun, to match the circuit impedance of the premise wiring and to the outlet signal type.

2.09 TELEPHONE/VOICE TERMINAL BLOCKS

A. General

1. Terminal blocks Type 110, shall consist of wiring blocks, connecting blocks, direct wire/patch cord cross connection and designation strips. Arrange in unitized, modular, vertical mounting sections, for telephone/voice.

2. Completely 100% front accessible for cross connections, terminating conductors, training, and fanning of cables. Rear access for any reason shall not be permitted.

3. Telephone/voice terminal blocks shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements. Telephone terminal blocks and connections performance shall comply with ANSI/TIA/ EIA-568C and related Standards, Addendums and TSB and shall comply with and be listed under UL 1863. Category rating shall match the cables connecting to the patch panel.

4. The telephone/voice terminal blocks shall provide cross connection of telephone/voice four pair premise copper wiring from telephone/voice handset outlets to multiple copper wire telephone/voice feeder cables and external free standing telephone equipment.

5. Each full height vertical section terminal block assembly shall terminate a minimum of 900 pairs (including specified spares for future construction phases) of telephone/voice conductors, plus associated cross connection wiring and patch cords in a nominal 20-inches wide by 90-inches high space. Provide multiple vertical sections of terminal block assemblies adjacent to each other, total quantity as required for quantity of telephone/voice conductor pairs and telephone/voice feeder cable pairs shown on the Drawings and requirements, plus specified spares.

6. Each telephone/voice terminal block vertical section assembly shall provide 15% or 100 (whichever is the larger quantity) of spare unused conductor pair terminals for future telephone/voice connections.

7. Provide a common ground bus in each terminal block section with a minimum of six ground conductor termination positions, #10AWG through #6AWG.

8. Terminal blocks shall be the product of the same Manufacturer.

B. Wiring Blocks

1. One piece molded, dielectric thermoplastic blocks. The wiring block shall support and secure all the components of the terminal block assembly, and provide cable/conductor training and organization.

2. Fire retardant complying with UL 94V-0.
3. Standoff type support legs for mounting to backboard with pre-drilled anchor holes.
5. Horizontal index strip rows, for termination of not less than 25-conductor pairs on each row. Color coded and marked in groups of four pairs or five pairs to match connecting cables.
6. Removable retainers at the ends of each horizontal connecting block index strip row. shall support cross connect wires at corner turns.
7. Distribution rings shall retain cross connect wire horizontal routing between terminations.
8. A full width, horizontal trough between each 100 pair wiring block shall provide a path for patch cord training and retention.

C. Connecting Blocks
1. Connecting blocks shall provide gas tight conductor electrical connections with conductor insulation displacement punch down slots, for insertion onto the telephone/voice wiring block index strips.
2. Connecting blocks shall electrically connect one-to-one between each conductor terminated at the wiring block index strips, and each cross connect/patch cord conductor terminated/connected to the opposite front side of the connecting block.
3. Both sides of the connecting blocks shall terminate telephone/voice UTP 22-26AWG stranded or solid copper wire individually insulated conductors. The front side of the connecting blocks shall also provide "plug-in" connections for portable patch cords, 110 style "plug-in" connectors.
4. Connection blocks shall be 4-pair insulated copper conductor type.
5. Provide insulated, removable termination caps for each connector block.
6. Connector blocks shall be marked to indicate tip and ring conductors and to indicate polarization.

D. Designation Strips
1. Designation strips shall provide retention of interchangeable labels. The labels shall show circuit identification of each terminated conductor pair.
2. The designation strips shall mount on the center and outside positions of the wiring block.

E. Telephone/Voice Cross Connection
1. The cross circuit connection between incoming and outgoing feeder cables and telephone voice outlet wiring shall be provided in the terminal block assembly.
2. The cross connection wiring shall terminate incoming and outgoing circuit conductors between respective connecting blocks.
   a. Direct connect cross connection shall provide internally wired one-to-one conductor twisted pair cross connection. Provide cross connection of each 4-pair telephone/voice outlet cable to corresponding 4-pairs of the telephone/voice feeder cable and cross connection of feeder to feeder cables, as applicable.
   c. Prewired 50 pin-Amphenol connectors:
      1) Provide factory prewired 50-pin Amphenol connectors for connection from telephone/voice terminal blocks to the telephone switch equipment and Telephone Utility Company outside telephone service lines.
2) Provide 50-pair ANSI/TIA/EIA-568C and related Standards, Addendums and TSB cables, connected to 50-pin Amphenol connectors at one end (telephone equipment connection) and connected to the respective telephone/voice terminal wiring blocks at the other end.

3) The 50-pin Amphenol connectors shall group together and be positioned at the top of the respective terminal block section near the ceiling.

4) The pin-to-pin conductor assignments shall conform to the Telephone Switch Manufacturer's requirements.

5) The Amphenol connector/cable assemblies shall connect to and extend the telephone/voice outlet premise wiring from telephone/voice terminal block to the telephone switch equipment. The Amphenol connector/cable assembly shall connect to and extend the Telephone Utility Company outside telephone service lines to the telephone switch equipment.

d. Prewired "RJ" style modular jacks
   1) Provide factory prewired eight position/contact plug-in "RJ" style jacks for patch panel portable patch cord cross connects, located on the front side of the terminal blocks.
   2) The pin-to-pin conductor assignments shall conform to the Telephone Switch Manufacturer's requirements.

2.10 EQUIPMENT RACK

A. General
   1. An equipment grounding bus, nominal 19-inches long, UL labeled as a ground terminal bus, shall be provided on each equipment rack. The ground bus shall be bolted to the rack main metal frame member with 1-inch standoff non-insulating bolts. Provide a minimum of ten drilled and taped bolt holes in the ground bus with ground lug bolts, for connection of equipment grounding conductors to the ground bus, size to accept ground conductors #14-#4AWG.

   2. Vertically mounted, cable management metal rings (aluminum or stainless steel) shall be provided full height, continuously along the front and rear of each vertical rail of the equipment rack. The rings shall be bolted to the equipment rack. The rings shall train and dress portable patch cords connecting between outlet connectors located in the equipment rack or in adjacent equipment racks.

   3. Provide horizontal cable management panels with multiple cable training rings on each panel (not less than five rings for each panel). Management panels (for up to 24-outlet grouping) nominal 19-inches wide by 1.75-inches high by 3-inches deep and/or (for up to 48-outlet groupings) 3.5-inches high by 3 inches deep, for EIA rack installation. Rings shall provide horizontal routing and support by grouping portable patch cords connecting between patch ports in the same equipment rack or adjacent racks. Patch cords shall be grouped and bundled with "Velcro" tie wraps and shall not overlap patch fields or rack mounted equipment. The cable management panels shall be installed on both the front and rear of the equipment racks, mounted both above and below horizontally between groups of patch ports as follows:
      a. One cable management panel (front and rear of rack) for each group of 48 or less copper wire outlets for patch ports.
b. One cable management panel (front and rear of rack) for each group of 48-fiber optic outlet patch ports.

4. The entire rack assembly including any support arms shall comply with seismic earthquake requirements for install location structural standards.
   a. The assembly shall provide support for the weight of the equipment installed on the rack, but in no case less than 500-pounds of equipment, plus the weight of the rack and connecting cables. A 2.0 time’s safety factor shall be included in the equipment rack assembly structural design.

5. Provide plug strip Transient Voltage Surge Suppressors with RF Supresser (TVSS) and Power Distribution Units (PDU). Horizontal strip, mounted in each equipment rack. Each unit shall contain not less than six “plug-in” on the rear of the TVSS and not less than two plug-in on the front of the TVSS protected outlet plugs.
   a. Provide two TVSS/PDU units in each equipment rack, to supply “dual-corded” equipment.

6. Provide pre-drilled mounting holes the entire length of equipment vertical mounting frames, EIA-310D-19 inch (nominal) wide standard spacing for indicated equipment. Racks shall provide 17.75-inches (nominal) equipment horizontal mounting space between vertical rails.

7. Provide all floor standing equipment racks with wall bracket support arms extending from the stationary portion of the rack to adjacent wall. Provide "dual-rail arm" cable “runway tray”, horizontally from each equipment rack, to the wall directly behind the equipment rack
   a. The tray shall extend from and bolt to the top of the equipment rack “fixed” top rail.
   b. The tray side rail arms shall be a minimum of 6-inches deep, with "ladder" type rungs spanning horizontally between the side rail arms. The rail arms shall be parallel with each other. The rail-to-rail arm spacing shall be the same as the equipment rack width.
   c. The rungs shall be spaced not more than 6-inches on center between the side rails, along the length of the side rail arms. The rungs shall have a minimum cable-bearing surface of not less than 0.75-inches, lengthwise along the tray.
   d. The runway tray shall support a minimum of 200 pounds per linear foot live conductor/cable loading, with not more than 0.25-inches deflection at mid-span.
   e. Provide a continuous horizontal support “C” channel along the wall behind the equipment racks and bolt the dual-rail arm cable runway tray to the channel at the wall. The channel elevation on the wall above the finish floor shall support the runway tray horizontally (± 0.2-inches), from the equipment rack to the wall.
   f. Equipment racks shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
   g. The wall mounted horizontal support channel shall be securely through bolt to wall structural member, a minimum of 16-inches on center. The horizontal support channel shall extend a minimum of 6-inches past each side of the runway tray. Support channels as manufactured by Unistrut-P1001C Series; or B-Line; or Kindorf.

8. Provide a copper ground – bus for equipment bonding, in each equipment rack.

9. Equipment racks shall be Manufacturer’s standard rust inhibitor primer.
   Manufacturer’s standard color finish paint over primer, unless noted otherwise.
B. Swing Gate Open Equipment Rack Style:
   1. Combination wall and floor mounted rack frame nominal 78-inches of usable equipment vertical space for mounting equipment into the rack. The equipment mounting portion of the rack shall be a hinged gate frame assembly. The rack shall provide access to the rear of the installed equipment, the wall behind the rack assembly and wall mounted terminal blocks, when hinged open.
   2. The gate assembly shall hinge open not less than 90 degrees from the closed (normal position) on a fixed frame combination floor/wall mounted support structure. A positive latching mechanism shall lock the gate in the fully open and fully closed positions. The rack construction shall allow opening the swing gate, with the installed equipment depth, without obstruction. The fixed stationary portion of the swing gate rack assembly shall be supported from both the fixed floor bracket and wall located behind the rack with adjustable length "dual rail arm" wall brackets. The arms shall provide field adjustment (approximately 24-inches) of the equipment rack spacing from the wall behind the rack. Provide a minimum of two support arms for each swing gate equipment rack.
   3. The rack assembly shall be constructed of extruded metal; aluminum gold irradiates finish, or hot dip galvanized steel. Bolted or welded assembly. Hardware shall be stainless steel.
   4. Provide steel caster rolling wheel support on the bottom rail of the moveable swing gate frame. The wheel shall provide additional support, but not the main support, of the moving gate assembly and rack mounted equipment along the floor travel "outside arc" of the gate in the open or closed position. The vertical height of the wheel assembly shall be adjustable ±3 inches.
   5. Swing gate equipment racks as manufactured by B-Line; or Saunders; or Hendry.

C. Floor Standing Equipment Rack Fully Metal Enclosed Style:
   1. Floor mounted self-supporting rack, nominal 80-inches high by 24-inches deep, by 24-inches wide. Internal bolted or welded hot dip galvanized steel or gold irradiate finish aluminum, support frame. Metal enclosed with screw attached removable metal panels. Manufacturer's standard finish color.
   2. The front and rear of the rack shall be a full height hinged door, opening not less than 90 degrees from the closed position. The doors shall be readily removable with positive latching mechanism to lock to the doors in fully open or fully closed positions. Doors shall be pad-lockable. Rack shall provide a minimum of 4-inches of clear space between front door and internal mounting face for rack mounted equipment. Smoke/grey impact resistant, tamper resistant see-through windows in the doors, front and rear. Hardware shall be stainless steel.
   3. Provide six 120-volt 60Hz AC motor direct drive air ventilation, "muffin" style, nominal 4-inches square, exhaust air fans. Flush mount fans in the top of each equipment rack. The fans shall be low speed, low noise type with wire guards to prevent accidental contact with the fan blades. The fan motor shall be high impedance, self-protecting type motors. Provide "SO" cord with plug caps to connect from the fans to the 120 volt plug-strip in the equipment rack.
   4. Provide cooling air intake louver with a removable 19-inches wide air filter and air filter holder, mounted in the bottom of the rack front nominal 6-inches high.
   5. Floor standing metal enclosed equipment racks as manufactured by Stantron; or BUD; or equal.
D. Fixed Position Floor Standing Open Frame Equipment Racks:

1. Floor mounted self-supporting rack, nominal 78-inches of usable mounting frame height for equipment.
2. Bolted or welded hot dip galvanized steel or gold irradiate finish aluminum support frame. Hardware shall be stainless steel.
3. Open frame rack construction, fixed, non-swing gate.
   a. “Two-post” style for equipment racks not designated as containing UPS equipment nor server equipment.
   b. “Four-post” style for equipment racks designated as containing UPS equipment and/or server equipment.
4. Open frame equipment racks as manufactured by B-Line; or Saunders; or Hendry.

E. Floor Standing Modular Frame Equipment Racks

1. Provide a modular frame equipment rack, bolt together modular rack system with all accessories for a completely assembled equipment rack unit. The rack system, when configured for specific equipment, shall support and organize network servers, keyboards, printers, tape drive units, RAID units, CRT's, UPS units, telephone switching equipment, desk top work spaces, etc.
2. Nominal overall dimensions 31-inches deep by 72-inches wide by 84-inches high. Left/right or right/left orientation as indicated on Drawings. Minimum weight capacity of the entire rack assembly shall be 1500 pounds.
3. Manufacturer’s standard finish painting, crème white color for metal surfaces. Horizontal flat support surfaces shall be post-formed, laminate top finish, white color.
4. "8L-01/8L-02" vertical support upright assemblies; shall be slotted the full height to "hook-on", lock in and support adjustable height (in 1-inch increments), modular components, with integral floor support "feet". Open back frame - "LF31". Minimum of three vertical support and open back frames in each complete assembly.
5. Provide vertical (on upright supports) and horizontal (on modular "hook-on" components) wire management raceways integral to the assembly.
6. Network server configuration - equipment rack unit:
   a. "LE28" computer tower "roll-out" horizontal floor shelf; nominal 47-inches wide by 24-inches deep. Shelf shall pull out on "ball-bearing" rails, with 23-inch extension for access to computers. Provide one tower shelf for rack unit. Minimum weight capacity 750 pounds. Mount at floor.
   b. "LE25"-computer tower horizontal shelf with ±12 inch end panels and two shelf support brackets; nominal 47-inches wide by 22-inches deep, fixed mounted. Provide one tower shelf for rack unit. Minimum weight capacity 500 pounds. Mounting height ±30-inches.
   c. "LB32" horizontal work surface; nominal 24-inches wide by 27-inches deep. Provide one work surface assembly for each rack unit. Minimum weight capacity 300 pounds. Install on left or right side of rack as shown on Drawings. Mounting height ±28-inches.
   d. LF10/LF11/W162 - General equipment shelf; nominal 72-inches wide by 15-inches high by 16.7 inches deep, with two horizontal shelf surfaces, full width of rack, ±10-inches nominal vertical height between shelves and five vertical shelf dividers. Minimum weight capacity 300 pounds. Provide one general equipment shelf assembly for each rack unit. Mount at top of rack.
   e. "LA-09" - Keyboard platform. Retractable keyboard platform with auxiliary mouse pad and up-down 15 degree adjustable tilt and adjustable 360 degree swivel. Nominal 23-inches wide by 11 inches deep. Provide three
keyboard platforms for each rack unit. Install below, upper tower computer shelf and work surface.

F. Plug Strip Transient Voltage Surge Suppressor (TVSS).

1. General
   a. Self-contained unit combining plug-in receptacle strip and TVSS. Rated 20 ampere, nominal 120-volt +10%, 60Hz, AC, 2400 watts full continuous load. Internal 20 ampere resettable overload protection circuit breaker. Red illuminated on-off switch. 9-foot, 12AWG 3-conductor grounded, high abuse heavy duty jacketed AC, line cord with NEMA 5-20P cap.
   b. Multi-outlet receptacles, suitable for use with the following types of plug in loads; data processing equipment, audio/video equipment, test instruments, medical equipment, photo graphic equipment and “switching type” power supplies.
   c. Protected 120-volt outlets shall be NEMA 5-15R 15 ampere, or 20 ampere NEMA 5-20R AC 60Hz receptacles, as applicable for connected equipment loads. Provide not less than eight protected outlet plugs on each unit. Each individual or group of two receptacles (duplex) shall be connected to separate protected load isolated filter banks.
   d. Each duplex shall be isolated from the other output receptacles, minimum isolation of 25dB at 1MHz line to line, line to neutral, line to ground and neutral to ground.
   e. Non-blocking plug-in locations/orientation, for plug-in self-contained “power-brick”, equipment power supplies.
   f. As manufactured by Liebert; or TRIPP LITE.

2. Operation
   Self-contained RFI and EMF shielded housing with mounting slots for temporary mounting of the unit. Protected outlet receptacles shall supply over current protected and filtered, electrical line voltage power to the connected equipment. Line noise RFI and EMI interference filtering suppression, transient voltage surge and spike protection shall occur in all three modes of operation line to ground, line to neutral and neutral to ground rated as follows:
   a. 13,000 ampere, 210 joules (watt-seconds) peak withstands capacity.
   b. Transient response time less than 5-nano seconds.
   c. 140-volt AC RMS initiate spikes suppression 330 volt maximum let through.
   d. RFI and EMI Suppression-Provide spectrum analysis test dB attenuation reports showing RFI filtering over specified frequencies.
   e. Diagnostic indicator lights located on the TVSS housing shall provide alarm alert for each of the following conditions:
      1) Loss of AC power.
      2) Damage, malfunction in the TVSS suppression circuits.
      3) Improper AC electrical outlet wiring.
   f. Standards Testing, Listing and Certification Compliance:
      1) IEEE 587 A and B compliance.
      2) UL 1449 transient voltage surge suppressers.
      3) UL 1363 temporary power taps.
      4) UL 1283 electromagnetic interference filters.

3. Rack Mounted TVSS
   a. TVSS units installed in equipment racks shall comply with all of the same performance requirements including as follows.
      1) EIA/TIA – Equipment rack horizontal mount style (19-inches or 24-inches as applicable).
2) Minimum of two front mounted outlets and not less than six rear mounted outlets.
3) Position in each equipment rack as directed by Owner's Representative.
4) Provide two TVSS units in each equipment rack, for “dual-corded” network equipment.

G. Power Distribution Unit (PDU)

1. General
   a. Self-contained unit combining main circuit breaker, multiple plug-in individual circuit breaker branch protection load receptacles, PDU metering status monitoring and network communication. All PDU components self-contained in a NEMA-1 metal enclosure.
   c. Standards Testing
      1) UL 60950-1 Information Technology Equipment.
      2) CAN/CSA-C22.2 No.60950-1-03 Information Technology Equipment.
      3) FCC, Title 47, Part 15 Subpart B for Class B operation as defined by ANSI Standard C63.4.
      4) ROHS Complaint.
      5) ISTA Procedure 1A and 2A.
   d. Provide two PDU units in each equipment rack, to supply two TVSS units in each equipment rack.
   e. Shall be a product of the same Manufacturer as the TVSS unit. As manufactured by Liebert; or TRIPP LITE.

2. System Description
   a. Remote monitoring and/or control capabilities for power distribution at each load/equipment rack level. For data/network equipment line voltage plug-in and TVSS line voltage plug-in electrical distribution.
   b. PDU shall meter and monitor electrical attributes of an individual Rack PDU, including real-time remote and local display of monitoring of aggregate and branch electrical parameters (status, thresholds, alarms) including voltage, ampere, and kW. Rack equipment PDU and Branch load monitoring and control.
   c. Self-contained metering and communications
      1) Local display ampere-meter demand load meter to monitor plug-in demand load and total PDU load.
      2) Digital Fast Ethernet LAN RJ-45 communications port for Ethernet SNMP and IP network monitoring of electrical status. Multi-user site-wide software license, compatible with PC-computer and IP-WEB HTTP protocols.
      3) Provide network array-interface for connection of multiple PDU units positioned in the same location.
   d. Nine foot input power (heavy duty high abuse) cord with appropriate conductors and input NEMA plug-in connection. Provide input overload protection with Hydraulic-Magnetic main input circuit breaker. Provide load output NEMA plug-in branch connection with overload circuit breaker protection for each load receptacle.
   e. Equipment rack mounting horizontal position form factor.
3. Electrical Power ratings shall be as follows and as additionally indicated on Drawings. Refer to Drawings for twist-lock verses straight-blade configurations.
   a. Single main input circuit breaker 30 ampere, 208/120 volt 3-phase 5-wire “WYE” grounded 60Hz AC.
   b. Branch load circuit breakers with a single plug-in receptacles for each load circuit breaker. Balance loads on each circuit phase.
      1) Three 20 ampere 1-pole circuit breaker and three NEMA 5-20R receptacles. Also provide matching caps.
      2) One 30 ampere 2-pole circuit breaker and one NEMA 14-30R receptacle. Also provide matching cap.
      3) Additional circuits and receptacles as indicated on Drawings.
4. Provide heavy duty high abuse flexible copper wire 300-volt insolated 15-feet long jacketed electrical cord. Connect from PDU to wall-outlet receptacle with same electrical rating as PDU. Rated for PDU voltages and amperes.
5. PDU units installed in equipment racks shall comply with all of the same performance requirements including:
   a. EIA/TIA – equipment rack horizontal mount style (19-inches or 24-inches) as applicable.
   b. Position in each equipment rack as directed by OWNER’s Representative.
6. Provide two Category-6A 4-pair UTP 15-foot long portable patch cable connects, PDU to respective network patch panel port.

2.12 WALL MOUNT FIBER OPTIC CABLE INTERFACE CABINET (WMIC)

A. General
   1. Metal (14 gauge) enclosure, with full height hinged metal door. Door shall be pad-lockable. Nominal size 12-inches deep by 18-inches wide by 36-inches high. Enclosure shall mount directly on the wall.
   2. WMIC shall be UL listed, complying with National Electrical Code, ETL Tested and Certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
   3. Interface cabinets shall be the product of the same Manufacturer.

B. The WMIC shall provide the following self-contained functions internal to the WMIC enclosure.
   1. Fiber cable splicing for "through splicing" of non-UL listed fiber optic cables, where the cables do not terminate in the building.
   2. Fiber cable management, training and strain relief.
   3. Transition from non-UL flame spread listed fiber optic cable, to UL flame spread listed fiber optic cables where the cables terminate in the building.

C. Cable routing rings shall organize optic fibers in a 360 degree loop inside the WMIC housing and provide cable strain relief.

D. Fiber Optic Splice Trays
   1. Provide fiber optic cable splice trays.
   2. Tray holders shall provide mounting and support for each splice tray.
   3. Provide two splice trays for each group (24 or less fibers per group) fiber optic fibers routed through the WMIC, but in no case provide not less than four splice trays in the WMIC.
2.13 UNIVERSAL SPLICE ENCLOSURES - USE

A. General
1. The universal splice enclosure shall provide splicing for multiple cables containing multiple, network copper wire conductors or fiber optic fibers.
2. The enclosure with the connecting cables installed shall be water tight, continuously submersible in up to 10-feet depth of water without leaking water into the enclosure interior.
3. The enclosure with splices shall be completely re-enterable to allow access to the interior splices, adding cables, and removing cables, without compromising the water tight integrity of the enclosure.
4. The universal splice enclosure assembly shall be UL listed.
5. The USE shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
6. USE shall be the product of the same Manufacturer.

B. Fiber Optic Splices
1. Provide fiber optic splice trays inside the USE. Each splice tray shall provide space for up to 12-splices in lieu of 24-splices on the tray.
2. A splice tray holder shall rigidly anchor splice trays inside the USE, with sufficient slack cable, to allow individual removal of each splice tray.
3. Provide one splice tray for each 12-fibers passing through the USE, but not less than 8 splice trays in the use enclosure.

C. Copper Wire Splices

2.14 SPLICE TRAY FIBER OPTIC FIBERS

A. General
1. Trays shall be suitable for installation in USE, WMIC, RMSE and RTDE enclosures.
2. The trays shall be the product of the same Manufacturer as the respective enclosures.
3. Splice trays shall be UL listed, complying with national Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

B. Splice Trays
1. A metal or non-metal splice tray shall provide space for up to 24-splices of individual fiber cable single mode and multimode optical fibers. The trays shall provide individual splice holder inserts for each splice to adapt the tray for mechanical or fusion splices, with or without splice sleeves.
2. The tray shall incorporate integral fiber tie down clamps, fiber routing rings, provide strain relief and two full 360-degree fiber loops around the tray perimeter with sufficient slack fiber for removal of the tray for access and splicing of the fiber cable. The tray shall insure the minimum bending radius of the optical fibers is not violated.
3. Provide a removable clear plastic tray top cover for each tray, to protect and isolate the fibers.
2.15 WORK STATION OUTLETS

A. General
1. Engrave outlet cover plates with the port number corresponding to the port number at the respective terminal block, patch panel, or head-end equipment.
2. The outlet cover plates shall be factory prepunched and formed to accommodate the installed outlet connector with attachment screws.
3. Workstation outlets shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.
4. Workstation outlets shall be the product of the same Manufacturer.

B. Computer/Data Workstation Copper wire Outlets
1. The outlets shall be the same configuration and type as the corresponding connector provided in the copper wire patch panel outlet, unless noted otherwise.
2. ANSI/TIA/EIA-568C, and related Standards, Addendums and TSB.
3. The copper wire outlet connectors for twisted pair wire connections in computer workstation outlets shall be universal outlet connector RJ-45 type.

C. Telephone/Voice Handset Twisted Pair Wire Connection Work Station Outlets
1. The copper wire outlet connectors provided in telephone/voice handset outlets, shall be universal outlet connector type, unless noted otherwise, ANSI/TIA/EIA-568C and related Standards, Addendums and TSB.
   a. RJ-45 type

D. Fiber Optic Workstation Outlets
1. The fiber optic outlet connectors workstation outlets shall be fiber optic fiber interconnection couplers, installed in universal outlet connectors. Provide one coupler for each fiber connecting to the outlet, but in no case less than the following for each outlet and as shown on the Drawing:
   a. Computer workstation data network two couplers and fiber connectors.
   b. Data network server - four couplers and fiber connectors.
2. The universal outlet connector housing and cover plates shall be the same as copper wire outlet connectors, except with adapters for fiber optic interconnection couplers, for the fiber optic fibers plug-in connectors.
3. The centerline-to-centerline spacing of the inter-connection couplers shall provide for "plug-in" insertion of “single or duplex” fiber connectors.
4. Color-code and identify the "in"-receiving and "out"-transmitting position for each interconnection coupler.

E. Outlet Boxes
1. General for Low Voltage Outlets Requirements
   a. Shall be UL approved and labeled for Life-Safety Appliances.
   b. UL listed and label for low voltage CEC/NEC class-2 wiring and devices.
   c. Shall be adjustable to fit into the wall/ceiling and attach into the wall/ceiling thickness at each install location.
   d. Provide cable “Strain-Relief” attachment and “Sharp-Edge” protection for each outlet cable connections.
2. Wall mounted
   a. Flush or surface wall mounted outlet box and size as indicated on the Drawings, but in no case less than 4.69-inches by 4.69-inches by 2.125-inches deep.
b. Two gang wide extension ring for outlet box to extend outlet flush with finish surface, or as noted on the Drawings.

c. Two gang wide cover plate, or as noted on the Drawings.

3. Pedestal Mounted "Poke-Thru".
   a. Shall combine a computer/data and a telephone/voice copper wire universal outlet connector in a duplex outlet in the pedestal/poke-thru outlet.

4. Inside flush floor boxes and other locations where indicated in the Contract Documents.

5. Low Voltage Outlets in Fire rated walls and ceilings
   a. Provide metal outlets for low voltage devices installed (recessed into) in fire rated walls or fire rated ceilings.
   b. Provide metal outlet box enclosed type, for each outlet location. Provide UL labeled and listed “Fire-Wrap” complete coverage protection on the exterior of each outlet box. The combined outlet box and “Fire-Wrap” protection shall be equal or greater than the respective wall or ceiling fire-rating location.

6. Low Voltage Outlets in Non-Fire Rated walls and ceilings
   a. Outlets for low voltage devices installed (recessed into) walls or ceilings, only where the wall/ceiling is not fire-rated.
   b. Provide the following for each outlet location
      1) Metal outlet box, enclosed type. All locations where one or more conduit(s) are required to connect to the outlet, then only metal outlet box shall be provided.
      2) Or device mounting bracket with trim ring, without (backless) enclosed outlet box. Do not use bracket-trim/ring configuration where conduit connection to the outlet with conduit is required, provide metal outlet boxes. Shall provide attachment for low voltage device(s), cover plates and low voltage wire strain relief.

7. Low Voltage outlet installed into accessible suspended ceiling with removable ceiling panels.
   a. Support outlet independent of ceiling supports and ceiling.
   b. Provide a minimum of three independent hanger wires for each outlet. Attach hanger wires to building structure above ceiling and to outlet.

8. Low Voltage Outlets in existing walls and existing ceilings
   a. Outlets installed (recessed into) existing walls or (recessed into) existing ceilings. Cut and patch to match existing surfaces for outlet installation.
   b. Provide “cut-in” retrofit mounting-attachment into existing ceiling/wall construction. Shall be UL rated for retrofit into “old-work”.
   c. Provide the following for each outlet location,
      1) Metal outlet box, enclosed type. Required for all Fire rated construction locations. Also permitted for non-Fire rated construction locations.
      2) Or device mounting bracket with trim ring. Permitted only for non-Fire rated construction locations only where no conduit connection to the outlet is required. Do not use in Fire rated construction locations. Do not use where conduit connection to outlet is required.
   d. Where the existing wall/ceiling existing fire rating is indeterminate, Contractor shall assume the existing fire rating is not less than 2-hours. Provide metal outlet box and Fire-Wrap for each recessed outlet box.
F. Multi-outlet Raceway Work Station Outlets

1. Copper wire outlet:
   a. Where copper wire connection is indicated for the workstation outlet, provide one universal outlet connector for each outlet.
   b. Each universal outlet connector shall be single connector housing type.
   c. Provide a rectangular cutout and metal device plate in the raceway sized to outlet Manufacturer's recommendations. The workstation copper wire outlet shall mount a modular faceplate kit with outlet bezel and faceplate sized to match the workstation outlet.
   d. Offset the location of outlets for electronic network systems 6-inches in the raceway from other outlets, do not "stack" outlets one above the other in the raceway.

2. Fiber optic outlet:

G. Combination Outlets

1. Infrastructure outlet connectors shown at the same location for either wall box outlet locations and floor box outlets locations.

2. The outlet connectors shall be installed in a common outlet box with a common cover plate in the respective wall location or floor location.

3. In infrastructure patch panels install the connectors in the respective patch panels.

2.16 PORTABLE PATCH CORDS

A. General

1. Provide portable patch cords for all copper wire and fiber optic cable infrastructure outlets:
   a. For interconnecting electronic network equipment to electronic network workstation outlets.
   b. For interconnecting equipment rack patch panel outlet patch locations with each other.
   c. For interconnecting patch panel outlets equipment rack mounted hubs, switches, routers, telephone equipment, A/V equipment, access control and intrusion detection equipment etc.

2. Patch cords shall be factory assembled tested and certified with factory terminated plugs at each end. Field terminated portable patch cords shall not be permitted. Terminated plugs shall incorporate integral bending radius limiting molded “boots” and strain relief. Patch cord assemblies shall be rated for “heavy duty”, “high-abuse” service.

3. Patch cords shall be UL listed, complying with National Electrical Code, ETL tested and certified to comply with or exceed specified requirements. ANSI/EIA/T1A-568C, related Standards, Addendums and TSB.
   a. NEC - OFNG/OFN for fiber optic portable patch cords.
   b. NEC - MPP/CMP/CMR/CMG/MPG for copper wire twisted pair portable patch cords.
   c. NEC - CATV for coaxial cable portable patch cords.

4. Patch cords which are not installed shall be delivered to the OWNER in cardboard boxes. The patch cords shall be neatly bundled and tied together. Mark each box with quantity and type of cords contained in the box.

5. Patch cords shall comply with the same cable communication performance, requirements, protocol requirements and testing requirements as the respective infrastructure cables and outlets to which the patch cords are
intended to be connected (plug-in). Patch cords shall be the product of the same Manufacturer.

6. The outer jacket of each portable patch cord shall be imprinted with date, Manufacturer’s model and catalog number and AHJ listing identification.

7. Provide a permanent, visible, factory applied identification number on each end of each patch cord. The identification number shall be the same on each end. However, the numbers shall increase sequentially on each patch cord and shall be unique and not duplicated on other patch cords. Permanently apply the identification numbers on the cable jacket or connectors.

B. Twisted Pairs, Copper Wire Portable Patch Cords

1. Twisted Pairs portable patch cords, general:
   a. "Male" eight position modular "RJ" male style jacks install on each end of the patch cord cable. The jack shall be provided with a rear "fin" to prevent the plug tab from snagging when pulled backwards through adjacent wiring.
      RJ-45 style “male” jack, typical unless noted otherwise.
   b. Patch cord cable shall be UTP and ANSI/EIA-Category rating, shall match respective permise wiring, 4-pair twisted, stranded copper individually insulated wires, thermoplastic jacket over all the wires [and shield].
   c. Connectors shall comply with FCC 68.5 and Part 68 Subpart F.
   d. Connectors UL listed and shall comply with UL-94V-O.
   e. Contacts gold plated with not less than a 750 insertion/withdraw cycle rating.

2. Portable patch cord quantities and lengths for connecting port-to-port equipment rack patch panels
   a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire equipment workstation outlet patch port in the equipment rack patch panels. One-to-one straight through pin-to-pin wiring. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for copper wire computer workstation outlets in the equipment rack patch panels. Cable jacket color shall be blue:
   b. Provide the following lengths of copper wire patch cables for copper wire equipment rack patch panel outlets.
      1) 2-feet long - 10% of total quantity
      2) 4-feet long - 30% of total quantity
      3) 6-feet long - 30% of total quantity
      4) 10-feet long - 20% of total quantity
      5) 16-feet long - 10% of total quantity

3. Portable patch cord quantities and lengths - for connection from equipment workstations to equipment workstation outlets, located remote from equipment racks.
   a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire workstation outlet located remote from the equipment rack patch panels. Provide additional spare patch cords, quantity equal to 15% of the total quantity of patch cords provided for each copper-wire computer workstation outlets. Cable jacket color shall be blue:
      1) Infrastructure network outlet segments the pin-to-pin patch cord wiring configuration and jacks shall be compatible with the equipment protocol communications interface, and the respective workstation outlet.
b. Provide the following lengths of copper wire patch cables for equipment copper wire infrastructure network workstation outlets. The patch cords shall provide internal cross-over wiring to conform the pin-to-pin connections required between the equipment workstation outlet and the equipment protocol communications interface installed in the respective workstation equipment:
   1)  8-feet long - 30% of total quantity
   2)  15-feet long - 70% of total quantity

4. Portable patch cord quantities and lengths for connection from electronic equipment rack patch panel ports to equipment installed in equipment racks, such as HUB’s, servers, switches, router, telephone and concentrator equipment ports. Cable jacket color shall be white.
   a. Patch cord quantity: Provide one complete patch cord assembly for each copper wire outlet port located in electronic equipment. Provide additional spare patch cords, quantity equal to 25% of the total quantity of the equipment rack equipment ports.
      1)  The pin-to-pin patch cord wiring configuration and jacks shall be compatible with the respective equipment and patch panel outlets as applicable.
   b. Provide the following lengths of copper wire patch cables for outlet ports located in electronic equipment installed in equipment racks. The patch cords shall provide quantity of conductors, wiring shall conform the pin-to-pin connectors and jack/ connectors to the ports in the equipment mounted in the equipment racks.
      1)  4-feet long - 15% of total quantity
      2)  6-feet long - 30% of total quantity
      3)  10-feet long - 35% of total quantity
      4)  16-feet long - 20% of total quantity

5. Portable patch cord quantities and lengths for connection of equipment requiring customized pin-to-pin wiring configurations and/or customized port connector configurations. Cable jacket color shall be tan.
   a. Patch cord quantity: Provide one complete patch cord assembly for each outlet port install as part of the Contract and not identified in any other patch cord descriptions. The patch cords shall be customized and configured to comply with the respective Manufacturers recommendations.
   b. Provide one patch cord for each port-to-port connection length as required for actual installation condition.
      1)  Provide 100% spare but not less than one spare patch cord for each custom configuration.

C. Telephone/Voice Copper Wire Portable Patch Cords-110 style
   1. 110 style jacks for plugging into the 110 style connecting blocks located in the telephone/voice terminal blocks.
   2. Patch cords shall be UTP 4-pair twisted; 24AWG stranded copper individually insulated wires with a thermoplastic jacket over all the wires. Cable shall be ANSI/TIA/EIA-568C.
   3. Patch cord quantity and length - telephone/voice terminal block:
      a. Provide one complete patch cord assembly for each copper wire telephone/voice outlet connecting to the telephone/voice terminal block. Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided for telephone/voice 110 patch cords.
b. Provide the following lengths of copper wire patch cables for telephone/voice 110 style connecting block portable patch cords.
   1) 3-feet long - 25% of total
   2) 5-feet long - 50% of total
   3) 15-feet long - 25% of total

D. Coaxial Cable Portable Patch Cords
   1. BNC type connectors on each end of each patch cord. Shall be compatible with patch panel outlets, workstation outlets and respective equipment rack electronic equipment.
   2. Patch cord quantity: Provide two complete patch cord assemblies for each coaxial cable outlet.
      a. One patch cord for workstation outlet located remote from the equipment rack patch panel, 15-feet long each patch cord.
      b. One patch cord for equipment rack (IDF/MDF) patch panel each outlet location, 10-feet long each patch cord.
      c. Provide 15% additional spare patch cords of each patch cord length.

E. Fiber Optic Portable Patch Cords
   1. General
      a. Provide fiber optic fiber connectors installed on each fiber end of the patch cord cable. The fiber optic portable patch cord shall be “single” with one fiber strand type, for each patch cable. The connector shall be mechanically and optical compatible with the respective connecting patch panel couplers and network work equipment couplers.
      b. The entire patch cord assembly total insertion loss shall be less than 1.0dB at the specified operating wavelengths.
      c. Operating temperature range 30-degrees centigrade through +60 degrees centigrade. Cables shall be flame retarding.
      d. Each fiber shall be individually identified with factory color-coding and factory imprinted label. The outer cable jacket shall be imprinted with date, Manufacturer's model and catalog number, along with agency listing identification. The cable jacket color shall be yellow.
      e. All fiber optic patch cord cable shall be a product of the same Manufacturer.
      f. Optical fiber shall be coated, 900 micron diameter uniform coating, with uniform tight buffering over the coating, uniform dielectric strength member surrounding the buffering coating and an overall jacket around each optical fiber assembly.
      g. A dielectric strength member shall surround the fiber assemblies.
      h. An outer dielectric jacket shall envelope the entire cable.
      i. The cable shall be UL listed and comply with NEC and NFPA requirements for each installation location shown in the Contract Documents.
      j. Patch cord quantity and length
         1) Patch cord quantity: Provide one complete patch cord assembly for each fiber optic patch panel outlet in the equipment rack.
         2) Provide one complete patch cord assembly for each computer workstation fiber optic outlet remote from the patch panel.
         3) Provide additional spare patch cords, quantity equal to 25% of the total quantity of patch cords provided.
      k. Provide the following quantities and lengths of fiber optic patch cords.
         1) 3-feet long - 20% of total
2. Multimode patch cords  
a. Patch cord cable shall be fiber optic cable with equal or better characteristics as the premise fiber optic cables.

2.17 CIRCUIT PROTECTORS

A. General  
1. The circuit protectors shall be UL listed, complying with National Electrical Code, ETL Tested and Certified to comply with or exceed specified requirements, ANSI/TIA/EIA-568C including related Standards, Amendments and TSB.

B. Circuit Protectors  
1. Cables containing non-dielectric electrical conducting components entering from the exterior of the building shall be provided with individual circuit protectors combining both lightning circuit protection and TVSS circuit protection on each circuit conducting component, as required in NEC Articles 770 and 800.
2. Install circuit protectors in the respective backboard/equipment rack where copper wire conductors terminate, connect each protector to room/closet ground bus equipment with #10AWG green insulated bond/ground copper conductors.

PART 3 - EXECUTION

3.01 NETWORK CABLE TESTING AND COMMISSIONING (ADDITIONAL REQUIREMENTS)

A. General  
1. In addition to the testing recommended in ANSI/TIA/EIA-568C and related Standards, Amendments and TSB. End-to-End test 100% of all individual optical fiber, individual copper wire conductors, each outlet and each connector in all terminated and un terminated cables, portable patch cord, outlets and patch panels provided in the Contract, shall be tested after installation as a complete channel pathway installation, splicing outlets and termination is completed, including the following end-to-end tests on each installed individual circuit;
   a. Each circuit wire and fiber map and length  
   b. Each circuit insertion Loss  
   c. Each circuit NEXT (Pair-to-Pair) Loss  
   d. Each circuit NEXT Loss (Power Sum) PS  
   e. Each circuit ELFEXT Loss (Pair-to-Pair)  
   f. Each circuit ELFEXT Loss (Power Sum) PS  
   g. Each circuit return Loss (RL)  
   h. Each circuit propagation delay  
   i. Each circuit propagation delay-skew  
2. The test equipment and (Tester) shall comply with the accuracy requirements for Field Testers as defined in the ANSI/EIA/TIA Standards for the specific cable type. The Tester including the appropriate interface adapter shall meet the specified accuracy requirements. The Tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy. The Tester shall be calibrated to extend the reference
plane of the Return Loss measurement to the permanent link interface. The CONTRACTOR shall provide proof that the interface has been calibrated within the period recommended by the Vendor.

3. The Pass or Fail condition for the channel pathway link-under-test is determined by the results of the required individual tests (ANSI/EIA/TIA) Any Fail result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass. A Pass or Fail result for each parameter is determined by comparing the measured values with the ANSI/EIA/TIA test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field test. The Field Test Equipment Manufacturer shall provide documentation as an aid to interpret results marked with asterisks.


5. Provide six copies of all test reports, bound in three ring binders. Provide three digital CD/DVD ROM copies. Organize test reports into rows-and-columns spread-sheet format, with data common groupings by IDF and NDF location. Submit to Owner’s Representative.

6. The CONTRACTOR shall repair or replace equipment, cables, outlets, connectors, splices, terminations, etc. identified during testing as not complying with the Contract Documents, without additional cost to the Contract. Retest all replaced or repaired components at CONTRACTOR’S expense.

B. Twisted Pair Copper Wire Testing
   1. Channel insertion loss (dB).
   2. Channel near-end cross-talk NEXT loss (dB).
   3. Channel equal-level far-end cross-talk ELFEXT (dB).
   4. Channel return loss (dB).
   5. Channel power sum PSACR (dB).
   6. Channel propagation delay, propagation speed, and delay skew.
   7. Channel wire map and circuit length.
   8. Channel ring-out test for continuity and correct point-to-point matching terminals.
   9. Channel DC resistance and capacitance.
   10. Channel attenuation-to-cross-talk ratio ACR.

C. Coaxial Cable Testing
   1. Channel full specified frequency spectrum attenuation insertion loss (dB).
   2. Channel wire mapping, ring-out and circuit length.
   3. Channel propagation delay and propagation speed.
   4. Channel impedance and continuity for center conductor and shields.

D. Fiber Optic Cable Testing, Optical Testing for Each Specified Wave-Lengths for Both laser and LED sources.
   1. Channel link insertion losses (dB) OLTS.
   2. Channel loop-back attenuation (dB).
   3. Channel signature Optical Time Domain Reflectometer – OTDR, for installation characterization testing (event and attenuation resolution dead zone at specified wave lengths, shall be less than 10-feet).
   4. Channel continuity and correct point-to-point matching terminals.
   5. Channel propagation delay and propagation speed.
6. Channel fiber optic mapping, circuit length, and tracing.

3.02 FIBER OPTIC CABLE TYPE

A. General
   1. Cables shown as fiber optic type shall comply with the following installation locations.
   2. Provide matching compatible outlets and terminate all fiber optic cables into matching fiber optic connectors.
   3. Fiber optic cable installed in indoor locations without enclosed raceway or conduit.
      a. Provide non-metallic, flexible corrugated continuous inner duct-raceway and install fiber optic cable in the innerduct.
      b. Innerduct shall be heavy duty, plenum-rated, Limited-Combustible (LC) type UL FHC – 25/50, orange color. Support innerduct 36-inches on center, independent of ceiling supports and independent of other equipment supports.
      c. Innerduct size shall be selected to insure percentage-fill with fiber optic cables shall not exceed 30%, but in no case less than 1.25-inch diameter innerduct.

B. Provide loose tube gel filled or indoor/outdoor type fiber optic cable for any of the following installation location conditions.
   1. Inter building (between buildings)
   2. In a conduit or raceway located underground below grade.
   3. In an exposed outdoor conduit or raceway not located underground or below grade.
   4. Do not install loose tube gel filled type fiber optic cable inside a building or exposed on a building without providing Rigid Steel (RGS) conduit raceway for the loose tube gel filled fiber optic cable along the entire length of the cable inside the building or on the building.

C. Provide tight buffered or indoor/outdoor type fiber optic cable for any of the following installation location conditions.
   1. Intra-building (inside a building) where raceway continuously encloses the cable and the raceway is not located underground, below grade.
   2. In an exposed outdoor conduit or raceway not located underground or below grade.

D. Provide plenum rated type fiber optic cable for any of the following installation location conditions in building spaces.
   1. Any building space air plenum (supply or return) when a conduit or enclosing raceway is not provided for the entire cable length. Additionally, Cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
   2. All building space locations where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in a building. Additionally, Cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
   3. Building spaces and/or cavities that are 100% fully protected with fire sprinklers, including fire sprinklers located above in ceiling cavities and fire sprinklers located below in access floor cavities. Cables installed in these locations shall be rated with one or more of the following additional characteristics.
      a. Limited–Combustible (LC) UL FHC-25/50 plenum rated cable.
b. Or plenum rated cable without the UL FHC-25/50 Limited-Combustible (LC) rating.

E. Optical Fiber Quantity:
1. The minimum fiber quantities in each fiber optic cable shall be as follows, but in no case less than indicated on the Drawings.
2. Between main IDF (SUB-MDF) in separate buildings and the MDF main terminal rack fiber optic patch bay for the entire site/campus.
   a. Twenty-four optical fibers, multimode plus six optical fibers, single mode.
3. Between satellite IDF terminal rack fiber optic patch bays and the main terminal rack IDF (sub-MDF) patch bay located in the same building.
   a. Twenty-Four optical fibers, multimode plus six optical fibers, single mode.
4. Between a terminal rack patch bays (IDF or MDF):
   a. To an individual workstation outlet located inside the same building - two multimode optical fibers, (typical only for locations where fiber is specifically shown on the Drawings for the specific work station outlet).
   b. To each network file server outlet location whether or not shown on the Drawings, four optical fiber, and multimode.
5. Between a terminal rack patch bay and individual multimedia network (television/video/audio) workstation outlets and/or intrusion/access program display devices located inside the same building - two optical fibers, multimode.
6. Other locations as indicated on the Drawings or described in the Contract Documents.

3.03 COPPER WIRE CABLE TYPE

A. General
1. Cables shown as copper wire type shall comply with the following installation conditions, unless noted otherwise on the Drawings.
2. Provide matching compatible outlets and terminate all copper wire cables into matching copper wire connectors.

B. Cable Types and Quantities - Cable types and quantities shall be as follows unless specifically noted otherwise on the Drawings. The following minimum type and quantity of copper wire cables from each individual workstation/device outlet, to the respective terminal equipment patch panel/bay, (unless specifically noted otherwise), but in no case less than what is shown on the Drawings and in no case less than one 4-pair cable to each outlet “Jack” position:
1. Two Category-6A, UTP 4-pair cable:
   a. Each network workstation outlet location.
   b. Each network “wireless-access-point” outlet location.
2. One Category-6A UTP 4-pair cable, for each telephone handset (instrument) workstation outlet location.
3. Trunking-Cables shall be Category-5E.
   a. 100-pair between buildings main IDF (SUB-MDF) and campus main MDF.
   b. 50-pair inside building between SUB-IDF to buildings main IDF (SUB-MDF).
8. Other locations as indicated on the Drawings or described in Contract Documents.
C. Provide plenum rated copper wire cable for any of the following installation location conditions in building spaces.
   1. Any air plenum (supply or return) when a conduit or enclosed raceway is not provided for the entire cable length. Additionally, cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
   2. All building space locations where the cable is installed without a conduit or the cable is not fully enclosed in a raceway along the entire cable length in the building. Additionally, cables shall be rated Limited-Combustible (LC) type UL FHC-25/50.
   3. Building spaces and/or cavities that are 100% fully protected with fire sprinklers, including fire sprinklers located above in ceiling cavities and fire sprinklers located below in access floor cavities. Cables installed in these locations shall be rated with one or more of the following additional characteristics.
      a. Limited–Combustible (LC) UL FHC-25/50 plenum rated cable.
      b. Or plenum rated cable without the UL FHC-25/50 Limited-Combustible (LC) rating.

D. OSP Insulated Copper Wire Cables
   1. Outside – Plant (OSP) CEC/NEC rated, UL listed, labeled and approved insulated copper wire cable assemblies. Moisture barrier resistant and UV resistant cable jacket. Non-flammable, water blocking, non-conductive gel internally filled infrastructure cable assembly.
   2. Provide rated insulated copper wire OSP type cable for any of the following copper wire infrastructure cable install locations.
      a. In underground conduit or in conduit under the building.
      b. In conduit exterior to the building, or in conduit exposed outdoor on the building.
      c. Outdoor aerial with aerial messenger wire cable carrier.
   3. Except for aerial install locations, install all OSP cable in continuous conduit pathways, end-to-end.

3.04 CABLE INSTALLATION

A. General
   1. Cables connecting to equipment racks and terminal blocks shall be installed with not less than 6-feet of slack cable between the equipment rack/terminal block and terminal backboard. The slack cable shall be coiled and supported on the backboard and/or cable tray.
   2. Cables in terminal closets and terminal rooms shall be trained, dressed and racked on the plywood backboards. Provide cable, metal support arms and re-enterable type cable support rings not less than 12-inches on center mounted onto the plywood along the entire length of all cables.
   3. Provide separate routing paths on plywood backboards for fiber optic cables, computer data and copper wire cables and telephone/voice copper wire cables and multimedia, audio/video, TV cables. Provide separate routing paths on plywood backboards for shielded copper wire cables and unshielded copper wire cables.
   4. Cables shall be routed parallel to floors and walls. Do not route cables diagonally on backboards.
   5. Spare cable slack
      a. Provide 25-feet of cable slack where unterminated cables are specified at terminal backboards.
b. Provide a minimum of 18-inches of slack cable in each workstation outlet box and outlet locations.
c. Provide 10-feet of cable slack in ceiling above each work station outlet.
d. Provide 24-inches of slack in each cable at patch panel locations.
e. Coil and "Velcro" wrap slack cable.

6. Provide “horizontal wiring” cables installed from individual equipment locations and workstation outlets to respective MDF/IDF terminal closet/room patch panel. Cables shall be continuous without cutting or splices.

7. Provide “backbone” cables installed from each IDF location to respective MDF/Sub-MDF location terminal closet/room patch panels. Cables shall be continuous without cutting or splices.

B. Cable Pulling Lubrication

1. Cable pulling lubricants shall be specifically approved by the Cable Manufacturer. The following lubricants shall be used where approved by the Cable Manufacturer.
   a. Slip X -300, American Colloid Co.
   b. Bishop #45, Bishop Electric.
   c. MacLube CA51, MacProducts.
   d. Minerallac H2B, Minerallac Electric.
   e. Winter grade #7437-PC, General Machine Products.
   f. Gel-lube 7/5, Cable associates.

2. Lubricants shall be continuously applied as cable enters raceway.

C. Cable Installation:

1. Do not pull conductors until factory test reports have been submitted and reviewed.

2. Minimum bending radius of fiber optic cables shall not be less than the following. Maximum pulling tension shall not exceed the following. In no case shall the Manufacturer's recommendations be violated.

<table>
<thead>
<tr>
<th>Cable Type</th>
<th>Cable Fiber Quantity</th>
<th>Minimum Bend Radius</th>
<th>Maximum Pulling Tension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loose Tube</td>
<td>2-84</td>
<td>9 inches</td>
<td>600 pounds</td>
</tr>
<tr>
<td>Loose Tube</td>
<td>86-192</td>
<td>10 inches</td>
<td>600 pounds</td>
</tr>
<tr>
<td>Tight Buffered</td>
<td>2-12</td>
<td>5 inches</td>
<td>400 pounds</td>
</tr>
<tr>
<td>Tight Buffered</td>
<td>14-24</td>
<td>7 inches</td>
<td>600 pounds</td>
</tr>
<tr>
<td>Tight Buffered</td>
<td>26-28</td>
<td>11 inches</td>
<td>1100 pounds</td>
</tr>
<tr>
<td>Tight Buffered</td>
<td>48-72</td>
<td>12 inches</td>
<td>1200 pounds</td>
</tr>
</tbody>
</table>

3. The minimum bending radius for copper wire cables shall be 10 times the cable outside diameter. The maximum pulling tension and minimum bending radius shall not violate Manufacturer's recommendations.

4. Cables installed in manholes and pullboxes on terminal backboards shall be installed on wall mounted cable support racks.

5. Provide a full 360-degree loop of cable around manhole and pullbox interiors.

6. The attachment of pulling devices directly to the cables shall be with individual split mesh basket grips. Direct connection for pulling cables to cable fibers and copper wires shall not occur. Securely tape cable ends to prevent moisture or pulling compound from penetrating cable.

7. The attachment of the pulling device to the cable basket grips shall be made through a swivel connector.

8. The Contractor shall ensure that the cables are fed straight into the raceway taking care to avoid short bends, sharp edges and cable "cross-overs".
9. All lashings used for temporary bunching of the individual cables shall be removed before the cables enter the raceway.

10. Cables shall be "pulled through" or pulled from a "center of run pull" without splices or terminations and minimize cable rolling tension. Lead-out the cables at all manholes, pullboxes and conduits taking care to feed them in again by hand for the next portion of the cable run.

11. For each cable pull where a cable direction change is required, flexible feed-in tubes, pullout devices, multi-segmented sheaves etc. shall be used to insure proper cable pulling tensions and side wall pressures. Cables shall not be pulled directly around a short right angle bend. Any device or surface the cable comes in contact with when under pull-in tension shall have a minimum radius 50% greater than the final specified minimum installed cable bending radius. The maximum possible size radius sheaves and feed-in tubes, usable in the available working space, shall be provided in all situations, to insure the minimum possible cable side-wall pulling pressure. Do not use devices with multi-segment "roller" type sheaves.

12. Cable lengths over 50 feet shall be machine pulled not hand pulled into and through all raceways. Cables shall be pulled in a continuous, smooth operation without jerking or stop-start motion after initiation of pull. Maximum cable pulling speed shall be less than 50 feet per minute. Minimum cable pulling speed shall be greater than 15 feet per minute.

13. Cables shall be pulled straight into or out of the raceway without bends at the raceway entrance or exit. Pull in cable from the end having the sharpest bend (i.e., bend shall be closest to reel). Keep pulling tension to minimum by liberal use of lubricant, hand turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one at manhole or pull-hole during this operation. Cables shall be pulled directly from cable reels.

14. Cables shall be trained or racked in trenches, vaults, manholes and pull boxes with consideration given for the minimum specified bending radius of the cable and the possibility of cable movements due to load cycling. The cables shall be racked and supported in such a manner that adequate space is allowed for splicing and the cables shall always be fanned out from the duct or conduit so as not to cross other ducts, conduits or cables. To prevent damage from falling objects or personnel entering the manhole the cables shall not pass directly under the manhole opening.

15. Cable shall be supported in manholes, pull boxes and vaults a minimum of 18-inch on center with cable racks. Provide hot dip galvanized, T-slot racks and support arms. Secure cables to racks with porcelain supports for each cable on the racks. Loosely lash cables to racks. Splices shall be directly supported, on racks. Do not install cables more than one feeder on the same rack hook.

16. Cables shall be routed the long way around manhole, pull-hole, etc. with not less than a full 360-degree loop around the perimeter walls unless noted otherwise.

17. Existing conductors shall be protected at all times when Contract work occurs in the same area, including but not limited to pullboxes, vaults manholes, cable trenches etc. Provide temporary electrical insulating blankets and barriers over existing conductors to reduce the possibility of accidental mechanical damage to existing conductors.

18. Where cable tray is provided, all cables shall be routed and trained on the cable tray. The cables shall enter the cable tray and route along the tray prior to entering any equipment racks or computer works station outlets.
19. A dynamometer to measure pulling tension shall be used on all cable runs in excess 200-feet or with more than 180 degrees in bends. The actual pulling tension value shall be calculated and recorded for each pull.

20. Bends shall not be made in cable splices or terminations.

21. The portions of cables installed without raceways or cable tray supports shall be installed with metal “J-hook” cable supports.
   a. The “J-hooks” shall provide multi-tiered “J” shaped hooks, with wide flat cable support base (0.5 inch wide minimum) and smooth rounded corners. Specifically designed for copper wire and fiber optic infrastructure cable support as manufactured by Erico Inc.
   b. The individual “J-hook” attachment to the building structure shall be metal, “beam clamp”, “hanger rod”, clevis hanger styles as applicable for each attachment location.
   c. Install “J-hooks” not more than 48-inches on center along the entire cable length and within 6 inches of each cable change in direction. Locations of “J-Hooks” and tension of cables shall insure between 4-inches and 6-inches of cable sag between adjacent hooks. Secure cables to “J-hooks” with re-enterable cable tie wraps. “J-hook” supported cables, bundle cables together with re-enterable tie wraps not less than 12 inches on center along the entire cable length.
   d. Each J-hook shall not support more than 12 individual cables. Provide multiple “tiered” J-hooks for additional cable quantities at each location.
   e. “Bridle rings” shall NOT be used to support cables.
   f. Cables shall not lay directly on nor attach to ceilings, ceiling hangers, lighting fixtures, air ducts, piping, or equipment.

22. Re-enterable cable tie wraps shall be, “limited-combustible” and air plenum rated, reusable, color coded. Chemically and mechanically compatible with the respective cables and install locations. Shall allow multiple open-close operations for securing cables.

23. Electronic network cables containing non-dielectric components shall be installed with a minimum separation from other electrical power conductors and equipment as follows:

<table>
<thead>
<tr>
<th>Equipment Type</th>
<th>Minimum Separation</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Lighting fixtures</td>
<td>12 inches</td>
</tr>
<tr>
<td>b. Electric motors, electric solenoids, electric Heaters</td>
<td>40 inches</td>
</tr>
<tr>
<td>c. Transformers</td>
<td>48 inches</td>
</tr>
<tr>
<td>d. Circuits over 100 volts to ground, in metallic raceways</td>
<td>5 inches</td>
</tr>
<tr>
<td>e. Circuits over 100 volts to ground, in non-metallic raceway or without any raceway</td>
<td>12 inches</td>
</tr>
<tr>
<td>f. Circuits over 100 volts to ground, suspended on overhead pole lines</td>
<td>48 inches</td>
</tr>
</tbody>
</table>

D. Movement, Storage, and Handling of Cable:
1. Reels of cable shall not be dropped from any height, from trucks or other transporting equipment.
2. Lift and move cable reels using following methods:
   a. Crane or boom type equipment-insert shaft (heavy rod or pipe) through reel hubs and lift with slings on shaft, with spreader or yoke to reduce or avoid sling pressure against reel head.
   b. Forklift type of equipment may be used to move smaller, narrower width reels. Fork tines should be placed so that lift pressure is on reel heads, not on cable, and shall reach all the way across reels so lift is against both reel heads.
c. Reels may be moved short distances by rolling. Reels shall be rolled in the direction indicated by arrows painted on reel heads. Surfaces over which the reels are to be rolled shall be solid clear of debris, and also clear of protruding stones, humps, etc. which might damage the cable if the reel straddles them.

3. Storage of reels of cable:
   a. Cable ends shall be sealed prior to shipment to prevent moisture entry into cable. Cable ends shall remain sealed at all times including during installation. Where ends seals are removed, reseal cable ends by stripping cable finishes back 2-inches down to insulation. Then apply four layers of an insulating tape criss-cross over the cable end and carry back at least 4-inches onto cable outer finish. Add a containing cover of two layers of vinyl electrical tape completely over the end seal.
   b. Cable reels shall be shipped with factory applied lagging (protective cover) left in place until removal is absolutely necessary. Additional covering such as tarpaulin, plastic sheeting, etc. shall be used if cable is to be stored outdoors.
   c. Store reels of cable on a firm surface, paved, or on planking to prevent settling into soft ground.
   d. Use fencing or other barriers to protect cables and reels against damage by vehicles or other equipment moving about in the storage area.

3.05 CABLE SPLICES

A. General
   1. Splice(s) in cables shall occur only in the following locations:
      a. Pullboxes or manholes.
      b. Terminal backboard, closets or rooms.
      c. Equipment racks.
      d. Wall mounted interface cabinet.
      e. Do not splice cables in conduit, cable tray, raceways or plenums.
   2. Polarity and color-coding shall be maintained consistent through splices, terminations and outlets for the entire electronic network system.
   3. Cable splices in outdoor areas, manholes, pullholes shall be water tight, inside universal splice enclosures.

B. Fiber optic cable splices unless specifically indicated otherwise below, fiber optic cable splices between fiber optic cables fibers shall be fusion type splices.
   1. Splices between loose tube gel filled fiber optic cable fibers shall be fusion type splices.
   2. Splices between indoor/outdoor fiber optic cable fibers shall be fusion type.
   3. "Pigtail" splices of tight buffered and indoor/outdoor fiber optic cable fibers to loose tube gel filled cables shall be fusion type splice.
   4. Splices between tight buffered fiber optic cable fibers to indoor/outdoor fiber optic cables shall be fusion type splice or mechanical type splice.
   5. Splices between tight buffered fiber optic cable fibers shall be mechanical type splice or fusion type splice.
   6. "Pigtail" splices of tight buffered fiber optic cable fibers to tight buffered fiber optic cable fibers shall be mechanical type splice or fusion type splice.
   7. Fiber optic splices shall be performed to maintain the data transmission rates specified for the entire respective system.
C. Copper Wire Splice
   1. Copper wire extending from infrastructure workstation outlets to respective 
      equipment rack patch panel outlets shall not be cut or broken and shall be 
      continuous end to end.
   2. Copper wire extending from telephone/voice workstation outlets to respective 
      terminal blocks shall not be cut or broken and shall be continuous end to end.
   3. Continuity of cable shields (where occurs), polarity and color coding shall be 
      maintained across all splices.
   4. Copper wire splices shall be performed to maintain the data transmission rates 
      specified for the entire respective system.

3.06 CABLE TERMINATIONS

A. General
   1. Infrastructure workstation outlets connecting to ports in patch panels and 
      terminal blocks shall be grouped together in the patch panel and terminal block 
      by outlet function, room location and building area location (i.e. Group #1 Room 
      #120 1st floor; Group #2 Room #200 east wing, etc.). Each group shall be 
      identified with engraved (etched) nameplates indicating grouping identification 
      and individual port numbers.
   2. Polarity and color coding of cable connections at splices, terminations and 
      outlets shall be consistently maintained throughout the entire electronic 
      network system.
   3. Terminate all cables onto respective outlets connectors, interconnection 
      couplers and terminals. Terminations shall comply with Manufacturer's 
      recommendations; ANSI/TIA/EIA-568C related Standards, Amendments and 
      TSB.
   4. Fiber optic cable fiber strands and copper wire cable conductors terminated at 
      outlet locations shall be connected with a strain relief device attached to the 
      cable jacket to prevent cable tension from being transmitted to the termination 
      connectors.
   5. Cable terminations shall be performed to maintain the data transmission rates 
      specified for respective entire system.

B. Fiber Optic Terminations
   1. Individual fiber optic fibers shall each be terminated with a fiber optic fiber 
      connector. The connector for each fiber shall be "plugged" into separate fiber 
      optic fiber interconnection couplers on the rear of each respective outlet.
   2. Each fiber optic termination ferrule shall be inspected, after completion of the 
      termination, visually with a fiber optic inspection microscope and an 
      interferometer, to insure fiber “undercut”, “protruding” fiber, over polish and 
      under polish of fiber termination ends does not exist in the finished termination 
      ferrule.
   3. Fiber optic cables terminated between two fiber optic patch panels located in 
      separate equipment racks. The fibers shall be paired together (Duplex-Pair) for 
      purposes of identification and connection transmit/ receive pair. Each pair of 
      connectors for fibers shall be "plugged" into separate, physically adjacent fiber 
      optic fiber duplex-pair interconnection couplers at each patch panel. The 
      horizontal/vertical arrangement of paired patch panel fiber couplers shall match 
      at both ends of the fiber cable.
   4. Fiber optic cable fiber strands terminated at patch panels shall be installed with 
      a minimum of 540 degrees of each fiber strand looped around the splice tray 
      individual fiber "training" rings.
5. Fiber optic cable connecting from infrastructure workstation outlet to a fiber optic patch panel.
   a. The connectors for fibers shall be "plugged" into separate, physically adjacent fiber optic fiber interconnection couplers.
   b. The patch panel coupler shall be color coded to identify the polarity of the transmitting and receiving optical fibers.

6. Fiber optic cable connections at workstation outlets.
   a. The connectors for fibers shall be "plugged" into separate physically adjacent fiber optic fiber interconnection couplers in the outlet.

C. Copper Wire Terminations
1. Where occurs, the shield on metal shielded copper wire shall be terminated and connected to the shield grounding connection at each termination point.
2. Twisted wire pairs shall not be untwisted for a length of more than 0.4-inch at any location and the cable jacket shall not be stripped back not more than 0.5 inch any location including splices and terminations.
3. Unless specifically directed otherwise by the Owner's Representative, pin assignment for wiring terminations shall comply with ANSI/TIA/EIA-568C type T568A or Type T568B as required for compatibility with the electronic network equipment. The termination type shall be consistent throughout the project Contract area.
4. Copper wire termination's shall be performed to maintain the transmission rates specified for the respective entire system.

3.07 EQUIPMENT RACKS

A. General
1. Install, assemble, mount and connect devices and equipment in the respective equipment racks, bolted securely to the rack frame with stainless steel hardware. "Star" style lock washers shall be provided to insure an electrically continuous ground path between the equipment/devices and rack frames.
2. Provide blank metal filler panels to close unused equipment "front" mounting space in equipment racks, Manufacturer's standard finish color.
3. Provide a copper wire outlet connector in the respective equipment rack for each remote copper wire infrastructure workstation outlet and copper wire cable shown connected to the respective equipment rack, plus the spare copper wire outlet connectors required in the Contract Documents. The copper wire outlet connectors in the equipment racks shall be provided in equipment rack mounted copper wire patch panels. In no case shall the quantity of equipment rack mounted copper wire outlet connectors be less than the quantity of cables indicated on the Drawings, plus required spaces/spares.
4. Provide fiber optic fiber connectors and fiber optic fiber interconnection couplers in the respective equipment rack for each remote fiber optic infrastructure workstation outlet, and fiber optics cable fiber shown connected to the respective equipment rack, plus the spare fiber optic fiber connectors required in the Contract Documents. The fiber optic fiber connectors and fiber optic fiber interconnection couplers in the equipment racks shall be provided in equipment rack mounted fiber optic fiber distribution enclosures (RTDE). In no case shall the quantity of equipment rack mounted fiber optic fiber connectors and fiber optic fiber interconnection couplers be less than the quantity of cables indicated on the Drawings, plus required spaces /spares.
5. Fiber optics cable fibers specifically shown as non-terminated "splicing-thru" in the equipment rack shall route through fiber optic splice only enclosures (RMSE), mounted in the respective equipment rack.

6. The maximum quantity of cable terminations, in each equipment rack mounted patch panels shall not exceed the following. To insure not less than 50% of the rack space remains available for equipment installation:
   a. 100% copper wire outlet connectors, 196 maximum per rack.
   b. 100% fiber optic fiber terminations, 144 maximum per rack.
   c. Combination of copper wire outlet connectors and fiber optic fiber terminations in the same rack; 48 maximum fiber optic fibers plus 144 maximum copper wire outlet connectors per rack. 18 maximum fiber plus 48 maximum copper wire in 30 inches high.
   d. In addition to the quantity of patch panel outlets for termination of incoming and outgoing cables, provide not less than an additional 15% of patch panel spare outlets of each type, in each equipment rack for future use.

7. Provide additional equipment racks, quantity of racks to ensure the maximum specified quantity of terminations in single rack are not exceeded and the quantity of cable terminations complies with the requirements of the Contract Documents.

8. Terminal racks, equipment locations, patch panels, and cross connects shall be arranged to allow for natural cabling progression, minimize crossing of cables and allow easy access to each system component.

9. Equipment Rack Anchorage:
   a. Equipment racks installed on raised "access floor" systems, shall be supported and anchored with bolts that extend into the "structural" floor located below the "access floor".
   b. Securely anchor the support arms of swing gate racks to the wall structural support system.
   c. Securely anchor fixed support base of the racks to the floor.
   d. Mounting method shall support the total rack weight including installed equipment, but in no case less than 500 pounds with a 2.0 times safety factor.
   e. Attachments and anchorages shall comply with the requirements for earthquake seismic rating at the install location.

10. Unless specifically noted, otherwise provide the following equipment rack types:
    a. Floor standing equipment racks containing patch panel locations, computer/data network HUBS/switches and computer data network concentrators, shall be Swing Gate style equipment racks.
    b. Floor standing equipment racks containing multimedia, audio/video, TV head end equipment, shall be Metal Enclosed equipment racks.
    c. Wall mounted external to dedicated IDF/MDF terminal rooms/closets (i.e. inside individual classrooms), shall be Mini-Equipment racks.

11. Install ground bus, PDU/TVSS, cable management rings, equipment, patch panel and patch panel outlets, etc. in equipment racks.

12. Equipment rack terminology:
    a. The location containing the main campus equipment rack location shall be identified as the Main Distribution Frame – (MDF).
    b. The locations remote from the MDF containing satellite equipment racks shall be identified as Intermediate Distribution Frames (IDF).
    c. A individual building located on a multi-building campus site with multiple equipment rack locations in the building, the building main rack location
shall be identified as Sub-MDF (or building MDF) and the remaining equipment rack locations in the building shall be identified as IDF.

B. Swing Gate Racks
1. Position the swing gate rack frame to provide a minimum of 30-inches clear space behind the moveable swing gate, for deep recess rack mounted equipment enclosure clearance. 42-inches in front of each rack to allow space for swing-gate 90-degree open position and still allow personnel passage way with the swing gate open. Not closer than 30-inches from rack frame to side-adjacent walls, to allow rack to swing full open with installed equipment.
2. All incoming cables shall enter from the back of the rack. The cables shall cross the hinge side of the rack with sufficient cable slack to allow opening and closing of the swing gate.
3. Provide unobstructed open-close operation clearances of the moveable swing gate. Do not install the edge of the rack closer than 30 inches to an intersecting perpendicular surface or wall.
4. The bottom of the moveable swing gate frame shall be approximately 6-inches above the finish floor.
5. Multiple swing gate equipment racks installed adjacent to each other along a common backboard/wall shall be spaced not less than 44-inches center line to center line and to insure the rack-gate can swing open a full 90-degree Arc with 24-inches deep rack mount equipment enclosures. Adjacent equipment rack with side-by-side hinges on the same side of the rack (left-right) may reduce the edge-to-edge rack side by side spacing to 6-inches for the respective combined two rack location.
6. The fixed non-moving bottom of the rack shall be securely anchored to floor.

C. Floor Standing Equipment Racks
1. General:
   a. Securely anchor racks to floor.
   b. All incoming cables shall enter through the top or bottom of the racks.
   c. The front of the racks shall maintain a minimum of 42-inches of clear working space.
   d. Multiple floor standing racks shall be installed directly adjacent to each other (i.e. side by side), with not less than 6-inches (edge-to-edge) space between adjacent racks.
   e. Cables entering racks shall enter into the top of the rack from overhead cable tray, or from wall along wall support arms to rack.
2. Floor standing metal enclosed equipment racks:
   a. The rear of the rack shall maintain a minimum of 36 inches clear working space.
   b. Provide a minimum spacing between adjacent (edge-to-edge) racks of not less than 6-inches.
3. Floor standing open (non-swing gate) equipment racks.
   a. The rear of the rack shall maintain a minimum of 54-inches clear working space behind the rack frame rails for adequate installation depth of HUBS/switches equipment, for "walk" behind access to equipment and for cable terminations access.
   b. Provide a minimum spacing between (edge-to-edge) racks of not less than 6-inches.
4. Floor standing modular frame equipment racks:
   a. The rear of the racks shall abut against the wall, or as shown on the Drawing.
3.08 TELEPHONE/VOICE TERMINAL BLOCKS

A. The telephone/voice terminal blocks shall be assembled in vertical sections, for wall mounting. Install adjacent vertical sections with not less than 8-inch blank space between sections, for cable training space.

B. Install terminal blocks on plywood terminal backboard with #8 x 1-inch wood screws. Minimum 6-inches on center, along each side of each terminal block.

C. Terminal block wire pair capacity:
   1. The minimum wire termination capacity shall not be less than 600 [900, 1200] pairs of telephone/voice conductors, at any telephone/voice terminal block.
   2. The quantity of wire pair terminations provided at each terminal block shall be based on the following formula. However, under no case shall any terminal block wire pair capacity be less than the specified minimum.
      \[
      \text{Total quantity of telephone/voice feeder copper wire pairs connected to the terminal board} = \text{QFP} \\
      \text{Total quantity of telephone/voice outlets connected to terminal board} - \text{QTO} \\
      (\text{QFP}) \times (\text{QTO} \times 4) + (\text{specified spares}) = \text{Minimum terminal block pair capacity.}
      \]

3.09 MDF AND IDF CIRCUIT TERMINAL ROOMS AND CLOSETS

A. Terminal Backboard
   1. A ¾-inch thick marine "A-C" grade plywood backboard shall fully cover each wall of terminal closets and terminal rooms, including all MDF and IDF rooms/ closets. Provide backboard on the wall for equipment racks, incoming cable raceways and terminal blocks. Plywood shall extend continuous from the finish floor to 8-feet above the finish floor on all walls. "A" side of plywood shall be exposed.
   2. Attach plywood to wall structural framing with mechanical fasteners a minimum 6-inches on center vertically on walls at each framing vertical member, and along the length of the wall, but not less than 16 inches on center horizontally along the length of the wall.
   3. Paint plywood terminal backboards after installation and prior to mounting any equipment. One coat of wood paint fire resistant primer and two (2) coats of fire resistant/intumescent, non-conductive finish coats of paint. Finish color matt/flat white, acrylic enamel fire resistant/retardant latex paint.

B. Cable Tray
   1. Locations with equipment racks, and/or terminal blocks are installed in the same room/closet (MDF or IDF).
      a. Provide a horizontal cable tray above the equipment racks and terminal blocks in each circuit terminal room and closet.
      b. Provide a horizontal cable tray continuous “loop” around the perimeter inside each MDF and IDF room, within 12-inches of the ceiling. Parallel with and adjacent to all walls in the room.
   2. Ladder type cable tray 18 inches wide by 6 inches deep; length-end wall to end wall, of the closet or room.
   3. Install the cable tray centered above all equipment racks, and around the room perimeter at ceiling/walls [and terminal blocks] with ceiling and wall suspension system. Install trays not more than 36-inches above and not less than 12-inches above the top of the equipment racks.
4. Where multiple segments of cable trays occur in terminal closets and rooms, provide interconnecting cable trays between each segment located in the respective room/closet.

C. Conductor Training and Support
1. Provide conductor/cable training and racking support distribution rings installed on backboards. As manufactured by Newton 3042 series, Saunders or equal.
2. Support rings shall be spaced a minimum of 10-inches on center along all cable/conductor routing paths on backboards and within 4-inches of each change in cable/conductor direction.
3. The capacity of support rings shall be equal to the weight and quantity of conductors/cables passing through the respective support ring plus 100% spare capacity for installation future conductors/cables. In no case shall support rings be smaller than 3 inches.
4. Attach support rings to backboards with not less than two (2) 3/8-inch diameter by 1⅛-inch long threaded wood anchor bolts for each individual bracket.

D. Environment Space Monitoring (MDF and IDF)
1. In each room/closet provide one automatic environmental monitor. Self-calibrating, simultaneous monitoring and software programmable, with alarm set points. Shall measure and monitor ambient conditions and provide data-logging for conditions in the space for the following:
   a. One ambient temperature port and plug-in indoor sensor.
   b. One ambient humidity port and plug-in indoor sensor.
   c. One spare plug-in port for an external digital sensor.
2. Digital Fast Ethernet LAN RJ-45 communications port, with alarm alerting and communications software for remote monitoring of the ambient conditions via the LAN. Multi-user site wide software license, compatible with PC-computer and IP-WEB HTTP remote operations.
3. Local internal audio and visual alert annunciators, with local silence and reset.
4. 120 volt, 60Hz AC input power supply operation. Equipment rack mount self-contained unit housing configuration. Provide all interconnect cabling and connectors.
5. Provide the environmental unit in one of the equipment racks located in each of the respective spaces.
6. As manufactured by Avtech-Room Alert; or SensaTronic-Environmental Systems; or IT Watch Dog-Climate Monitors.

3.10 GROUND (ADDITIONAL REQUIREMENTS)
A. Electronic Equipment MDF, IDF and Terminal Rooms and Closets
1. Terminal Equipment Ground Bus (TEGB) - Provide a wall mounted TEGB ground bus in each MDF location. Also provide a TEGB where two or more equipment racks and/or terminal blocks are provided in each IDF. The TEGB ground bus shall be copper ¼-inch by 2-inches (nominal) by 12-inches long (minimum). Install the TEGB on the wall with a minimum of two "stand-off" electrical insulators. Drill and tap the ground bus and provide bolted type ground lugs for connection of each ground conductors size #10AWG - #1AWG. Provide four spare unused ground lugs on the TEGB.
2. Provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB homerun to the building main ground reference bus. Provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the
TEGB homerun to the nearest building main structural steel member and to the nearest metal cold water pipe larger than 0.6-inch diameter pipe.

a. Provide the same ground connections from the equipment rack ground bus where only a single equipment rack occurs in the IDF location.

3. The ground conductor required from the TEGB to the building main ground reference bus may be looped and connected between separate TEGB ground bus locations if all of the following conditions are met.
   a. The ground conductor is increased to 1.5-inch conduit with 1#2/0AWG copper insulated and the total end to end length does not exceed 300-feet.
   b. The building exceeds two floors in height.
   c. Not more than four TEGB buses are connected to the same "looped" ground conductor.
   d. The TEGB ground conductor is continuous (not cut, spliced or broken) along its entire length.
   e. The TEGB ground conductor is connected to the TEGB ground buses with a UL listed "Exothermic" welding process.

B. Equipment Racks:
   1. Provide a separate 12AWG copper stranded green insulated ground conductor from each individual equipment element in the rack to the respective rack ground bus.
   2. Provide a separate #8AWG copper insulated ground conductor from each equipment rack ground bus to the TEGB terminal equipment ground bus located in the same space.
   3. Where only one equipment rack is installed, provide 1.25-inch conduit with 1#1AWG copper insulated ground homerun conductor from the equipment rack ground bus homerun to the building main ground reference bus and provide 1.25-inch conduit with 1#1AWG copper insulated ground conductor from the TEGB or single equipment rack ground bus (as applicable), to the nearest building main structural steel member and to the nearest metal cold water pipe larger than 0.6-inch diameter pipe.
   4. Provide 1.25-inch conduit with 1#4AWG copper insulated ground conductor from each wall mounted fiber interface cabinet to the respective TEGB ground buses.
   5. Provide a 1#10AWG copper insulated ground conductor connecting in a continuous loop to all miscellaneous cable trays and metal support equipment located in the terminal closet or room and connect to the TEGB ground bus.

C. Telephone/Voice Terminal Blocks:
   1. Provide a separate #8 copper insulated ground conductor from each terminal block section ground bus to the TEGB terminal equipment ground bus.
   2. Provide a separate #6 copper insulated ground conductor from the terminal room/closet to the lightning ground system.

3.11 WALL MOUNTED FIBER INTERFACE CABINET - WMIC

3.12 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. General
   1. Fiber optic and copper wire cables shall be identified in each manhole, pull box, equipment rack, patch panel and computer workstation outlets.
   2. Infrastructure documentation, identification labels and color coding shall comply with ANSI/TIA/EIA-606A Administration Standard for Telecommunications
Infrastructures, Class-1 thru Class-4. Provide management software MS-Windows-based single user license, with all as-built data entry documentation information complete.

B. Identification tags shall include the following information:
1. Cable name as indicated on Drawings (i.e., HV1, F4, MSB3 etc.).
2. Installation month and date (i.e., 3/92, 4/78 etc.).
3. Conductor size conductor type (i.e., loose tube fiber; #24AWG ScTP Category 5, 200-pair, telephone/voice etc.).
4. Feeder taps to equipment or building shall also be identified with equipment name or building (i.e. library, SW1, Rack #21, etc.)

C. Identification Tags
1. Tags shall be ¼-inch thick 98% lead, approximately 2-inch square with chamfered corners. Two holes shall be drilled for attachment to primary cable. Lettering shall be ½-inch high, engraved or die stamped. Attach tags to primary cables with two #14AWG (THWN insulated) solid copper conductors "twist-tied", with insulated CAP wire-nut on the tie-wire ends, to cover sharp edges of tie-wire conductor.
2. Alternate identification tags, at the CONTRACTOR’S option in lieu of lead tags. Provide polypropylene tag holders with interchangeable, yellow polypropylene tag with black alphanumeric characters sets. Characters shall be approximately .25-inch high. As manufactured by Almetek industries "EZTAG" - Ledgewood, New Jersey.

D. Equipment and outlet naming identification and color-coding shall comply with ANSI/EIA/TIA latest revision.
1. Naming method for equipment, outlets and cables; where a position in the naming string is unused, provide multiple "*****" symbols.
   Typical naming string "ADM-02-1141-PP17-1271"
   a. "ADM" - Abbreviated Building Name or Number (i.e., Administration, B127, etc.)
   b. "02" - Floor Level #2 or as applicable.
   c. "1141" - Outlet, Equipment or Terminal Room/Closet name or room number as applicable.
   e. "1271" - Individual Outlet or Port Identification.
2. Connecting hardware color coding shall be as follows:
   "Green" - Main central terminal location for entire site.
   "White" - Distributed terminal locations other than the main terminal.
   "Blue" - Horizontal wiring hardware systems for workstations.

E. Provide warning nameplates on fiber optic patch panels, fiber optic outlets, and any location where fiber optic cables are terminated. Minimum ¾-inch high engraved/etched letters. "WARNING - LASER LIGHT SOURCE. DO NOT LOOK DIRECTLY AT OUTLET OR FIBER CABLE ENDS. RISK OF SEVERE EYE DAMAGE OR BLINDNESS".

END OF SECTION 27 2000
112316/223037
PART 1- GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessary limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to the included as work under this Section.
   2. General provisions and requirements for electrical work.
   3. Design, provides equipment for, and installs a complete instructional classroom Audio-Video technology system.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit product data sheets for all wire, supports, conduit, fittings and splicing equipment.

B. Product Data:
   1. Provide a complete bill of materials, including all quantities of components, devices, equipment, and wiring required to complete this work.
   2. Submit product data, including Manufacturer’s data sheets for all proposed system components.

C. Shop Drawings, Indicate on a Floor Plan for each room system topology with the following:
   1. All equipment part numbers shall be listed to the bill of materials and the System Drawings.
   2. Configuration.
   3. Wiring diagram.
   4. Sizes.
   5. Materials.
   6. Finishes.
   7. Locations.
   8. Utility connections, types, and locations.

D. Manufacturer’s Qualification Statement.

E. Specimen Warranty.

F. Certificate: Certify that products of this section meet or exceed specified requirements.

G. Evaluation Service Reports: Show compliance with specified requirements.

H. Installer’s Qualification Statement.
I. Project Record Documents: Record actual locations of equipment and wiring types with color coding.

J. Warranty: Submit Manufacturer warranty, dated at Substantial Completion and ensure that forms have been completed in District’s name and registered with Manufacturer.

K. Maintenance Materials: Furnish the following for District's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Spare Parts: One of each kind of equipment or portable device.
   3. Tools: One each of every special tool required for maintenance of equipment.

1.03 REFERENCE STANDARDS


B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of conduits, switches, and equipment with size, location and installation of service utilities.

B. Pre-installation Meeting: Conduct a pre-installation meeting one week prior to the start of the work of this Section; require attendance by all affected Installers.

C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this Section, with not less than 3-years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this Section with minimum 5-years of experience.
   1. Must be an Authorized Extron Reseller at time of bid.
   2. Must be an Epson Reseller at time of bid.
   3. Must have a CTS-D Engineer on Staff at time of bid.
   4. Must have a RCCD on Staff at time of bid.
   5. Installing Technicians must be Trained and Certified for the implementation of PoleVault Systems at time of bid.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver Equipment to Project Site in unopened boxes.

B. Store Equipment under cover and elevated above grade.
   1. Equipment shall be kept in a locked environment to avoid theft.
1.07 WARRANTY

A. See Section 01 7800 Closeout Submittals, for additional warranty requirements.
B. Correct Defective Work within a 2-year period after Date of Substantial Completion.
C. Provide 5-year Manufacturer Warranty for Equipment.

PART 2 - PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. All systems must be approved under Part 15, Subpart B, and Section 17.107b of the FCC Rules and Regulations.
B. All material and systems must be UL approved.
C. The system shall follow Local and National Codes and be installed in accordance.
D. All enclosures and A/V equipment shall be anchored to the structure and shall comply with CBC Section 163A.

2.02 BASE BID MANUFACTURER

A. Extron Electronics: www.extron.com; 1230 South Lewis Street, Anaheim, California 92805, (714) 491-1500 or (800) 633-9876.
B. Other acceptable Manufacturers:
   1. Substitutions: Extron matches District Standards. No substitutions will be approved.

2.03 SYSTEM DESCRIPTION

A. Provide a complete Audiovisual System in each classroom where shown on plans. The system switching and audio amplification equipment shall be securely mounted and concealed in an enclosure mounted to the ceiling. Audio and image source equipment can be connected to the system and displayed via active (powered) interface panels located throughout the room. The audio and image signals from source devices shall be transmitted from the active interface panels over standard UTP Cabling Architecture.
B. Classroom Definition: Rooms that has fixed instructional media video projection capabilities, internet connectivity at the teacher's station, student networking (usually wireless), a document camera, DVD/VCR and-or other multimedia input devices, standard laptop interface, multimedia control system that is connected to the network and capabilities for additional add-on modular features.
C. Technology Enhanced Classrooms (TECs) use standardized control/interface systems and employ a standardized operational protocol. The principles of this recommendation are to establish desirable goals with respect to classroom design and installed technology. The TEC Classroom Standard includes control systems that have ADA, Section 508 compliant buttons that are discernible without activating the controls or buttons on the control panel, easily reached control panel locations, closed captioning, hearing assistance capability and user friendly operator protocols among the features that are consistent with universal design principles.
provide the following media source equipment for the audiovisual system in each classroom, conference room and platform area listed above and shall include the following:

1. Pole Vault PVS-400
2. District provided, Contractor installed LCD projector
3. All required connectors, cabling and installation for a complete Audio/Video Integrated System

**2.04 GENERAL EQUIPMENT REQUIREMENTS**

A. The room shall be equipped with a standard easy to operate teacher interface (a tactile button keypad layout). The audio system may be monaural or stereo for program sound. The instructional media system will be controlled by a control system with a control panel mounted near the Teacher's area. System parameters can be monitored, administered and controlled over the data network. The instructional media equipment will be located within close proximity to the Teacher's area or through a Graphical User Interface (GUI) on a computer to allow for ease of operation during instruction.

B. Acceptable functionality requirements are listed below in this specification categorized by type of equipment. Quantities are listed for movable, portable or loose equipment, and other selected entries. Where quantities are not listed, refer to the System Drawings.

C. Deviations from this Specification must be documented in writing to the Architect and Owner at least 10-business days before the submittal date.

D. The System components shall all be correctly listed and labeled by Underwriters Laboratories Incorporated (UL) for their intended use.

E. All products shall be new and under warranty at the time of installation. B-stock, previously installed, refurbished or used equipment shall not be allowed on this Project.

F. Where Specification lists several Manufacturers for a major item, or group of items, the A/V Contractor shall provide that entire item from one Manufacturer only.

G. The Contractor shall provide all options, accessories and hardware necessary to meet the function of the design even if they are not specifically listed (i.e. mounting kits, separate or additional power supplies, input modules, transformers, etc.).

**2.05 FIXED EQUIPMENT**

A. Provide the following Audio Visual System as an all-inclusive system as described below, one system for each room:

1. Projector Mounting - shall be mounted using the following components.
   a. Extron PCM 340 projector drop ceiling mount with adjustable pole.
      1) The PCM 340 projector mount must be capable of mounting to the structural ceiling (concrete or wood joists) above the suspended t-bar ceiling via trunnuckles and tie wire or threaded rod, to provide a full 100 degrees of adjustment enabling a PMP Series pole to hang level.
      2) The mount shall be capable of supporting up to 50 pounds (23kgs) of A/V equipment.
3) The mount must also include a 1.5-inches threaded pipe adapter for projector mount poles.

b. Extron UPB 25 Universal Projector Bracket.
   1) The bracket shall be able to support projectors up to 25 pounds.
   2) The projector bracket must have independent adjustments of horizontal tilt or roll (± 4 degrees of horizontal tilt), vertical angle or pitch (± 25 degrees of vertical angle), and rotation or yaw (360 degrees of rotation).
   3) The projector bracket shall also use a 1.5-inches NTP (National Tapered Pipe) threaded pipe adapter for mounting a projector pole.
   4) The projector bracket should also maintain positioning adjustments even if the projector is removed for service.
   5) The bracket should also feature security flanges that enable the entire unit to be padlocked to prevent theft.

c. Extron PMP Projector Mounting Pole.
   1) The projector mounting pole shall be 1.5-inches NTP (National Tapered Pipe) threaded pipe threaded at both ends to facilitate mounting the projector to the ceiling mount and to the universal projector mount.
   2) The projector mounting pole shall be of a custom length for proper mounting from building structure.
   3) The pole shall provide a cutout section to all for cable access.

d. Extron PMK 550 Pole Mount Kit.
   1) The Project Mounting Kit is a lightweight, fully enclosed vented housing for quickly installing and securing Extron PoleVault System components above a pole-mounted projector. These products may be Extron PVS 305SA TP, Switcher, power supplies, audio amplifiers, IP Link products and other Extron quarter rack product options.

2. Media Source Switching:
   a. System source selection and switching shall be provided by a PVS A/V Switcher.
   b. The switcher shall have two RGB video inputs capable of VGA - UXGA RGBHV, RGBS, RbSb and RsGsBs input resolution via two pairs of female RJ-45 connectors.
   c. The switcher shall have two inputs that can be configurable for either composite video via two female RJ-45 connectors or two additional RGB video inputs capable of VGA-UXGA RGBHV, RGBS, RbSb an RsGsBs input resolution via two pairs of female RJ-45 connectors.
   d. Audio input shall be via four stereo, balanced/unbalanced inputs via the same four and/or six RJ-45 RGB and composite video connectors.
   e. The switcher shall have two video outputs, one RGB output capable of outputting VGA - UXGA RGBHV, RGBS, RbSb and RsGsBs (following input type) via a 15-pin HD female connector and one composite video via one RCA female connector.
   f. Connection from the switcher to the display device shall be provided with one 3-foot VGA to VGA and one 3-foot composite video cable.
   g. An onboard audio amplifier shall provide gain/volume adjustment from -10db to +10db, adjustable in 1db steps. The speaker amplifier shall have two channels, one stereo (default) or dual mono channels via one 5.0mm 4 pole captive screw connector. The output of the amplifier shall be 25watts (rms) per channel at 2/4/8 ohms.
   h. In addition to the stereo/mono speaker output, an additional audio output that will produce line level output shall also be available. This line level
audio output must be capable for being set at with "fixed" or "variable" and with Balanced or Unbalanced settings.

3. Media Source Control:
   a. Provide Media Source Controllers, MLC 104 IP Plus, in each designated classroom.
   b. The room media sources shall be controlled with a MediaLink Controller with IP Link.
   c. The MediaLink Controller shall contain six tri-color, multi-status LEDs push-buttons for device selection and projector on/off control. A rotary volume control knob with five LED volume indicators shall permit system volume level control.
   e. The MLC Controller shall feature Extron IP Link Ethernet for monitoring, scheduling and control. This IP technology shall enable the device to be controlled, scheduled, and monitored over a LAN, WAN or the Internet using Extron Global Viewer or MLC controller software.
   f. The Controller shall contain a serial host port which shall consist of one bi-directional RS-232 front panel 2.5mm mini stereo jack. This host connection port shall be for configuration and control of the controller itself and to install device drivers for the equipment to be controlled.
   g. The Controller shall also feature two bi-directional serial ports to provide device control. These two ports shall control the display device and PBS Switcher respectively via two bi-directional RS-232 control via one 3.5mm direct insertion captive screw connector.
   h. The MLC Controller shall also have two configurable (via software) digital input/outputs for devices such as sensors, switches, LEDs and relays via one 3.5mm 4-pole direct insertion captive screw connector.
   i. Connection from the MLC Controller to the display shall be provided by one 50-foot Projector control cable.
   j. Connection from the MLC Controller to the PVS Switcher shall be provided by one 50-foot Switcher Control cable.

4. Audio and Speech Reinforcement:
   a. Speakers: In suspended ceiling applications, provide one pair of Extron FF120 speakers in each designated classroom and conference room.
      1) These speakers shall be 3.5-inches deep low profile featuring a deep aluminized composite enclosure, rectangular shape with a metal grille.
      2) The coverage angle of the speaker offers an extraordinary wide dispersion area of 170 degrees, providing a very wide room coverage pattern.
      3) Meeting the Regulatory Compliance Safety Specifications of NFPA90A, NFPA70, UL listed for use in plenum air-spaces, meets UL 2043 for heat and smoke release meets UL 1480 for commercial and professional audio.
      4) The speakers feature a frequency response of 68Hz to 18kHz-10db, half space.
      5) The power capacity is 16watts of continuous pink noise or 32watts of continuous program media.
      6) The nominal impedance is 8ohms.
      7) The input connector shall be one 5mm captive screw for one input.
      8) Connection from the PVS 305SA Plus switcher to the FF120 speaker is provided by one 50-foot 18 Gauge Speaker Cable Extron SPK-18.
5. Media Source Interfacing:
   a. The media source equipment shall be connected to the audiovisual system via two or four Active (powered) Twisted Pair Transmitter Wall Plates as shown on Plans. These wall plates shall enable the system to display video and graphic data from Laptop computers, DVD and VCRs, document camera, camcorders, etc.
   b. These active interface transmitters shall be placed in convenient locations throughout the room to facilitate easy connection of sources.
   c. Provide two types of active interface transmitter panels. The RGB Video Twisted Pair Transmitter – Wall plate shall be used to connect up to one RGB device to the system and transmit the video and audio data to the switcher.
   d. The RGB Video Twisted Pair Transmitter - Wall Plates shall fit a standard, single-gang electrical box with typical type faceplates.
   e. The RGB Video Active Twisted Pair Transmitter – Wall plates shall transmit RGB video over UTP cable to the PVS Switcher and support video input resolutions of VGA - UXGA RGBHV, RGBS, RBsB and RsGsBs via one female 15-pin HD connector. The RGB input plate shall also support EDID emulation.
   f. Stereo audio shall be input via one 3.5mm mini stereo jack.
   g. Connection to each PVT RGB D shall be provided via an Extron male VGA to male VA and male 3.5mm TRS to male 3.5mm TRS cable for RGBHV and audio, length to be coordinated by Owner.
   h. The output of the interface shall be via two female RJ-45 connectors.
   i. Connection to the PVS Switcher shall be via two UL plenum rated UTP cables.
   j. The System shall include one Extron PVT CV D Composite Video Twisted Pair Transmitter – Wall Plate.
   k. The Composite Video Active Twisted Pair Transmitter – Wall Plates shall transmit composite video over UTP cable to the PVS Switcher and support video input via a RCA female connector.
   l. The Composite Video Twisted Pair Transmitter – Wall plates shall fit in a standard, single-gang electrical box and feature Decora® type faceplates.
   m. Stereo audio shall be input via two RCA female connectors.
   n. Connections to the PVT CV D from the DVD/VCR shall be provided via one Extron male 3 x RCA to male 3 x RCA cable for composite video and audio, cable length to be coordinated by Owner.
   o. The output of the interface shall be via one female RJ-45 connector.
   p. Connection to the PVS Switcher shall be via one UL plenum rated UTP cable.
   q. Provide USB Extender D Rx and connect via one UL plenum rated UTP cable to USB Extender Rx located at the PVS switcher.

2.06 ACCESSORIES

A. Supports:
   1. All supports shall meet or exceed the load requirements of the intended application with a minimum safety factor of five.
   2. Provide support structure and hardware with a SAE Grade 8 load rating (minimum).
PART 3 - EXECUTION

3.01 GENERAL

A. All Equipment and Enclosures described in this Specification shall be installed plumb and square per Manufacturer’s instructions.

B. All Equipment, except that designated as movable, portable or loose equipment, shall be secured and permanently attached to the permanent structure in a manner which will require the use of a tool (e.g.: screw driver, nut driver, etc.) for removal.

3.02 EXAMINATION

A. Site Verification of Conditions: Verify that related conditions, including equipment that has been previously installed under other sections, are acceptable for product installation in accordance with Manufacturer’s instructions.

B. All Devices Connected to Equipment specified in this section shall bear the UL label and comply with the applicable California Electrical Code (CEC) Standards.

3.03 INSTALLATION

A. Contractor shall furnish all equipment, labor, system setup, and other services necessary for the proper installation of the products/system as indicated on the Drawings and specified herein. System setup information shall include each component’s proper mounting and alignment and properly verified signal pathways and operation. Proper operational and network support control functions shall be verified.

B. Install in accordance with Manufacturer’s handling and installation instructions.

C. Install in accordance with all local and pertaining Codes and Regulations

D. Utilize an Installer with demonstrated experience in Projects of similar size and complexity.

E. Equipment shall be configured and ready for use to condition at the end of installation.

F. Energize and commission equipment in accordance with Manufacturer’s instructions.

3.04 PROTECTION AND CLEANING

A. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the Manufacturer.

B. Repair or replace damaged components before Substantial Completion of the Project.

C. Remove temporary tags, coverings, and construction debris from interior and exterior surfaces of the equipment. Remove construction debris from equipment area and dispose of properly.

END OF SECTION 27 4100

112316/223037
SECTION 27 5126

ASSISTIVE LISTENING SYSTEM

PART 1 – GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment, facilities, transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit block wiring diagrams and catalog data showing component interconnection and descriptive literature for all component parts and cabinets.

1.03 EQUIPMENT QUALIFICATION

A. All Equipment shall conform to Federal, State and Local applicable Codes, Ordinances and AHJ, and shall be listed and labeled by Underwriters Laboratories.

B. Assistive-Listening Systems
   1. Assistive-listening systems shall be provided in accordance with CBC Section 11B-219 and shall comply with CBC Section 11B-706.
   2. The minimum number of receivers to be provided shall be equal to 4% of the total number of seats, but in no case less than two. 25% minimum of the receivers provided, but no less than two shall be hearing-aid compatible in accordance with CBC Section 11B-706.3.
   3. If the system provided is limited to specific areas or seats, then such areas or seats shall be within a 50-foot viewing distance of, and have a complete view of, the stage or playing area. CBC Section 11B-219.4.

PART 2 - PRODUCTS

2.01 GENERAL

A. The Assistive Listening System shall include the following items
   1. Instructor (program source) wireless transmitter units.
   2. Student (audience) portable wireless receiver units.
   3. Plug-in microphones and earphones, for each unit.
   4. Multiple program source inputs for, Instructor’s microphone, respective room audio/video A/V system input/output and Instructor’s computer audio input/output.
   5. System accessories.
B. Function

1. The Assistive Listening System shall provide amplified available audio programs for hearing impaired students/audience, originating from classroom/stage/room instructors and audio/video instructional program source materials, and equipment in respective building spaces, rooms, classrooms and outdoor areas.

2. The audible program shall be transmitted wireless from the program source to the student/audience, with reception coverage throughout not less than approximately 80% of the respective floor space/area space.

3. Shall provide automatic stereo or mono audio full system operation, depending on program source input.

4. The system in each space shall comply with Federal ADA, State and Local AHJ requirements for the hearing impaired.

2.02 MATERIALS (RF WIRELESS)

A. General

1. Power for each portable unit operation shall be supplied by internal, changeable rechargeable NiCad batteries and alternately by alkaline disposable batteries. Rechargeable batteries shall be recharged without removal from the unit. Each unit shall have a charging indicator light. The batteries shall be recharged from either a portable charger/organizer and with wall transformer/two unit chargers. The units shall operate for up to 40-hours with alkaline batteries, and up to 10-hours with NiCad (NiMH) batteries. The batteries shall be rechargeable without removal from unit.

2. Provide power on-off control on each unit, to extend battery duration.

3. A protection circuit shall prevent battery “back-drain” if the power to the charger is turned off while the unit is being recharged.

4. The receivers and transmitters shall be US Government FCC and Industry Canada-approved, for FM-RF (radio frequency) wireless operation.

5. All components shall be the product of the same Manufacturer.

6. As manufactured by Williams Sound; or PhonicEar; or Listen Technologies; or Centrum Sound.

B. Instructors Portable (Program Source) RF Transmitter Units

1. The transmitter, shall be compact, easily portable units, self-contained ABS, plastic housing/enclosure shall clip to a pocket or belt.

2. Each portable transmitter shall provide RF transmitting on one of the US Government 40 different FCC – and Industry Canada-approved narrow-band channels in the 72-86MHz RF band.

a. Line-of-sight transmit distance range of not less than 100-feet up to 150-feet from transmitter to receiver.

3. Easy-to-read channel label and volume adjustment on the front unit face. Stereo and mono audio processing.

4. 3.5mm auxiliary input jack that allows transmission of audio from an auxiliary source such as a cassette recorder, computer, CD/DVD player or television audio source. The transmitter shall also provide a second 3.5mm microphone input source jack. The two input sources shall be simultaneously operational to provide a mixed signal output RF transmission of the two sources.

5. Select the separate independent RF transmission frequency for each transmitter to prevent transmission interference between units and to provide for at least two student receiver units to selectively overlap reception of the transmitter.
6. **Quantity of instructor’s portable RF transmitters**
   a. Provide quantity of nine instructor portable transmitters, three-on low band; three-on mid band and three-on high band RF frequencies.
   b. Provide a quantity of one portable transmitter at the respective room audio/video (A/V) equipment, program output source. Provide 120 volt AC-to-DC power-supply for portable transmitter at the A/V equipment location.

7. **Extended range fixed base non-portable RF transmitter.**
   a. Provide fixed location non-portable base unit RF transmitter for spaces larger than 9,000 square foot indoor or outdoor spaces.
   b. Shall have the same RF characteristics and performance as the portable transmitter except as follows:
      1) Line-of-sight transmit distance range of not less than 800-feet from transmitter to receiver.
      2) Fixed install location non-portable, with NEMA-1 metal housing.
      3) Radiated RF energy intensity shall provide manual attenuation adjustments to prevent multiple adjacency RF interferences.
   c. Provide a student/audience portable RF receiver unit at the RF base unit to receive RF signals from an instructors RF transmitter. Connect to the base unit to rebroadcast. Provide a self-contained 120-volt AC-to-DC power-supply for the portable receiver at the base unit transmitter.
   d. Shall operate on 120 volt 60Hz AC branch circuit. Provide remote system master on-off control.
   e. Provide remote RF antenna (outdoor/indoor) rated, for fixed base RF transmitter. Antenna shall extend the transmitter range for large spaces. Provide two RG-6 coaxial cable connects from antenna to base transmitter.

C. **Student/Audience Receiver Units**
   1. The multi-channel narrow-band FM receivers shall be compact easily portable units, self-contained ABS/plastic housing/enclosure and shall clip to a pocket or belt.
   2. The receiver shall provide an on/off switch and volume control which adjusts the output level as required by the listener.
   3. The receiver shall have a 3.5mm output jack which accepts one of any of the plug-in listening accessories. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation.
   4. The receiver shall have an easy-to-read channel label on the front face. The receiver shall incorporate an automatic squelch circuit which eliminates white noise when the receiver is out of transmission range. Stereo and mono audio reception and processing.
   5. The multi-channel receiver shall receive any six of the US Government forty different FCC-approved narrow-band FM frequencies within the 72-76MHz band from the respective transmitter units. The user shall be able to change to any one of these six frequencies by using a slide or rotary switch on the receiver. Label on the front face shall indicate the receiver is a multi-channel unit. A label inside the battery compartment shall indicate the six channels that are available to the user.
   6. **Quantity of portable RF receivers**
      a. Provide a quantity of two receivers with matching frequencies for each transmitter, not less than eighteen total quantities of receivers.
      b. Provide a quantity of one receiver with matching RF frequency of the transmitter at the respective room audio/video (A/V) equipment, program
input source. Provide 120 volt AC-to-DC power-supply for portable receiver at the A/V equipment location.

b. Provide hearing aid compatible units at a ratio of one per four receivers in accordance with ADA 219.3.

c. RF System Accessories
   1. Battery recharger portable charger/organizer pack. Locking, portable case with cover, shall accept a group of not less than twelve plug-in portable transmitter and receiver units in each pack for simultaneous multi-unit battery recharging. Provide a quantity of one organizer for each quantity group of twelve (or fraction thereof) transmitters receivers provided as part of the Contract.

   2. Stereo audio headset style automatic noise canceling microphone, integral on-off-volume control and with behind the neck support style each with cable and outlet plug-jacks to match transmitter jacks. Provide two cables for each transmitter.

   3. Equipment wall mount support brackets.

   4. Auxiliary audio program source 15-feet long cables with plug-in at both ends to match transmitter jacks. Provide two for each transmitter.

   5. Stereo audio headset style ear phones with cable and plug to match receiver jacks. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation. Provide one headset for each receiver.

   6. Rechargeable Ni-Cad (NiMH) batteries, one complete set for each transmitter and receiver unit.

   7. Locking auxiliary equipment storage cases for cables, microphones and headsets, with quantity and capacity for all auxiliary accessories furnished as part of the Contract.

2.03 MATERIAL (INFRARED WIRELESS)

A. General
   1. All equipment shall be the product of the same Manufacturer.

   2. The receivers and transmitters shall be US Government FCC and Industry Canada-approved.

   3. Provide power on-off control on each unit, to extend battery duration.

   4. As manufactured by Williams Sound; or PhonicEar; or Listen Technologies; or Centrum Sound.

B. Master (Program Source) Transmitter (Infrared Emitter) Units
   1. The infrared emitter/transmitter shall be compact, portable units, self-contained ABS/plastic housing/enclosure.

   2. The emitter panel shall be a dual-channel system operating on both 2.3 and 2.8MHz invisible infrared light waves frequencies. The channels shall be designated “CHANNEL A” for the left and “CHANNEL B” for the right.

   3. The emitter shall provide left and right AUDIO IN jacks to accept an input signal from a sound system, left and right “SYNC IN/SYNC OUT” jacks for master/slave daisy-chaining with other emitters if desired, and left and right “MIC-IN” jacks to accept an audio signal from a microphone or Audio/Video preamplifier.

   4. The emitter shall provide separate LED input level detectors for each channel which illuminate when the audio signal peaks. Stereo and mono audio processing.
5. The emitter shall be mounted by the following methods:
   a. Fixed to a wall with an adjustable, wall-mounting support bracket accessory.
   b. Portable mounted to a table-top-or floor-stand, using accessory support-stand adapter.
6. Each emitter shall provide an array of not less than 130-infrared LEDs covered by an infrared transparent acrylic lens. The infrared signal from each emitter shall cover not less than 3,000 square feet (32,000 cubic feet) enclosed space. Note: For room sizes smaller than 3000 square feet, the infrared transmitter/emitter infrared output shall be reduced to accommodate the actual smaller room square feet size and height.
7. 120 volt 60Hz AC input to nominal 24-volt DC output (plug-in “power-brick”) power supply external transformer shall be UL approved, with cable “plug-in” connection to emitter/transmitter. Provide remote system master on-off control.
8. Slave emitter/transmitter for rooms exceeding 30,000 cubic feet. Provide one additional infrared emitter/transmitter repeater slave unit, for each additional 30,000 cubic feet room volume, or fraction thereof. The slave repeater shall receive and retransmit the program signals from the master unit. Provide one 100-foot long “master-to-slave” auxiliary portable extension wire cable for each slave unit.
9. Provide wall mount plug-in outlets for instructors’ microphone outlet connect ports to emitter/transmitter.
   a. Provide 1.0-inch conduit and wire, homerun connect from microphone outlet to each room respective emitter/transmitter and slaves. Provide conductors as recommended by Manufacturer.
   b. Provide 1.0-inch conduit and wire homerun connect from microphone outlet to respective room Audio/Video (A/V) equipment, microphone program source input. Provide conductors as recommended by Manufacturer.
10. Provide a quantity of nine emitter/transmitter “master” units, plus additional “slave” units for adjusted room sizes.

C. Student/Audience Receiver Units
1. Battery Power
   a. Power for each unit operation shall be supplied by internal, changeable rechargeable NiCad batteries and alternately by alkaline disposable batteries. Rechargeable batteries shall be recharged without removal from the unit. Each unit shall have a charging indicator light. The batteries shall be recharged from either a portable charger/organizer and with wall transformer/two unit chargers. The units shall operate for up to 40-hours with alkaline batteries, and up to 15-hours with NiCad (NiMH) batteries.
   b. Provide power on-off control on each unit, to extend battery duration.
   c. A protection circuit shall prevent battery “back-drain” if the power to the charger is turned off while the unit is being recharged.
2. The receiver shall be a dual-channel unit for wearing around the neck with an adjustable strap. Stereo and mono audio reception and processing.
3. Compatible with the transmitter (emitter) and operate on 2.3MHz and 2.8MHz frequencies invisible infrared light waves. Self-contained and switchable from “CHANNEL A” to “CHANNEL B” through a switch located on the back of the unit.
4. The receiver shall provide an infrared light-gathering lens on the front of the unit to focus the light signal from the emitter onto the infrared detector element.
The receiver shall detect and decode the infrared emitter/transmitter light source within a 160° acceptance angle.

5. Audio squelch circuit which turns the output circuit off when the infrared signal is reduced or not received, with on/off and volume control.

6. Output jack, which accepts any of the listening accessories. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation.

7. Shall be compact easily portable units, self-contained ABS/plastic housing/enclosure with red infrared receiver lens. Shall clip to pocket or belt.

8. Provide quantity of two infrared receivers for each master transmitter, not less than eighteen total quantities of receivers.

D. Infrared System Accessories

1. Battery recharger portable charger/organizer pack. Locking, portable case with cover, shall accept a group of not less than twelve plug-in portable transmitters and receivers units in each pack for simultaneous multi-unit battery recharging. Provide a quantity of one organizer for each quantity group of twelve (or fraction thereof) receivers provided as part of the contract.

2. Stereo audio headset style automatic noise canceling microphones, integral on-off-volume control and with behind the neck support style. Each with 25-feet long extension cables and outlet plug-jacks to match transmitter outlet jacks. Provide two cables for each emitter/transmitter.

3. Equipment wall mount support brackets.

4. Auxiliary audio program source 15-feet long cables with plug-in at both ends to match transmitter jacks. Provide two for each transmitter.

5. Headset style ear phones with cable and plug to match receiver jacks. Headsets shall provide magnetic induction pick-up for hearing impaired, hearing aid interface operation. Provide one headset for each receiver.

6. Rechargeable Ni-Cad (NiMH) batteries, one complete set for each unit.

7. Locking auxiliary equipment storage cases for cables, microphones and headsets. Quantity and capacity as required to store all accessories.

8. Portable floor stand, for infrared emitter/transmitter units mounting and support, with variable height adjustment and tip-resistant weighted base. Provide one floor stand for each infrared emitter/transmitter.

9. Locking, portable case for infrared emitter/transmitter. One for each emitter/transmitter unit.

10. Provide microphone extension cable with plug to match microphone and infrared emitter/transmitter microphone input jack, 25-feet length. One for each microphone.

PART 3 - EXECUTION

3.01 GENERAL

A. Each System General

1. Assemble, set up, and test each transmitter, receiver, and accessories units.

2. Install and fully charge all batteries prior to and after testing/set up is complete.

B. Wireless RF Units

1. Perform an onsite RF frequency survey to determine available unused RF channels, prior to selecting unit operating channels and prior to ordering the equipment.
2. Select operational RF frequency to prevent system RF interference’s with other
equipment.

3. Provide - one 0.75-inch conduit with two Category–6A, ANSI/EIA/TIA-568C 4-
   pair, UTP cables connecting from each emitter/transmitter master outlet box
   location to respective room instructors microphone outlet box location. Provide
   matching RJ-45 Category-6A female jacks at each outlet box for each cable.
   Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for
   RJ-45-to-portable cable plug-in transition and circuit impedance matching
   audio/transformer, into respective equipment. Additionally provide four
   portable Category-6A patch cables with RJ-45 jacks on each end of 7-foot long
   patch cable. Typical for each outlet location.

C. Wireless Infrared Units

1. Provide aiming and intensity adjustments of emitter/transmitter units to insure
   complete room coverage.

2. Provide - one 0.75-inch conduit with two Category–6A, ANSI/EIA/TIA-568C 4-
   pair, UTP cables connecting from each emitter/transmitter master outlet box
   location to respective room instructors microphone outlet box location. Provide
   matching RJ-45 Category-6A female jacks at each outlet box for each cable.
   Provide an audio circuit matching Balun at each outlet RJ-45 jack location, for
   RJ-45-to-portable cable plug-in transition and circuit impedance matching
   audio/transformer, into respective equipment. Additionally provide four
   portable Category-6A patch cables with RJ-45 jacks on each end of 7-foot long
   patch cable. Typical for each outlet location.

3. Provide - one 0.75-inch conduit with two Category–6A, ANSI/EIA/TIA – 568C,
   4-pair UTP cables connecting from each emitter/transmitter master outlet box
   location to respective room audio amplifier/preamplifier location. Provide
   matching RJ-45 Category-6A female jacks at each outlet box location for each
   UTP cable. Provide an audio circuit matching Balun at each outlet RJ-45 jack
   location, for RJ-45-to-portable cable plug-in transition and circuit impedance
   matching audio/transformer, into respective equipment. Additionally provide
   four portable Category-6A patch cables with RJ-45 jacks on each end of 7-foot
   long patch cable. Typical for each outlet location.

END OF SECTION 27 5126
112316/223037
SECTION 27 5313
CLOCK SYSTEM

PART 1- GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances tools, equipment, facilities transportation and services necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Sections for work related to those other Sections and required to be included as work under this Section.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Product Data Sheets and Descriptive Literature for all Component Parts.

B. Submit Block Wiring Diagram of the Clock and Paging systems. Showing headend equipment, terminal cabinets, remote power supplies, and typical clock for each zone.

1.03 EQUIPMENT QUALIFICATION

A. The Specification is based on the Equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance Specifications which are published in the most recent Manufacturer's data sheets available at the time of bidding this project shall be applicable to the present work as though fully written out herein.

B. All Equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.

1.04 QUALIFICATIONS

A. To qualify as an Acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-Contractor, the System Bidder or Contractor shall be Qualified Sound Contractor and shall hold a valid C61 License issued by the Contractors State License Board of California. The System Bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted Authorities Having Jurisdiction over the work. The Contractor shall be the Factory Authorized Distributor for the brand of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment.
1.05 GENERAL REQUIREMENTS AND SCOPE

A. Furnish and Install a complete new GPS Wireless clock system using Primex Wireless Inc. GPS Wireless system or equal by American Time and Signal, Sapling. All bids shall be based on the equipment as specified herein.

B. Section includes Transmission Systems GPS Receiver, Primary Transmitter, and Satellite Transmitter.
   1. Clocks:
      a. Analog
      b. Digital

1.06 RELATED SECTIONS

A. Division 26 – Electrical (120 volt grounded outlet required for transmitter).

1.07 REFERENCES


1.08 DEFINITIONS

A. GPS: Global Positioning System, a worldwide system that employs twenty-four satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world’s most accurate and reliable time.

1.09 SYSTEM DESCRIPTION

A. GPS Wireless Clock System shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.

B. The System shall provide wireless time using GPS and be synchronized to UTC. The system shall not require hard wiring. Clocks shall automatically adjust for Daylight Saving Time.

C. Analog Clocks shall be synchronized to within 10-milliseconds 6-times per day, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.

D. The System shall include an internal clock reference so that failure of the GPS signal shall not cause the clocks to fail in indicating time.

E. The System shall incorporate a “Fail-Safe” design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal Operation without the need to reset the system or any component thereof.

F. Clock Locations shall be as indicated, and clocks shall be fully portable, capable of being relocated at any time.
G. The System must operate in accordance with a “Radio Station Authorization”, Form FCC 601 – LM, granted by the Federal Communications Commission (FCC). This license will be issued to and held by the end user.

1.10 REGULATORY REQUIREMENTS

A. Equipment and Components Furnished shall be of Manufacturer’s latest model.

B. The End User Will Hold a License, known as a “Radio Station Authorization” granted by the FCC.
   1. This license grants the end user protected use for wireless transmission at the designated frequency.
   2. This license will designate a unique “call sign” for each end user.

C. Transmitter and Receiver shall comply with Part 90 of FCC rules as follows:
   1. This device may not cause harmful interference, and
   2. This device must accept interference received, including interference that may cause undesired operation.
   3. Transmitter frequency shall be governed by FCC Part 90.35.
   4. Transmitter output power shall be governed by FCC Part 90 257 (b)

D. System shall be installed in compliance with Local and State Authorities Having Jurisdiction.

E. Operating License: Submit evidence of application for FCC Radio Station Authorization prior to installing equipment. Furnish the license or a copy of the application for the license, to the District/End User prior to operating the equipment. The original license must be delivered to the District/End User.

F. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.

G. Manufacturer’s Instructions: Submit complete installation, set-up and maintenance instructions.

H. Floor Plans indicating the location of system transmitter(s), approved by Manufacturer, will be submitted to District prior to installation.

1.11 QUALITY ASSURANCE

A. Permits: Obtain Operating License for the Transmitter from the FCC.
   1. Qualifications:
      a. Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented experience including 4 years’ experience producing GPS wireless time systems.
      b. Installer: Company with documented experience in the installation of commercial time systems.
   2. Prior to installation, a site survey must be performed to determine proper transmitter placement.
1.12 DELIVERY STORAGE AND HANDLING

A. Deliver all Components to the Site in the Manufacturer's original packaging. Packaging shall contain Manufacturer's name and address, product identification number, and other related information.

B. Store Equipment in finished building, unopened containers until ready for installation.

1.13 PROJECT SITE CONDITIONS

Clocks shall not be installed until painting and other finish work in each room is complete. Coordinate installation of GPS receiver for access to the roof or exterior side wall so that the bracket and related fasteners are watertight.

1.14 SYSTEM STARTUP

At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all clocks are functioning.

1.15 WARRANTY

Manufacturer will provide a 1-year warranty on GPS receiver, transmitter, and satellite transmitter. All other components will have a 1-year warranty.

Part 2 - PRODUCTS

2.01 MANUFACTURER


2.02 SEQUENCE OF OPERATION

A. Transmitter Operation: When power is first applied to the transmitter, it checks for and displays the software version. It then checks the position of the switches and stores their position in memory. The transmitter looks for the GPS time signal. Once the transmitter has received the GPS time, it sets its internal clock to that time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock every time it receives valid time data from the GPS.

B. Analog Clock Operation:

1. Apply power or insert batteries. Follow set up procedures detailed in Manufacturer’s instructions.

2. After initial setup, the clock will shut off the receiver. Six times each day, the microprocessor will activate the receiver and starting with the stored channel, it will again look for a valid time signal. If necessary, the clocks will resynchronize to the correct time.

3. If the clock has not decoded a valid time signal for a pre-determined number of days, it will go to a step mode. Non signal reception can be caused by low battery voltage. If this occurs, replace the batteries.
2.03 EQUIPMENT

A. General: The Clock System shall include a transmitter, a roof or window mounted GPS receiver, indicating clocks, and all accessories for complete operation.

B. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.

C. The GPS Receiver cable must be plenum rated where required by local code.

D. Transmitter: Primex Wireless Model 14400, consisting of wireless transmitter with GPS receiver, a surge suppressor/battery backup, and a mounting shelf. The unit shall obtain current atomic time from satellite. The clock system shall transmit time continuously to all clocks in the system.

1. Transmission:
   a. Frequency Range: 72.100 to 72.400 MHz.
   b. Transmission Power: 1 watt (30dBm) maximum
   c. Radio technology: Narrow band FM
   d. Number of channels: 16
   e. Channel bandwidth: 20kHz maximum
   f. Transition mode: One-way communication
   g. Data rate: 2 KBps
   h. Operating range: 32 degree F to 158 degrees F (0 degrees C. to 70 degrees C).

2. Transmitter:
   a. Transmitter output power: +26 to +30 dBm
   b. Frequency deviation: +/- 4 kHz
   c. Transmitter power requirements: 120 VAC 60 Hz
   d. Internal power requirements: 5 VDC
   e. Carrier frequency stability: +/- 20 ppm

3. Transmitter shall have 16-selectable channels to assure interference-free reception.

4. Transmitter shall have the following switches:
   b. Daylight Saving Time bypass switch.
   c. 12-hours or 24-hours display.

5. Transmitter housing shall be black metal case, 16-3/4 inches (424.4mm) by 12 inches (304.8mm) by 1-7/8 inches (46.4mm) in size.

6. Antenna shall be 46-inches (1168mm) high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be < 2.2 dB. Antenna polarization shall be vertical.

7. Transmitter housing shall incorporate a display which shall include the following:
   a. Time readout
   b. AM and PM indicator if 12-hour time display is set
   c. Day and date readout
   d. Indicator for daylight savings or standard time
   e. LED which shall flash red in event of reception problem
   f. GPS reception indicator

8. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.
9. Power supply (included):
   Input: 120 volt AC 50/60 Hz, 0.4 amps.
   Output: 9 volt DC, 1.5 amps.

E. Surge Protector/Battery Backup (included).
   Input: 120 volt AC 60 Hz +/- 1 Hz.
   Output: 120 volt AC, 500VA, 300 watts
   Surge Energy Rating: 365 joules

F. Additional Equipment
1. Wireless Receiver Switches: Switches shall receive time packets from the Primary Transmitter and relay the synchronized time to the Satellite Transmitter connected to it. The unit shall include the following:
   a. Antenna mounted on top of the switch housing, 11½-inches (292mm) long.
      Power Supply:
      · Input: 120 VAC 50/60Hz, 0.4 amps
      · Output: 9 volt DC, 1.5 amps
      · RS 232 data cable, 5 feet (1.5mm) long
   b. Daylight Savings Time bypass switch
   c. Dimensions: 4¼-inches (108mm) long, 5¾-inches (146mm) wide, 1¼-inches (31.75mm) deep.
   d. Weight: 12 ounces (.34kg)
   e. Operating Range: 32 degrees F to 158 degrees F (0 to 70 degrees C)

2. Satellite Transmitters Primex Wireless Model 14401: Satellite Transmitters shall receive the signal from the Wireless Receiver Switches and transmit the signal to the devices in its vicinity, which are out of the range from the Master Transmitter. The unit shall include the following:
   a. Antenna mounted on top of the housing, 46 inches (1168mm) long.
   b. Wireless Receiver Switch.
   c. Power Supply Input: 120 VAC, 50/60Hz, 0.4 amps
   d. Output: 9 volt DC, 1.5 amps.
   e. 6 foot (1.83m) cord
   f. Surge Suppressor/Battery Backup
   g. Mounting Shelf.
   h. Transmission Power: 1 watt maximum
   i. 72 MHz frequency.

3. Traditional analog clocks (battery): Analog clocks shall be wall mounted. Clocks shall have polycarbonate frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black.
   a. 9 inches (228.6mm) diameter analog clock: Primex Wireless Model 14280
   b. 12½-inch (317.5mm) diameter analog clock: Primex Wireless Model 14155
   c. 16 inches (406.4mm) diameter analog clock: Primex Wireless Model 14163
   d. 24 inches (610mm) diameter analog clock: Primex Wireless Model 14346

4. Additional colors, finishes, and dial faces are available from Manufacturer.
   a. Analog clocks shall be battery-operated,
   b. Analog clocks shall be capable of automatically adjusting for Daylight Saving Time. An on-off switch located on the transmitter shall disable this function if desired.
   c. Time shall be automatically updated from the transmitter 6 times per day.
   d. Analog clocks shall remember the time during changing of batteries.
e. 9 inches (228.6mm) and 12.5 inches (317.5mm) analog clocks shall have a tamper proof/ theft resistant clock lock mounting slots.

5. Analog clock receivers shall be as follows:
   a. Receiver sensitivity: >-110 dBm
   b. Receiver power: 24 VAC or 120 VAC (see model #)
   c. Antenna type: internal
   d. Antenna gain: -7 dBi

   If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. If signal transmission is not restored after 96 hours, the second hand will “five step” as a visual indicator that the signal has been lost. Should the clocks lose power and signal, the clocks will not function.

6. Wire guards: Provide one for each analog clock as follows:
   a. Analog clock wire guard Primex Wireless Model 14131, 14-inches by 14-inches (355.6 by 355.6 mm) size, for nominal 12½-inch (317.5 mm) diameter analog clocks.
   b. Analog clock wire guard Primex Wireless Model 14123, 18-inches by 18-inches (457.2 by 457.2mm) size, for 16 inches (406.4mm) diameter analog clocks.

7. Cable Connection Sealant: Radio Shack Coaxial Cable Connector Sealant 278-1645, or approved electrical grade silicone sealant.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.

B. Verify that 120-volt electrical outlet is located within 6 feet (1.83m) of location of transmitter and the outlet is operational and properly grounded.

3.02 INSTALLATION

A. Provide All Equipment necessary for a complete and operable system.

B. Transmitter:
   Locate transmitter where indicated, a minimum of 2 feet to 3 feet (.6 to 1 meter) above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls. Transmitter(s) will be placed at locations indicated below:
   1. Attach receiver to transmitter using cable.
   2. Connect antenna to transmitter, using care not to strip threads.
   3. Connect power supply to the transmitter. Set the channel number on the display to correspond to the FCC license.
   4. Plug power supply into electrical outlet.

C. Analog Clocks shall perform the following operations with each clock:
   1. Set clock to correct time in accordance with Manufacturer’s instructions.
   2. Observe analog clock until valid signals are received and analog clock adjusts itself to correct time.
   3. Install the analog clock on the wall in the indicated location, plumb, level and tight against the wall. If using 12½-inch (317.5mm) clock, attach using clock-lock hanging method and suitable fasteners as approved by Clock Manufacturer.
4. Wire guards: Secure to wall, using approved theft-resistant fasteners.

3.03 ADJUSTING

A. Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.

3.04 CLEANING

A. Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by Clock Manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.05 DEMONSTRATION

A. Provide Training to District’s Representative on setting and adjusting clocks, replacing batteries and routine maintenance.

3.06 PROTECTION

A. Protect Finished installation Until Final Acceptance of the Project.

3.07 TESTING

A. All Devices must be tested at their operational location under normal operational conditions to assure reception of signal.

END OF SECTION 27 5313
112316/223037
SECTION 28 1600

INTRUSION DETECTION SYSTEM

PART 1 GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26 0000, 27 0000, and 28 0000.
   2. General provisions and requirements for electrical work.

1.02 QUALIFICATION OF BIDDERS AND EQUIPMENT

A. To qualify as an acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-contractor, the System Bidder or Contractor shall be Qualified Contractor and shall hold a valid License issued by the State of California Department of Consumer Affairs Collection and Investigation Services for the purpose of installing security systems. The System Bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted Authorities Having Jurisdiction over the work. The Contractor shall be the Factory Authorized Distributor for the branch of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment. The Contractor shall be financially able to provide a performance bond covering the work and the guarantee described. The Contractor shall provide that bond if requested.

B. The Equipment specified herein shall be DMP #XR-500N or equal.

C. The System shall be serviced by a field supported 2-year warranty.

D. The Specification is based on the Equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance Specifications which are published in the most recent Manufacturers data sheets available at the time of bidding this Project shall be applicable to the present work as though fully written out herein.

E. All Equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.

F. Installation Certification
   1. Work and Material for Cables, cable terminations and related components shall be performed by certified Installers. The Installer shall be certified by the respective Product Manufacturers.
   2. The Manufacturers of the indicated work and material shall provide an Installer education/training and Certification Program for the supplied products.
3. The Installers performing the Contract Work for the indicated products shall have attended and successfully completed each of the respective Manufacturer's installation Training Education Programs for the specified products.

4. Submit six copies of the Manufacturer's Certifications for each Installer performing the work. The submittal shall be approved prior to initiating any related Contract Work.

5. Contract material installed and work performed by Installers not complying with these requirements shall be removed. Removal of work and material not in compliance with these requirements shall be done at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions. New material and work required to replace the non-compiling removed work and material shall be provided at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions.

1.03 PERFORMANCE REQUIREMENTS

A. Provide Main Control Panel, Terminal Cabinets, Keypads, and Site Underground Conduits as indicated.

B. Provide Motion Sensor(s) in each room having exterior doors, exterior glass, or skylights. Quantity of sensors in each room shall be as required to detect entry through exterior doors, exterior glass, or skylights.

C. Provide a Magnetic Switch at the entry door to each building, near its respective keypad. Connect to the system to initiate a timing circuit for keypad operation.

D. Provide Magnetic Switches at roof hatches.

E. Provide all conduits, cabling, and outlet boxes required for a complete and operable system.

F. Meet with Representatives of the District at a time and location convenient to the District. Advise the District of programming options and incorporate all requirements onto the Shop Drawings before submittal to the Architect.

1.04 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit Evidence of having met with District Representatives as specified herein.

B. Submit Product data sheets for all switches, keypads, wiring devices, device plates, controllers, power supplies, cabinets, etc.

C. Submit detailed Shop Diagrams including Dimensioned Plans, elevations, details, schematic and point-to-point wiring diagrams and descriptive literature for all component parts and cabinets.

D. Submit six copies redrawn Building Floor Plans showing all components of the intrusion detection system including interconnecting cabling and conduits. Sensors shall be located on the Drawings in the location conforming to the requirements stated herein. Drawings shall be prepared to scale and show all exterior glass, exterior doors, all interior and exterior building walls, roof hatches, architectural and
structural elements relevant to the installation of the system. Each zone shall be shown on the Plans.

PART 2  PRODUCTS

2.01 SYSTEM FUNCTIONS

A. Provide a Complete and Operable Supervised Intrusion Detection System as shown on the Plans including but not limited to master control panel, key pad stations, motion detectors, connections to door switches, a State Fire Marshal listed digital communicator and an automatic dialer.

B. Upon Detection of an intruder by initiation of any device in the system, the system shall cause the annunciator LED to light and sound an alarm signal on the school's telecommunication system. Alarm information shall be sent by digital dialer to Central Station Alarm Monitoring Agency.

C. Systems shall detect the motion of a body taking not more than four steps in an area secured with motion detection equipment where entry doors or windows are possible access.

D. Each Building Area shall be on a separate zone with each zone controlled separately so that any building area may be secured while others remain unsecured.

E. The System shall be capable of off-site computerized access for remote access, programming and control.

2.02 CONTROL PANEL

A. Control/Communicator Panel shall be a DMP control panel with an integral digital communicator and shall be Underwriters Laboratories listed. All external circuit connections shall be UL listed as power limited in accordance with the provisions of Article 760 of the California Electrical Code (CEC).
1. Provide Point of Protection (POPEX) modules at the control panel for Popit module supervision.
2. Provide Point of Protection Identification Transponders (Popit) modules at building terminal cabinets to individually identify each detector in the system.

B. The Control/Communicator shall be IP based.

C. System shall include the following features:
1. Real time clock and test timer.
2. Battery charging circuit.
3. Battery voltage supervision.
4. Supervised automatic reset circuit breakers.
5. Onboard warning buzzer and diagnostic LEDs.
6. Automatic answer modem.
7. Lightning and RFI protection.
8. Central Station reporting format.
9. Printer/CRT interface module for on-site serial data printer recording or CRT display of events.
10. Quad serial output module for enhanced serial data interface capability for specific accessory modules and devices.
11. Individual zone responses.
12. Custom annunciator text.
13. Audible alarm output, steady or pulsed.
15. Attack-Resistant enclosure and lock meeting Underwriters Laboratory Local Burglary requirements.
16. A minimum of eight auxiliary form "C" dry contacts for a variety of programmable responses to alarm and trouble conditions.
17. Transformer enclosure for internal mounting of Class 2 transformer.
18. Two telephone numbers with selective signaling options.
20. Automatic test reports.

2.03 BAR-CODE PROGRAMMER FOR DIAGNOSTICS AND PROGRAMMING CAPABILITY.

2.04 RECEIVER

A. Receiver shall be Bosch Security System #D6600 Series, UL listed for fire and intrusion detection.
B. Provide a 50VA Class 2 plug in transformer for power input.
C. System shall contain 48 hours of standby power utilizing rechargeable sealed lead acid batteries and a battery charger.
D. System shall be FCC approved for telephone connections.
E. An Alphanumeric LCD Display shall indicate account number, area number, time, date, event, zone or point number, line or group number, status and external devices.
F. Twenty-four hour Clock and 128 year calendar.
G. Forty Character Line internal printer and interface capability with an external serial printer.
H. Transmission verification appropriate with the format utilized.
I. Storage of 249 separate events.
J. Transmission Format shall support the control panel.
K. Turn the Receiver over to the District for Central Station or Campus Monitoring.

2.05 REMOTE ACCOUNT MANAGER

A. System shall be Bosch Security Systems #D5300 Series or equal with all equipment necessary for computerized access, programming, diagnostics, and remote control of the system. It shall be possible to remotely change passcodes, locate faults, shunt problem zones, arm and disarm the system, silence alarms, and control the auxiliary output contacts in the control panel.
B. System shall permit remote diagnostics including utility and battery power conditions, phone line condition, event memory by zone, and current clock and calendar settings.
C. System shall be 100% IBM compatible for use with personal computers.

D. System shall include a plug-in modem and software necessary for a complete and operable installation. Furnish the District with a Software License Agreement for updated software enhancements as they develop.

2.06 KEYPADS

A. Master Keypad shall be DMP or equal capable of displaying system status and controlling the alarm system. Unit shall receive its operating power from the main control panel. Keypad shall be flush-mounted on a wall near the entry doors of each building. Faceplate shall be brass or stainless steel as selected by the Architect.

B. Sub-Zone Keypads shall be DMP or equal to allow individual zones to be bypassed. Keypad shall be flush wall where shown on Plans Faceplate shall be brass or stainless steel as selected by the Architect.

2.07 MOTION SENSORS

Motion sensors shall be Honeywell DT-7450 with Bosch B328 mounting bracket. Sensors shall be dual performance, dual event devices to minimize false alarms or equal passive infrared devices detecting thermal motion signals. Sensor coverage patterns shall be as required for optimum coverage at each individual location. Sensor shall be adjustable Gimbal mounted with plate and outlet box. Provide an attack resistant enclosure DS AE774 at Multipurpose and Gymnasium areas.

2.08 MAGNETIC SWITCH

Magnetic switch shall be fully concealed in the door frame, Admeco, Sentrol or equal.

2.09 INTRUSION DETECTION SYSTEM

Each intrusion detection system terminal cabinet shall contain a power supply for motion sensors and/or POPIT/POPEX (Zonex) modules.

2.10 CABLING

Cabling shall be as required for system operation. All cabling shall be shielded.

2.11 SIREN

Siren shall be ATW (mascon) PR-D550PW or equal.

PART 3 EXECUTION

3.01 CONNECTIONS

All connections throughout the system shall be soldered, crimped by means of AMP lugs, fastened with screw type terminals, made by spring tension clip "punch block" terminals or make by standard plugs and receptacles. Each wire twisted pair or cable shall be tagged throughout the site with EZ Markers with the room number it serves. All conductors in terminal cabinets shall be carefully formed and harnessed in a workmanlike manner.
3.02 SYSTEM CABLING

All system cabling shall be installed in conduit except where wiring occurs above accessible ceilings. Wiring not in conduit shall be UL listed plenum-type cable. All wiring in walls shall be in conduit. All conduits shall be run concealed. Where Architecture precludes concealed conduits, run conduits on top of beams or trusses and minimize the exposure to view. Identify on the submittal Drawings all locations where conduits must run exposed.

3.03 MOTION SENSORS

Locate motion sensors to provide optimum coverage of the space and to avoid conflicts with the architectural aesthetics of the building. Submittal Drawings shall show the exact locations of all system sensors and keypads for approval by District's Maintenance Managers.

3.04 CONCEALED DOOR SWITCH

Coordinate concealed door switch installations with Finish Hardware Manufacturer.

3.05 SYSTEM PROGRAMMING

Provide all system programming as required by the District's Maintenance Managers, including the necessary product handlers, so that all parameters are entered into the system and the annunciator displays a text, which is customized to the facility.

3.06 SYSTEM TESTING AND DOCUMENTATION

A. Before the Contract shall be considered complete, the Contractor shall program the system per District requirements and demonstrate the performance of the system in the presence of the District. The Contractor shall provide all test and reception gear required to prove the performance as outlined.

B. Actuate Motion Sensing Devices and Verify that the system performs as specified.

C. The Communication Loops shall be opened in at least two locations per building to check for the presence of correct supervisory circuitry.

D. When the Testing has been completed to the satisfaction of both Contractor's Job Foreman and the Representatives of the Manufacturer and the DSA Inspector, a notarized letter co-signed by each attesting to the satisfactory completion of said testing shall be provided by the Contractor and forwarded to the Architect.

3.07 INSTRUCTIONAL TRAINING

Provide a minimum of two 4-hour periods to instruct District Personnel in proper operation of all systems. The first instructional period shall be held prior to final acceptance of the systems. Instructional training shall be done at the project site and shall be conducted by factory-trained Technical Personnel. Furnish the District with videotape VHS cassette(s) of the first instruction session. The second instructional period shall be within a period of 1-year after final acceptance of the systems, upon request of the District.

END OF SECTION 28 1600

112316/223037
SECTION 28 3100

DIGITAL ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. Work Included: All labor, materials, appliances, tools, equipment necessary for and incidental to performing all operations in connection with furnishing, delivery and installation of the work of this Section, complete, as shown on the Drawings and/or specified herein. Work includes, but is not necessarily limited to the following:
   1. Examine all other Specifications Sections and Drawings for related work required to be included as work under Division 26, 27, and 28.
   2. General provisions and requirements for electrical work.

1.02 SUBMITTALS (ADDITIONAL REQUIREMENTS)

A. Submit eight copies of the following to the Architect for approval.
   1. A listing of all fire alarm components and equipment including the California State Fire Marshal (CSFM) listing numbers.
   2. CSFM listing sheets of all devices being used.
      a. The submittal shall be arranged in the order of the Specification and shall list the Specification paragraph number, the name, the proposed model and Manufacturer for each item as well as a reference indicating the specific piece of data which can be easily located in the brochure.
      b. The Manufacturers’ data sheets shall be marked to indicate the specific item being proposed in cases where the sheet covers several types or sizes of item. The data sheet shall completely describe the proposed item.
      c. Where modification to the equipment is necessary to meet the operational requirements of the Contract Documents, the data sheets shall include complete Mechanical and Electrical Shop Drawings detailing the modification.
   4. A listing of the outlet rough-in needed for every device and equipment item. The applicable symbol which illustrates that rough-in item on the Job Plans shall be drawn on the proposal, opposite the description of the rough-in to facilitate locating the data by Field Personnel.
   5. Elevation and dimensional information.

1.03 APPLICABLE STANDARDS

A. The Equipment shall be listed, labeled, and approved for the application shown in Contract Documents, as fire alarm equipment complying with the following requirements:
   1. List of applicable Codes as of January 1, 2014:
      a. 2013 Building Standards Administrative Code, Part 1, Title 24 C.C.R.
      b. 2013 California Building Code (CBC), Part 2, Title 24 C.C.R.
      c. 2013 California Electrical Code (CEC), Part 3, Title 24 C.C.R.
      d. 2013 California Mechanical Code (CMC), Part 4, Title 24 C.C.R.
      e. 2013 California Plumbing Code (CPC), Part 5, Title 24 C.C.R.
      f. 2013 California Fire Code (CFC), Part 9, Title 24, C.C.R.
2. NFPA Standards and Guides:

3. The fire alarm system shall conform to the applicable Standards and Guides referenced in CBC Chapter 60.

B. Written Certification by the Fire Alarm Equipment Manufacturer shall be submitted to the Architect, stating that the system and its component parts are listed and approved by the California State Fire Marshal and the installation has been tested, is operational and conforms to the requirements as set forth in Part 3, Article 24, Title 19, California Code of Regulations.

1.04 EQUIPMENT AND INSTALLING QUALIFICATIONS

A. The equipment shall be manufactured by Simplex to match existing fire alarm equipment on campus.

B. The Specification is based on the equipment of Manufacturers who have been approved by the District and the Manufacturers herein named shall be considered as meeting the requirements of this Specification. For all items which are identified by part number and Manufacturer the Performance Specifications which are published in the most recent Manufacturer's data sheets available at the time of bidding this Project shall be applicable to the present work as though fully written out herein.

C. All equipment shall conform to all local applicable Codes and Ordinances, and shall be listed by Underwriters Laboratories.

D. To qualify as an acceptable Bidder, whether the bid is submitted to the District, his Agent, a General Contractor or a Sub-Contractor, the System Bidder or Contractor shall be qualified Fire Alarm Contractor and shall hold a valid C10 License issued by the Contractors State License Board of California. The System Bidder or Contractor shall hereinafter be referred to as the Contractor. The Contractor shall hold all other licenses required by the legally constituted authorities having jurisdiction over the work. The Contractor shall be the Factory Authorized Distributor for the branch of equipment offered and shall have been engaged in the business of supplying and installing the specified type of system for at least 5-years. The Contractor shall maintain a fully equipped service organization capable of furnishing adequate repair service to the equipment. The Contractor shall be financially able to provide a performance bond covering the work and the guarantee described. The Contractor shall provide that bond if requested.
E. Installation Certification

1. Work and material for cables, cable terminations and related components shall be performed by Certified Installers. The Installer shall be certified by the respective Product Manufacturers.

2. The Manufacturers of the indicated work and material shall provide an Installer education/training and certification program for the supplied products.

3. The Installers performing the Contract Work for the indicated products shall have attended and successfully completed each of the respective Manufacturer's installation training education programs for the specified products.

4. Submit six (6) copies of the Manufacturer's certifications for each Installer performing the work. The submittal shall be approved prior to initiating any related Contract Work.

5. Contract material installed and work performed by Installers not complying with these requirements shall be removed. Removal of work and material not in compliance with these requirements shall done at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions. New material and work required to replace the non-compiling removed work and material shall be provided at the CONTRACTOR'S expense, without any additional cost to the Contract and without any additional Contract completion due date extensions.

PART 2 - PRODUCTS

2.01 GENERAL SYSTEM OPERATION

A. System shall be microprocessor-based, addressable, and power-limited with Class A or Class B supervised circuits.

1. The microprocessor shall execute all supervisory and control programming to detect, report the failure or disconnection of any system module or peripheral device and initiate programmed control sequences. An isolated supervision "watchdog" circuit shall monitor the microprocessor and, upon failure, shall activate the system trouble circuits.

2. The automatic fire detection and alarm system shall consist of main control panel, transponder panel(s), notification alarm devices, remote annunciator, automatic detection devices, manual stations, printer, and CRT/keyboard, installed and wired in accordance with the Drawings and shall function as specified herein.

3. The system shall be programmable in the field, by a non-computer trained person. All programmed information shall be stored in non-volatile memory.

4. The system shall operate both addressable and non-addressable ionization, thermal and photoelectric detecting devices, manual stations, water-flow switches, and external control modules.

5. The control panel shall provide power, annunciation, supervision and control for the fire detection and alarm system. The system shall be designed such that alarm indications override trouble and control conditions.

6. External circuit supervision shall not require additional wires other than the pair used for detection or alarm (only two wires shall be used from the control panel to each loop of initiating devices and two wires for the notification alarm devices). These two wires shall provide both supervision and notification alarm signals. There shall be no loss of supervision for Class "B" wired addressable devices. Class "A" supervision may be provided by adding an additional pair of wires.
B. Alarm Conditions
   1. Actuation of any manual or automatic alarm initiating device, connected to the system shall cause the following automatic functions.
      a. All notification alarm signaling units shall activate continuously. Audible notification alarms shall sound the California State Coded Signal.
      b. The respective zone alarm lamp or annunciator alpha numeric readout on the central control panel, and remote annunciator panel, shall be activated.
      c. Activate the Digital Alarm Communicator system.
   2. Actuation of HVAC air duct smoke detectors shall stop the designated fans and motors in the building's air distribution system.
   3. Actuation of smoke detectors on either side of smoke doors shall energize the release mechanism on the smoke door causing the door to close.
   4. Notification alarm signal duration shall be capable of continuous sounding or adjustable from three to 10-minutes.
   5. Perform any additional functions as specified herein or shown on the Drawings.

C. Trouble Condition
   1. A single open or single trouble condition in a manual or automatic fire initiating wiring circuit shall activate the respective zone trouble lamp or annunciator readout on the fire alarm control panel and sound a trouble signal at the control panel.
   2. A single open or single trouble condition in the notification alarm signaling wiring circuit shall activate the trouble lamp or annunciator readout in the control panel and sound a trouble signal at the control panel.
   3. 120 volt AC normal power shall be monitored with indication by a "power on" lamp. Upon normal power outage, the system shall activate a power trouble condition lamp or annunciator readout, and indicate a trouble condition.
   4. The control panel shall monitor the standby batteries and, upon a low battery condition, activate the low battery lamp or annunciator readout and indicate a trouble condition.
   5. System ground detection shall be provided for the entire system. Upon ground detection, activate the ground detection lamp or annunciator readout and indicate a trouble condition.

D. Control panels employing alphanumeric readouts shall display the trouble condition along with a prompt to review the list chronologically. The end of the list shall be indicated.

2.02 FIRE ALARM CONTROL PANEL

A. General
   1. The fire alarm control panel shall be software programmable, microprocessor controlled, solid state, electronic integrated system. The panel shall be the product of one Manufacturer. The control panel shall provide power, annunciation, supervision and control for the detection and alarm system. The detection system shall remain 100% operational, responding to an alarm condition while in the routine maintenance mode.
   2. Addressable detection and control devices shall be individually identified by the system, and any quantity of addressable detection devices shall be in alarm and any quantity of addressable control units shall be operable at any time up to the total number connected to the system.
3. The microprocessor shall access the system program, which is stored in non-volatile programmable memory, for all Control-by-Event (CBE) functions. The system program shall not be lost upon failure of both primary and secondary power. Volatile memory shall not be acceptable.

4. A means shall be provided for acknowledging each abnormal condition. Each activation of the appropriate acknowledge button shall sequentially acknowledge every point in the system. After all the points have been acknowledged, the LEDs shall glow steady and the panel audible signal will be silenced. The total number of alarms, supervisory, and trouble conditions shall be displayed along with a prompt to review each list chronologically. The end of the list shall be so indicated.

5. An alpha numeric annunciator readout shall indicate on the control panel the activation by type, loop, and address of the specific device, sub-loop or alarm/monitor/control point via an alpha numeric display. An audible alert shall sound at the control panel and an alarm light shall flash.

6. If the microprocessor fails, the system shall execute a default signaling program. This program shall enable the control panel to sound the audible signals and summon the Fire Department. In addition, a red LED shall light to indicate the communication loop wherein the alarm originated. Inability of the system to sound signals or summon the fire department during microprocessor failure shall not be acceptable.

7. Protected access to the system controls shall be provided to allow the user/operator access to the following system functions:
   a. Status of all addressable points.
   b. Status of all events logged.
   c. Set/change the real-time clock and date.
   d. Perform an operational manual test of the system from the control panel, including actuation of any initiating device and trouble circuit without alarming the remote central station. The panel shall automatically return to normal mode in the event the panel remains unattended in the service mode.
   e. Retrieve from event log the last 300 alarms, or control points and 300 trouble conditions.

8. Individual input (monitor) and output (control) device addressability shall all be performed on the same pair of wires. Wiring shall be Class "A" or "B". When Class "B" wiring is used, no special wiring sequence shall be required on addressable device circuits. An unlimited number of wiring branches shall be permitted with no loss of supervision.

9. A minimum of 25% addressable monitor, trouble and control points shall be provided.

B. Cabinet
   1. A metal tamper resistant cabinet shall contain the control panel components. Panel shall be surface or flush mounting as indicated on the Drawings. Provide a full height tamper resistant hinged locking cabinet door. The door shall have transparent, high impact windows to allow visual observation of all indicators and switches without opening the panel door.
   2. "In-out" circuit conductors shall terminate on numbered screw-type terminals.
   3. All groups of circuits or common equipment shall be clearly marked and shall be expandable by inserting interchangeable units.
C. The control panel shall provide positive protection against the fire alarm system inadvertently being left in a non-operating status. The alarm system shall automatically restore and resound alarms and trouble signals, if subsequent alarm initiating or trouble signals are received under any of the following conditions:
1. After the alarm or trouble silence switch have been activated.
2. Prior to resetting system after previous alarm or trouble conditions.

D. The system indicating and operational control devices shall be mounted on the control panel face behind the panel door and shall provide the following minimum functions:
1. Individual visual indicating pilot lights annunciator or alpha numeric readout to monitor the following alarm system conditions:
   a. Input power.
   b. System common alarm.
   c. System common trouble.
   d. Alarm or trouble signal silenced.
   e. Ground fault.
   f. Battery condition.
   g. Each individual alarm, control or initiating zone-activation.
   h. Each individual alarm, control or notification zone-trouble.
   i. Report, by specific device number, any device removed from an addressable initiating circuit, all other devices shall continue to function.
2. Manual control switches to allow the following system controls:
   a. Alarm silence.
   b. Trouble silence.
   c. Test all indicating pilot lights and readouts.
   d. System reset, including remote devices connected to the alarm panel.
   e. Alarm test to initiate an alarm condition from the control panel.
   f. Alarm disconnect for system testing without activating the Digital Alarm Communicator system.
   g. Changing the status of configured circuits (arming or disarming and changing status of relays). If any change in status degrades system operation as configured, a trouble condition shall be reported and remain until system operation again meets configured status.
   h. Perform multiple operations at the same time. These operations shall include but not be limited to timed functions and multiple configured sequences.

E. Alarm initiating zone modules.
1. Shall supervise and accept remote alarm actuating device input signals. An alphanumeric readout shall indicate separate zone alarm and trouble indicators for each zone.
2. Zones shall be compatible, and designed to operate with the connected initiating devices either addressable or non-addressable type.
3. A spare double throw set of software programmable auxiliary alarm relay contacts shall be provided for control of remote devices for each zone. Contacts shall be rated 120-volt, 60 Hz 3 Ampere.
4. Each device on the system shall report as its own unique address.

F. Notification alarm signal control.
1. Shall supervise and activate remote notification alarm devices.
2. Notification alarm shall be compatible and designed to properly operate with the connected audio and visual notification alarm devices, with no signal degradation.
3. The notification alarm shall provide group notification signal control of all notification zones.
4. The alarm modules shall be field resettable to provide either continuous or Coded notification alarm signals. The Coded alarm signal shall provide an intermittent "on-off" pulsed sound activation of audible notification alarm devices.
5. A notification alarm circuit trouble indicating readout shall be provided for each notification zone.

G. Automatic ground detection shall detect either positive or negative voltages when earth connections of 50,000 OHMS or less occur, and activate the ground trouble signal.
1. A Ground Fault Code shall provide indication of either a positive or negative ground fault and shall operate the general trouble devices as specified herein but shall not cause an alarm to be sounded.
2. A short circuit error message shall be a standard feature of the fire alarm control panel. Each communication loop shall be monitored for short circuits and shall have a distinctive error message for visual indication of circuits and operating trouble devices as specified herein but shall not cause an alarm to be sounded.

H. Power Supply
1. The power supply shall be adequately sized to properly operate the equipment, including remotely connected, spare and future indicated equipment with all alarm devices in alarm condition. Provide 20% spare power supply capacity for future expansion. Provide transfer modules and multiple power supplies as required for proper operation.
2. Input voltage 120/240 volt or 120/208 volt 60 Hz AC.
3. Surge transient voltage protection on the input and output phases of the power supply shall be provided.
4. Supervised voltage types (i.e., 120V-60HZ AC, 24 volt AC, 24 Volt D.C., etc.) required by special connected equipment shall be supplied, including but not limited to:
   a. Alarm initiating devices.
   b. Notification alarm devices.
   c. Control and annunciator panels.
   d. Fire and smoke dampers.
5. A solid-state power transfer circuit shall provide (UPS) Uninterrupted Power Supply between internal standby power and line power automatically and instantaneously if normal power fails or falls below 15% of normal ("brown out" conditions).
6. Individual circuit fuses shall be provided for smoke alarm detector power, main power supply notification circuits, battery standby power, and auxiliary output.

I. Battery Back-Up Operation
1. Internal batteries and battery power supplies shall be provided to allow 60 hours continuous automatic normal operation of the entire control panel and fire alarm system after the failure of the incoming utility power. Sufficient battery capacity shall remain at the end of 60 hour period to provide ten minutes of continuous operation of all connected notification alarm devices.
2. Batteries shall be maintenance free, sealed, lead-acid or lead calcium or gelled electrolyte type rated 25% larger than required to provide power for the entire system upon loss of normal 120 VAC power for a period of 60-hours with 5-minutes of alarm signaling at the end of this 60-hour period.
3. The battery charger shall be automatic, dual rate with capacity to recharge completely discharged batteries in 18 hours. Charger shall be temperature compensated.

J. Lightning and transient voltage surge protection shall be a standard feature of the fire alarm control panel and shall be incorporated in the power supply circuit, common control circuits, signal circuits, and telephone line circuit.

K. Circuitry shall be provided in the control panel to permit transmission of trouble and alarm signals over leased or privately owned telephone cables to a remote receiving panel. A reverse polarity or a master box circuit as required shall be provided in the control panel. There shall be a supervised disconnect switch to allow testing of the fire alarm signal without transmitting an alarm signal to the central station.

L. The alphanumeric annunciator (printer and CRT/keyboard) shall list upon request:
   1. Alarms with time, date and location.
   2. Troubles with time, date and location.
   3. Status of output functions, "on" or "off".
   4. Sensitivity of addressable smoke detectors.
   5. Detection device number, type and location.
   6. Status of remote relays, "on" or "off".
   7. Acknowledgment time and date.
   8. Signal silence time and date.
   9. Reset time and date.

M. The system shall also provide the following:
   1. Counting the number of addressable detectors within a "zone".
   2. Which are in alarm.
   3. Counting "zones" which are in alarm.
   4. Counting the number of addressable detectors which are in alarm.
   5. Alarm on the system.
   6. Differentiating among types of addressable detectors such as smoke detectors, manual stations, water-flow switches, thermal detectors.
   7. Assigning priorities to types of detectors, zones or groups of detectors.

N. Control Functions
   1. Control functions shall be assigned on the basis of multi-relational system initiation patterns of detection devices including full logic element equations using as "anding" zones, counting zones, counting devices, "anding" groups, conditional "if", "then", "or" programming and "anding" types of detection devices.
   2. Control functions shall be assigned on the basis of, cycle, delay, count, time of day, day of week, day of month and with a holiday schedule of up to 30-holidays per year. Each addressable detection device shall report its condition to the system control unit not less than every 4-seconds in a manner such that failure of the connections to the internal electronics of the device will result in a trouble signal which identifies the specific device involved.
   3. The system shall be field programmable for the response of control points to monitored devices.
   4. The operating software program shall provide programmable control for the Event-Initiated-Programs (E.I.P.) which shall allow automatic operation of system control points in the event of an alarm condition. To program these E.I.P.’s, the system shall use a specifically designed user friendly programming language,
which shall not require a knowledge of computer programming to learn and understand.

5. The operating software shall support the following additional capabilities:
   a. Three levels of designated and unique Priority Alarms for each point.
   b. Designated "Sense Mode" for status interpretation for each point.
   c. Designated Print/No Print/Vectoring Mode for each point.

6. The input statement defines the conditions required to activate the associated output statement. The input statement shall consist of single or multiple monitor point status, subroutine status, time comparison and the utilization of AND, OR, NOT, COUNT, and DELAY logic functions.

7. The output statement defines the action to be taken by the control panel. The output statement shall consist of activation/deactivation of single or multiple control functions, subroutines, and remote Annunciator status LED's. Output statements shall also include the "Alert" messages.

8. The software shall provide an "alert" message, unique to each point in the system, which will provide specific instructions for the operator on duty. These messages shall be up to 5 lines with up to 70 characters in each line. Each system monitor point shall have 5 specific alert messages when in alarm. Control points shall also be assigned alert messages.

9. The hardware and software shall have the capacity to accept up to 64 independent programs. Each program shall have "Edit" or "No Edit" capability. Each program shall be written in an equation format comparable to ladder-logic equations. The Equations shall consist of an input and an output statement.

10. Provide initial programming services for coding, loading and debugging the initial Owner specified programs, as part of the Contract.

11. Programming Command Definition
   a. Timing command shall provide time delay and time control functions based on internal clock/calendar by time of day; day of week; day of month; month in year.
   b. Count command shall provide a specific number of events to occur before a control action is initiated.
   c. Pulse command shall provide on control for a specific period of time.
   d. Cycle command shall provide on-off control for preset periods of time.
   e. Print command shall provide printing of specified information after an event occurs.

2.03 FIRE ALARM DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Enclosure shall be red.

B. Panel shall be solid state with eight zones for off premise monitoring of the fire alarm control panel.

C. System shall monitor alarm and trouble conditions. System shall be power limited.

D. System shall include dual telephone line switcher for central station reporting. Telephone lines shall be supervised.

E. System shall include dual battery harness, batteries, and battery charger.

F. System shall be UL listed for central station fire signaling systems (NFPA 71).

G. System shall be California State Fire Marshal approved for Central Station Reporting.
H. System shall be Radionics D8112FA Series or Simplex 5071 Series. System shall be approved for connection to the fire alarm control panel.

I. Verify specific requirements with District and Central Station prior to submittals.

2.04 MANUALLY ACTIVATED ALARM INITIATING DEVICES

A. An electronic, digital multiplex, addressable module shall be incorporated into each device. The module shall communicate the status and trouble condition of each device with a unique Address Code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.

B. Devices shall be suitable for use on a Class "B", 2-wire supervised alarm initiating circuit.

C. Numbered screw type terminals shall be provided for "in-out" connections of the alarm circuit wiring.

D. The face of the station shall have lettering indicating "FIRE" and operational instructions. Stations shall be tamper resistant, semi-flush mounting.

E. Auxiliary spare switch contact shall be provided for control of remote devices rated 120 volts - 60Hz, AC - 3AMP minimum.

F. Stations shall provide visual indication the station has been activated. A key (and/or special tool) shall be required to gain access into the station to reset the station after being activated.

G. Stations shall be "non-break-glass" type.

H. RF and transient filtering shall be provided in the device electronics.

I. Pull stations shall be Non-Coded double action, requiring a two district manual "pulling" actions to initiate the fire alarm system.

J. Stations installed outdoors shall be weather resistant construction, double action to activate the pull station.

2.05 AUTOMATIC ALARM INITIATING DEVICES

A. General

1. An electronic digital, multiplex, addressable module shall be incorporated into each device. The module shall communicate the status and trouble condition of each device with a unique Address Code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.

2. Devices shall be suitable for use on a Class "B", 2-wire supervised alarm initiating circuit. Where initiating devices are shown connected to an existing system, devices shall operate on 2-wire or 4-wire circuits plus 2-wire power circuit as required by the existing equipment.

3. Numbered screw type terminals shall be provided for "in-out" connectors of the alarm circuit wiring.

4. Auxiliary double throw spare relay contact shall be provided for activation of remote rated devices 120V, 60Hz, AC - 1 Ampere minimum.

5. RF and transient filtering shall be provided in the initiating device electronics.
6. Initiating devices shall be reset from the control panel and shall not require individual resetting.

B. Smoke Detector
1. Detectors shall comply with UL standard 268, 167 and 168, and shall use solid state electronic circuits throughout.
2. The smoke detector shall operate on a total of two circuit wires. Alarm signaling and detector power shall use the same conductors. Detector sensitivity shall be factory set at 1.5%.
3. A fine mesh insect screen shall be provided on all detector openings.
4. The detector shall lock-in on alarm and shall provide a visual alarm/trouble indicator light. An electromechanical test feature shall provide functional testing of the unit without smoke.
5. The detector shall also incorporate a fixed temperature heat detector rated at 135 degrees F. The heat detector shall operate the alarm circuit and alarm/trouble light.
   a. Photo electric type smoke detectors shall employ a Light Emitting Diode (LED) as the detector light source, activated by the presence of combustion smoke products. Failure of the LED shall activate the alarm/trouble light on the detector.
   b. Ionization type smoke detector shall employ the triple chamber (dual chamber) ionization principle, activated by the presence of combustion products. The ionization chamber shall be RF shielded.
   c. Air duct smoke detector photo electric or ionization type for installation on a mechanical air ducts. Two air tubes shall extend into the air duct. The sampling tube shall extend across the entire width of the air duct. The second tube shall allow air to escape back into the duct.

C. Fire Detector - Heat
1. Heat detectors shall be dual action electro-thermostatic combination rate of temperature rise and fixed temperature operation. An indicator shall be visible when detector has activated.
2. The rate of rise element shall be self-restoring, after activation.
3. The fixed temperature unit shall be set at 136 degrees F (190 degrees F for high temperature areas i.e. over 110 degrees F.)
4. Provide a wire guard cover for the detector.

D. Fire Sprinkler Water Flow Detector.
1. Vane-type water flow detectors shall be provided on the sprinkler system piping as shown on the Drawings. Detectors shall be designed for mounting on either vertical or horizontal piping, but shall not be mounted in a fitting or within 12 inches of any fitting that changes the direction of water flow.
2. The detectors shall have a sensitivity setting to signal any flow of water that equals or exceeds the discharge from one sprinkler head.
3. Detector switch mechanisms shall incorporate an instantly recycling pneumatic retard element with an adjustable range of 0 to 70 seconds. Switches shall have a minimum rated capacity of 7 amp 125-volt, AC -.25 amp 24-volt, D.C. A D.P.D.T. switch shall be actuated by a polyethylene vane extending into the waterway of the piping.
4. Detectors shall be of weatherproof, dust tight construction and shall provide a ¾-inch conduit entrance. Detector shall be finished in red baked enamel.
5. Flow switch shall be sized to match the fire sprinkler riser pipe diameter.
E. Fire Sprinkler Valve Tamper Switch
   1. Tamper switch shall monitor the position of the fire sprinkler shut-off valve. Operation of the valve shall activate the switch and activate a trouble alarm.

2.06 NOTIFICATION ALARM DEVICES

A. General
   1. Notification alarm devices shall activate automatically from the control panel. Devices shall operate on a Class "B" (Style Y), 2-wire supervised alarm notification circuit. Series wired alarm devices shall not be used.
   2. Numbered screw type terminals shall be provided for "in-out" connections of the alarm circuit wiring.
   3. Devices shall be installed in a box, 3½-inches deep maximum, flush mounting unless indicated otherwise on the Drawings. Size as required for the alarm indicating device and wiring connections. Provide a trim ring and metal grill cover assembly. Cover assembly shall be a minimum of 1/16-inch minimum thick flat stainless steel or aluminum. Finish color as selected by Architect. The word "fire" shall appear on the grill minimum ½-inch letters. The grill shall be attached with screws to the box.
   4. Each audible notification visual devices shall incorporate a visual alarm indicator. The visual alarm indicating device shall be an integral part of the audible alarm box assembly.
   5. Audible notification device and visual notification devices shall be connected to separate notification alarm signal circuits. Do not connect these devices to the same circuit conductors.

B. Audible Alarm Horns
   1. Horns installed indoors shall be electronic type.
   2. Horn shall provide a minimum sound level of 75dB at 10 feet, when installed in the field operating conditions shown on the Drawings.
   3. Outdoor horns shall be electro-mechanical, weatherproof and shall be mounted in a recessed backbox with vandal resistant grille, Soundolier 193-8/VP-161 Series.
   4. Audible devices shall provide a minimum sound level of 10dB over the ambient level measured 48-inches above the floor.

C. Visual Alarm Indicator
   1. Lamp/Strobe internally illuminated projecting lens assembly, with flasher system. Unit shall flash on and off to provide visual indicating of fire alarm.
   2. The word "fire" shall appear on the lens or lens plate.
   3. Flash rate, one flash per second, with a flash duration of approximately 0.001 second, flash rate independent of audible device.
   4. Light source, Xenon high intensity flash strobe tube white/clear color.
   5. Strobe shall have a minimum output of 75 candelas with a maximum flash intensity of 120 candelas.
   6. Strobe shall comply with NFPA requirements.

2.07 REMOTE FIRE ALARM ANNUNCIATOR

A. General
   1. The annunciator panel shall be powered and operated from the fire alarm control panel. "In-out" circuit conductors shall terminate on numbered screw-type terminals.
2. A metal tamper resistant weatherproof cabinet shall contain the annunciator components. The panel shall be surface or flush mounted as indicated on the Drawings. Provide a full height tamper resistant, hinged locking cabinet door. Door shall have transparent high impact windows to allow visual observation of all indicators and switches.

3. An electronic digital, multiplex, addressable module shall be incorporated into the annunciator. The module shall communicate the status and trouble condition of each device with a unique Address Code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.

B. Each alarm initiating zone (including spares) shall be individually annunciated in the annunciator panel.

C. A common fire trouble alarm shall be annunciated in the annunciator panel from the fire alarm control panel.

D. Annunciator lamp circuits shall be automatically supervised. Provide lamp test switch in the annunciator panel.

E. An audible alarm/trouble buzzer with silence switch and automatic resound for subsequent alarm/trouble signals shall be provided. The annunciator panel shall be automatically reset when the control panel is reset.

F. A keyed switch shall be provided for remote reset of the system. The annunciation panel shall also be automatically reset when the control panel is reset.

G. Provide a floor plan of the facility framed under acrylic and mounted adjacent to the fire alarm annunciator. The floor plan shall be to scale and shall have room numbers clearly displayed on all rooms corresponding to the annunciator for the purpose of easily identifying the fire zones.

2.08 REMOTE EQUIPMENT MONITORING AND CONTROL

A. An electronic digital multiplex addressable module shall be provide at each device or equipment indicated to be controlled by the multiplex system. Multiple addressable control ports shall be provided in each module quantity as required for each point controlled or monitored. The module shall communicate the monitor status control action and trouble condition of each device with a unique Address Code. The module shall communicate with and be supervised and monitored by the fire alarm control panel.

B. Where multiple points are monitored or controlled, provide digital, multiplex, Multi-Points, Monitor, Control Panel (MMCP). The panel cabinet shall be self-contained NEMA 1 construction and hinged locking door. Provide tamper switch detection zone on the cabinet door; provide 60 hour battery UPS backup and power supply, the same as required for the fire alarm control panel. Panel shall be expandable using plug-in circuit monitor/control printed circuit cards. Provide barriered numbered terminal strips.

C. Each control point shall provide a supervised "dry" relay contact single pole double throw maintained contact rated 10 ampere, 227 volt, 60Hz AC.
D. Each monitor point shall provide not less than one of the following supervised methods of monitoring a remote device or equipment action or status.
   1. Remote "dry" contact operation normal open, normally closed or momentary contact operation.

PART 3 - EXECUTION

3.01 IDENTIFICATION (ADDITIONAL REQUIREMENTS)

A. The inside cover of alarm initiating devices shall be marked with the zone initiating number corresponding to the zone number in the control panel. Marking shall be with a felt-tip pen.

B. Each fire alarm terminal cabinet shall be painted red.

C. Provide nameplate: "Power to Main Fire Alarm Control Panel" screwed onto the branch circuit overcurrent device supplying power to the main fire alarm control panel.

3.02 WIRING (ADDITIONAL REQUIREMENTS)

A. Review the total system point-to-point wiring layout to assure that the correct number and type of wires and conduit sizes are installed.

B. Final connections, testing, adjusting and calibration shall be made under the direct supervision of a Factory-Trained Technician of the System Supplier.

C. All wiring shall be in conduit.

D. All wiring in cabinets shall be neatly formed, laced and made up on bolt and nut terminal blocks. Tag all spare conductors. All conductors shall terminate on terminal strips with spade lugs, of adequate size for all incoming and outgoing conductors. The strips shall be labeled as to their use and wiring diagram shall be placed on the cabinet door showing connections of all related equipment to these strips.

E. Wiring requirements for shielding certain conductors shall be as recommended by the Manufacturer. Provide all conduit, raceways and conductors per Manufacturers recommendations and include all material and labor costs in the Contract price.

F. The conductors used for digital, multiplex communication between the fire alarm control panel and external remote initiation devices, control points and annunciators, shall be twisted, shielded, multi-conductor cable, #16 AWG copper minimum with a separate internal ground/drain conductor, UL listed for fire alarm system use. One spare pair of multiplex conductors shall be provided in all main and branch device/equipment connections for future system use. "Tees" and taps at any junction box location in the communication lines, shall be permitted by the system to additional devices without affecting proper system operation.

G. Wire Size: Wire shall be sized to insure installed circuit voltage drop does not exceed 10% to all devices.
3.03 OUTLET BOXES (ADDITIONAL REQUIREMENTS)
Device outlet boxes shall be flush mounted unless indicated otherwise on the Drawings. Provide extension rings to finish flush with finish surface. Where the Drawings indicate surface mounted devices, outlet boxes shall be cast metal with threaded hubs. Where the conduit entrances are not exposed for surface mounted devices, provide flush outlet box behind the device box and omit the conduit hubs on the device box. Size device boxes and outlet boxes per Manufacturers recommendation and as required by Code for wire fills.

3.04 SPECIAL INSTALLATION REQUIREMENTS
A. Air duct smoke detectors shall be installed in the supply air ducts and return air ducts with an air flow of 2000 CFM or greater, coordinate with mechanical Contractor. Sampling tube shall extend across entire duct width. Provide ¾-inch conduit with 2#12 to respective motor control device to automatically shut down the respective fan motor upon detection of smoke in the air duct.

B. Water flow switches shall be installed on each main fire sprinkler rise pipe, coordinate with the Fire Sprinkler Contractor.

C. Tamper switches shall be installed on each main fire sprinkler shut-off valve, coordinate with the Fire Sprinkler Contractor.

D. Equipment shall be weatherproof gasketed where installed in locations exterior to the building, or where indicated on the Drawings. Weatherproof equipment shall be tamper resistant.

E. Provide clear vandal resistant protective cover for all audio-visual devices located in student restrooms and public hallways.

F. Provide wire guard for ceiling mounted smoke and heat detectors located in student restrooms.

G. Connect fire alarm control panel with security/intrusion control panel for monitoring by Remote Monitoring Company.

H. Connect fire alarm control panel with master clock system to turn off class passing schedule, with paging system to turn off system when fire alarm system in alarm condition.

I. Conduit with fire alarm wiring shall be painted red.

J. Fire alarm system shall be programmed per actual building and room designation. Submit printout for review.

3.05 TESTING
A. The entire fire alarm system shall be tested in the presence of the Local DSA Inspector and a Representative of the Manufacturer after the installation is complete.
   1. Individually activate each manual initiating station and verify correct alarm operation and control panel response.
   2. Individually test each automatic initiating device and verify correct alarm operation, control panel response and remote equipment operation.
3. The communication loops and the notification alarm circuits shall be opened in at least two locations per building to check for the presence of correct supervisory circuitry.

B. Test the battery back-up system by disconnecting the incoming normal power and allowing this alarm system to operate 24 hours on battery power. Sound the alarm system for 5-minutes at the end of 24 hours on battery power.

C. Perform all Electrical and Mechanical Tests required by the Equipment Manufacturer's certification form. Measure and adjust each automatic detection detector to the maximum stable sensitivity setting. Detector tests shall be performed with the detector at its operational location and under normal operational environmental conditions in the area. Bench settings are not acceptable. An operational check-out test and report shall be performed. Submit six copies of test report results. The tests and report shall include, but not be limited to:
   1. A complete list of equipment installed and wired.
   2. Indication that all equipment is properly installed and functions and conforms with these Specifications.
   3. Test of individual zones as applicable.
   4. Serial numbers, locations by zone and model number for each installed detector.
   5. Voltage (sensitivity) settings for each ionization and photoelectric detector as measured in place with the HVAC system operating.
   6. Technician's name, certificate number and date.
   7. The completed manual and automatic monitoring and control system shall be tested to insure that it is operating properly. This test will consist of exposing the installed units to a standard fire test.
   8. Acceptance of the system shall also require a demonstration of the stability of the system. This shall be adequately demonstrated if the system operates for a 90-day test period without any unwarranted alarms. Should an unwarranted alarm(s) occur, the Contractor shall readjust or replace the equipment and detector(s) and begin another 90-day test period. As required by the Architect, the Contractor shall recheck the detectors using the fire test after each readjustment or replacement of detectors. This test shall not start until the District has obtained beneficial use of the building under tests.

D. After the testing has been completed to the satisfaction of the Inspectors, provide the NFPA certificate of compliance to the District, the Local Fire Official, the Architect and DSA.

E. Upon the receipt of Certificate of Compliance, the Installer/Supplier shall supply the Owner with a written operating, testing and maintenance instructions, Point-To-Point As-Built Drawings, and Equipment Specifications.

**3.06 INSTRUCTIONAL / TRAINING SESSIONS**

Provide a 2-hour instructional sessions conducted by a Factory-Authorized Technician at the job site after completion of all tests to instruct School District Personnel on the use of the system. The first session shall be videotaped and conducted prior to final acceptance of the Project. The second session shall be held within eleven months of final acceptance of the Project, when requested by the District.

**END OF SECTION 28 3100**

112316/223037
SECTION 31 2300
EXCAVATION AND FILL

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Materials, equipment, and labor required to provide grading and fine grading as indicated on Drawings and as specified.
   2. Work includes, but may not be limited to:
      a. Excavation, compacted engineered fill, and preparing of subgrade for building footings, slabs, walks, and pavements.
      b. Excavating and backfilling of trenches and excavations.

B. Related Sections:
   1. Section 01 4500: Quality Control; soil testing requirements
   2. Section 01 5000: Temporary Facilities and Controls; barriers and temporary controls.
   3. Section 01 5713: Temporary Erosion and Sedimentation Controls

C. Related Requirements:
   1. Excavating and Backfilling for Utility Work:
      a. Refer to Division 26 Sections for excavation and backfill required for underground electrical utilities and related buried appurtenances.
      b. Refer to Division 31 Sections for additional trenching and backfilling requirements for underground site utilities piping and related buried appurtenances.

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM D 1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
   2. ASTM D 2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

C. American Association of State Highway and Transportation Officials (AASHTO):


1.03 QUALITY ASSURANCE

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of authorities having jurisdiction.
B. Testing and Inspection Service: Owner shall employ and pay for qualified independent
geotechnical testing laboratory to perform soil testing and inspection service during
earthwork operations.

C. Testing Laboratory Qualifications: To qualify for acceptance, geotechnical testing
laboratory must be Division of the State Architect (DSA) approved and demonstrate to
Architect’s satisfaction, based on evaluation of laboratory-submitted criteria conforming
to ASTM E 699, that it has experience and capability to conduct required field and
laboratory geotechnical testing without delaying progress of Work.

D. Foundation Soils: Excavate for foundations to sizes indicated, clean and leave in
condition recommended by Civil Engineer.
1. Prior to placement of forms, reinforcing or concrete, obtain approval of Civil
Engineer and DSA Project Inspector as required, for proper conditions and
suitable bearing materials.

1.04 SUBMITTALS

A. Test Reports: Submit following reports directly to Architect from testing services, with
copy to Contractor:
1. Test reports on borrow material.
2. Verification of suitability of each footing subgrade material, in accordance with
specified requirements.
3. Field reports; in-place soil density tests.

1.05 DEFINITIONS

A. Excavation: Consists of removal of material encountered to subgrade elevations
indicated and subsequent use of excavated material as fill, disposal off-site,
or stockpiled for future use of materials removed.

B. Unauthorized Excavation: Consists of removal of materials beyond indicated subgrade
elevations or dimensions without specific direction of Architect.
1. Unauthorized excavation, as well as remedial work directed by Civil Engineer
upon receipt of written authorization from Architect, shall be at Contractor's
expense.
2. Under footings, foundation bases, or retaining walls, fill unauthorized excavation
by extending indicated bottom elevation of footing or base to excavation bottom,
without altering required top elevation.
a. Lean concrete fill may be used to bring elevations to proper position, when
acceptable to Civil Engineer.
3. In locations other than those above, backfill and compact unauthorized
excavations as specified by Civil Engineer for authorized excavations of same
classification, unless otherwise directed by Architect.

C. Additional Excavation: When excavation has reached required subgrade elevations,
notify Architect, who will notify Civil Engineer to make inspection of conditions.
1. Should Civil Engineer determines that bearing materials at required subgrade
elevations are unsuitable, continue excavation until suitable bearing materials are
encountered and replace excavated material specified by Civil Engineer and
directed by Architect.
2. Contract sum may be adjusted by appropriate Contract modification.
3. Removal of unsuitable material and its replacement as directed shall be paid on basis of General Conditions of the Contract relative to changes in Work.

D. Subgrade: Undisturbed earth or compacted soil layer immediately below granular subbase, drainage fill, or topsoil materials.

1.06 PROJECT CONDITIONS

A. Existing Utilities:
   1. Locate existing underground utilities in areas of excavation work by potholing prior to excavation.
      a. Report discrepancies immediately to Architect and Engineer of Record.
   1. Where utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
   2. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for direction.
   3. Cooperate with Owner and utility companies in keeping respective services and facilities in operation.
      a. Repair damaged utilities to satisfaction of utility owner.
   4. Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Architect and then only after acceptable temporary utility services have been provided.
      a. Provide minimum of forty-eight hour notice to Architect and Owner and receive written notice to proceed before interrupting utility.
   5. Demolish and completely remove from Project Site existing underground utilities indicated to be removed.
      a. Backfill for abandoned underground utilities shall conform to Articles 2.01 – Soil Materials and 3.05 – Backfill and Fill.
      b. Coordinate with utility companies for shutoff of service if lines are active.

B. Protection of Subgrade: Do not allow equipment to pump, rut or disturb subgrade, stripped areas, or other areas prepared for backfill or paving operations.

PART 2 – PRODUCTS

2.01 SOIL MATERIALS

A. Imported Soil Materials: Fill soil imported to Project Site shall be granular and shall have expansion index of less than twenty and be classified as SM, SW, and SP in accordance with ASTM D 2487.
   1. Import fill shall be free of rock and lumps of soil larger than three inches in diameter and shall be at least sixty percent finer than 1/4 inch sieve.

B. Utility Trench Backfill: Material for use in backfilling trenches shall consist of hard, durable, clean sand, gravel, or crushed stone, and shall be free from organic material, clay balls, or other deleterious substances.

C. Base Material: Base material under asphalt pavements shall be classified as Class II Aggregate Base as specified in Section 26-1, 02B of SSPWC.
PART 3 – EXECUTION

3.01 EXCAVATION

A. Excavation Classifications: Following classifications of excavation will be made when rock is encountered:
   1. Earth excavation includes excavation of pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; together with earth and other materials encountered that are not classified as rock or unauthorized excavation.

3.02 STABILITY OF EXCAVATIONS

A. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction.
   1. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
   2. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

3.03 STORAGE OF EXCAVATED MATERIALS

A. Stockpile excavated materials acceptable for backfill and fill where directed.
   1. Place, grade and shape stockpiles for proper drainage.
   2. Locate and retain soil materials horizontally away from edge of excavations equal to depth of excavation.
   3. Do not store within drip line of trees indicated to remain.
   4. Dispose of excess excavated soil materials not acceptable for use as backfill or fill.

3.04 TRENCH EXCAVATION FOR PIPES AND CONDUIT

A. Excavate trenches to uniform width, sufficiently wide to provide ample working room and minimum of six to nine inches of clearance on both sides of pipe or conduit.

B. Excavate trenches and conduit to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe or conduit on undisturbed soil.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
   2. Where rock is encountered, carry excavation six inches below required elevation and backfill with six inch layer of crushed stone or gravel prior to installation of pipe.
   3. For pipes or conduit less than six inches in nominal size, and for flat-bottomed, multiple-duct conduit units, do not excavate beyond indicated depths.
      a. Hand-excavate bottom cut to accurate elevations and support pipe or conduit on undisturbed soil.
   4. For pipes and equipment six inches or larger in nominal size, shape bottom of trench to fit bottom of pipe for ninety degrees (bottom 1/4 of circumference).
      a. Fill depressions with tamped sand backfill.
      b. At each pipe joint, dig bell holes to relieve pipe bell of loads to ensure continuous bearing of pipe barrel on bearing surface.
3.05 BACKFILL AND FILL

A. Fill material and backfill material shall consist of satisfactory soil material or imported soil materials as specified in Part 2 of this section, and shall be placed in maximum six inch thick compacted layers to required subgrade elevations, except as follows:
   1. Under Walks: Upper four inches of fill shall consist of sub-base as defined in Article 2.01D or base material as defined by Article 2.01E.
   3. Under Interior Building Slabs: Upper four inches of fill shall consist of compactible sand or rock as specified in Article 2.01B.
   4. Under Piping and Conduit and Equipment: Use sub-base materials where required over rock bearing surface and for correction of unauthorized excavation.
      a. Shape excavation bottom to fit bottom ninety degrees of cylinder.
   5. Backfill trenches with concrete where trench excavations pass within eighteen inches of column or wall footings and that are carried below bottom of such footings or that pass under wall footings.
      a. Place concrete to level of bottom of adjacent footing.
      b. Concrete is specified in Section 03300.
      c. Do not backfill trenches until tests and inspections have been made and backfilling is authorized by Architect.
      d. Use care in backfilling to avoid damage or displacement of pipe systems.

B. Backfill excavations as promptly as Work permits, but not until completion of following:
   1. Acceptance of construction below finish grade.
   2. Inspection, testing, approval, and recording locations of underground utilities have been performed and recorded.
   4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials.
   5. Removal of trash and debris from excavation.
   6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

3.06 PLACEMENT AND COMPACTION

A. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills.
   1. Plow strip or break up sloped surfaces steeper than one vertical to four horizontal (1:4) so that fill material will bond with existing surface.
   2. When existing ground surface has density less than that specified under "Compaction" for particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content or slightly above, and compact to required depth and percentage of maximum density.
   3. Where unsuitable material described above is greater than twelve inches thick, material will have to be removed and recompacted as directed by Civil Engineer.

B. Place backfill and fill materials in layers not more than eight inches in loose depth for material compacted by heavy compaction equipment, and not more than four inches in loose depth for material compacted by hand-operated tampers.

C. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content or slightly above.
1. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification.

D. Place backfill and fill materials evenly adjacent to structures, piping, or conduit to required elevations.
   1. Prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping, or conduit to approximately same elevation in each lift.

E. Control soil and fill compaction, providing minimum percentage of density specified for each area classification indicated below.
   1. Correct improperly compacted areas or lifts as directed by Architect if soil density tests indicate inadequate compaction.
   2. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density, in accordance with ASTM D 1557:
      a. Under Foundations, Building Slabs and Steps: Compact top eighteen inches of subgrade and each layer of backfill or fill material at ninety percent maximum density.
      b. Under Pavements: Compact top twelve inches of subgrade and each layer of backfill or fill material at ninety percent maximum density.
      c. Under Lawn or Unpaved Areas: Compact top six inches of subgrade and each layer of backfill or fill material at eighty percent maximum density.
      d. Under Walkways: Compact top twelve inches of subgrade and each layer of backfill or fill material at ninety percent maximum density.
   2. Moisture Control, under direction of Civil Engineer:
      a. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade or layer of soil material.
      b. Apply water in minimum quantity as necessary to prevent free water from appearing on surface during or subsequent to compaction operations.
      c. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
      d. Stockpile or spread soil material that has been removed because it is too wet to permit compaction.
      e. Assist drying by disk, harrowing or pulverizing until moisture content is reduced to satisfactory value.

3.07 GRADING

A. Uniformly grade areas within limits of grading under this section, including adjacent transition areas in compliance with approved precise grading plan.
   1. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.
   1. Finish surfaces free from irregular surface changes and as follows:
      a. Lawn or Unpaved Areas: Finish areas to receive topsoil to within not more than 0.10 foot above or below required subgrade elevations.
      b. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 0.10 foot above or below required subgrade elevation.
c. Pavements: Shape surface of areas under pavement to line, grade, and cross-section, with finish surface not more than 1/2 inch above or below required subgrade elevation.

3.08 EROSION CONTROL

A. Provide erosion control methods in accordance with requirements of authorities having jurisdiction.

3.09 MAINTENANCE

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion and keep free of trash and debris.

B. Repair and reestablish grades in settled, eroded, and rutted areas to specified tolerances.

C. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, reshape, and compact to required density prior to further construction.

3.10 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Removal from Owner's Property: Remove waste materials, including unacceptable excavated material, trash, and debris, and dispose of it off Project Site.

END OF SECTION 31 2300
SECTION 32 0118
PAVING REPAIR

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Grinding and resurfacing of existing asphalt paved areas indicated.
   2. Material and installation for following:
      a. Asphalt (bituminous) surfacing.
      b. Seal coat for asphalt surfacing

B. Related Sections:
   1. Section 01 7419: Construction Waste Management and Disposal; disposal of removed paving.
   2. Section 32 0523: Concrete for Exterior Improvements; repair of concrete paving.
   3. Section 32 2300: Excavation and Fill.

1.02 REFERENCES


B. ASTM International (ASTM):
   1. ASTM D 1188 – Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples

C. American Association of State Highway and Transportation Officials (AASHTO):

1.03 QUALITY ASSURANCE

A. Comply with Standard Specifications for Public Works Construction (SSPWC), current edition, as minimum requirement.

1.04 SUBMITTALS

A. Product Data:
   1. Bituminous Materials:
      a. Manufacturer's technical data for materials and products
   2. Manufacturer's product information and application procedures for seal coating.

B. Shop Drawings: Site plan indicating extent of paving and accessories.
PART 2 - PRODUCTS

2.01 MATERIALS

A. Bituminous Materials:
   1. Provide materials of class, grade, or type indicated, conforming to relevant provisions of SSPWC, Section 203 – Bituminous Materials.
      a. Asphalt Overlay Up To 1 inch: Asphalt Mix III-D2-PG6410.
      b. Asphalt Overlay Greater Than 1 inch: Asphalt Mix C2-PG6410

B. Seal Coat:
   1. Provide seal coat materials by one of following or approved equal:
      a. Guard-Top, Division of Western Emulsions Inc.
      b. OverKote by Diversified Asphalt Products
      c. Park Top by Western Colloid Products.

PART 3 - EXECUTION

3.01 PAVEMENT REMOVAL

A. Remove bituminous and concrete pavement in accordance with applicable provisions of Section 300 – Earthwork of SSPWC.

B. Pavement Heaved By Roots: Remove pavement to limits of distortion and expose roots. Trim roots to provide at least 12 inches clearance to pavement.

C. Remove protruding bituminous surfaces flush with the surrounding grade using a suitable tool or equipment so that adjacent finishes are not blackened.

D. Remove raveled and depressed bituminous pavement to limits indicated or required.

E. Saw cut existing improvements, trim holes and trenches in bituminous and concrete pavement to permit mechanical hand tampers to compact the fill.

F. Remove broken concrete by saw cutting.
   1. When required cut line is within 30 inches of score or joint line or edge, cut and remove to score, joint line, or edge.
   2. When broken concrete paving occurs within panel, remove and replace entire panel.

3.02 EXCAVATING, BACKFILLING, AND COMPACTING

A. Conform to requirements in Section 31 2300, as required.

B. Where subgrade or base is deemed to be unstable or otherwise unsuitable, excavate such materials to firm earth, and replace with a required material. Install and compact fill materials in accordance with the requirements of related Specification sections.
3.03 RESURFACING

A. Holes and Trenches: Remove loose dirt and backfill with cement-sand slurry allowing for surfacing one inch thicker than existing. Unless otherwise indicated on Drawings, resurface flush with existing adjoining pavement installing same type of materials and section provided in existing improvements.

B. Other Areas: Other surface improvements damaged or removed shall be cut to neat even line and excavated one inch below bottom of existing pavement. Resurface by following original grades and installing same type of materials provided in existing improvements.

C. Where bituminous surfacing abuts concrete, masonry, and walks or paving, tamp joint smooth, if necessary, as described above to obtain uniformly even joint, true to line and grade. Tamp and smooth materials before asphalt cools.

3.04 REPAIRING EXISTING SURFACES

A. Preparation of Surfaces: Prior to filling cracks, clean existing bituminous surfacing of loose and foreign materials and coat with a film of asphalt emulsion.

B. Repair of Existing Surfacing:
   1. Fill cracks 1/2 inch wide and less with RS-1 emulsion and silica sand or other required material. Cracks larger than 1/2 inch wide shall be filled with Type C2 Asphalt Concrete as specified. Cracks shall be filled to level of adjacent surfacing.
   2. Where low areas, holes, or depressions occur in existing surfacing, repair with emulsified asphalt. Install material; strike off emulsified asphalt with straightedge flush with adjoining surfacing. Finish with steel trowel, and after dehydration, compact by rolling or tamping.

C. Testing: Flood test entire area in presence of Project Inspector. Entire area tested shall be free of standing water or puddles.

3.05 SEAL COAT APPLICATION

A. General: After bituminous surfacing has passed flood test, clear and allow to dry and provide two coats of surface seal as specified.
   1. Where indicated, provide multiple coats of surface seal to existing bituminous surfacing.
   2. Where new bituminous surfacing joins existing bituminous surfacing, overlap surface seal minimum of 12 inches onto existing bituminous surfacing.

B. Surface Preparation:
   1. Thoroughly wash surfaces with water to remove dirt, debris, excessive oil and grease, or other foreign matter.

C. Application:
   1. Install seal coat in strict accordance with manufacturer’s written directions and recommendations.
   2. Install 2 coats of seal coat to new bituminous surfacing.
      a. First coat shall be installed before flood testing.
b. Clean surface and allow to dry before installing second coat.
c. Second coat shall be installed after bituminous surfacing has passed flood test.

3. Where new bituminous surfacing is installed adjacent to existing bituminous surfacing, overlap surface seal a minimum of 12 inches onto existing bituminous surfacing.

4. Where existing bituminous surfacing is indicated to be patched and sealed.
   a. Apply 2 coats of surface seal after patching.

### 3.06 CLEANING

A. Remove stains on Project Site and adjacent properties caused by or attributed to Work of this Section.

B. Remove and legally dispose of rubbish, debris, and waste materials off Project Site.
   1. Comply with requirements of Section 01 7419.

### 3.07 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 32 0118
SECTION 32 0523

CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Site concrete work consisting of:
      a. Portland cement concrete curbs and gutters.
      b. Sign post footings for parking signage.
      c. Precast wheel stops.

B. Related Sections:
   1. Section 07 9200: Joint Sealants; concrete paving joints.
   3. Section 31 2300: Excavation and Fill
   4. Section 32 1723: Pavement Markings
   5. Section 32 1726: Tactile Warning Surfacing

1.02 REFERENCES

A. ASTM International (ASTM):
   1. ASTM D 994 – Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)


C. Concrete Reinforcing Steel Institute (CRSI):
   2. CRSI Placing Reinforcing Bars

1.03 QUALITY ASSURANCE

A. Refer to Section 01 4500 for concrete testing requirements.

1.04 SUBMITTALS

A. Shop Drawings: Plans, elevations and details of site concrete work.

B. Product Data: Mix designs and manufacturer's technical data for materials and products.

1.05 PROJECT CONDITIONS

A. Traffic Control:
   1. Maintain access for vehicular and pedestrian traffic as required for other construction activities.
   2. Comply with other requirements specified in Section 01 5000.
PART 2 – PRODUCTS

2.01 MATERIALS

A. Form Materials:
1. Metal, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal and to provide full depth, continuous straight, smooth exposed surfaces.
2. Use flexible or curved forms to form radius bends as required.
3. Form Release Agent: Provide commercial formulation form-release agent complying with local Volatile Organic Compound (VOC) limitations that will not bond with stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

B. Reinforcing Materials:
1. Reinforcing Bars: ASTM A 615, Grade 40, deformed.
3. Joint Dowel Bars: Plain steel bars, ASTM A 615, Grade 60. Cut bars to length with ends square and free of burrs.
   a. Manufacture bar supports, according to CRSI Manual, from steel wire, plastic, or precast concrete or fiber reinforced concrete of greater compressive strength than concrete, and as follows:
      1) Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

C. Concrete Materials:
1. Comply with applicable provisions of SSPWC Section 201 – Concrete, Mortar and Related Materials.
2. Portland Cement Concrete (PCC) for non-structural uses:
   a. Meet requirements of SSPWC Subsection 201-1 and 302-6, and Section 303.

D. Admixtures:
1. Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
3. Water-Reducing Admixture: ASTM C 494, Type A.

E. Curing Materials:

2.02 RELATED MATERIALS

A. Control Joint Material:
1. Preformed Fiber Joint filler: ASTM D 1751 non-extruding preformed bituminous saturated fiberboard units.
2. Plain or punched for dowels as required.
B. Bonding Agent: ASTM C 1059, Type II, acrylic emulsion or styrene butadiene.

2.03 PRECAST WHEEL STOPS

A. Concrete Wheel Stops: Precast, air-entrained concrete, smooth finish, 3,000 psi minimum compressive strength, with continuous steel reinforcing, approximately 5 inches high by 7 inches wide by 4 feet long, or as indicated.
   1. Provide chamfered corners and drainage slots on underside.
   2. Provide holes for anchoring to asphalt substrate.
   3. Anchorage Dowels: Galvanized steel, diameter 3/4 inch, minimum length 18 inches.

PART 3 – EXECUTION

3.01 CONSTRUCTION OF FORMS FOR CAST-IN-PLACE CONCRETE

A. Concrete Curbs and Gutters: Install Portland cement concrete curbs and gutters in compliance with SSPWC Section 302 – Roadway Surfacing.

B. Parking lot signage post footings below grade, may be placed directly in excavations conforming to required sizes.

E. Perform reinforcement installation and concrete placement, surface finishes, curing and removal of forms in compliance with applicable provisions of this Section.

F. Finishing: After completion of floating and when excess moisture or surface sheen has disappeared, complete troweling and finish surface to match existing or as indicated.

3.02 JOINTS

A. General: Construct expansion, weakened-plane (contraction), and construction joints true to line with face perpendicular to surface of concrete.
   1. Construct transverse joints at right angles to centerline, unless otherwise indicated.

B. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

C. Weakened-Plane (Contraction) Joints: Provide weakened-plane (contraction) joints, sectioning concrete into areas as shown.
   1. Construct weakened-plane joints for depth equal to at least one-quarter (1/4) concrete thickness, as follows:
   2. Sawn Joints: Control joints are to be made using beveled saw blades, such as those manufactured by Soff-Cut International, Inc., No. XL-R250, or approved equal.
      a. Use joint protectors to prevent joint intersections from breaking down initial joint.

D. Construction Joints: Place keyed construction joints at end of placements and at locations where placement operations are stopped for more than one-half hour, except where such placements terminate at expansion joints.
   1. Expansion joints are to be slip doweled at 18 inches on center, using plastic alignment accessory Speed Dowel or equal.
3.03 CONCRETE WHEEL STOPS

A. Provide in locations indicated.
   1. Set units level and flush.
   2. Secure each unit with 2 steel stakes of type and size indicated.

3.04 CLEAN UP

A. Remove and legally dispose of rubbish, debris, and waste materials off Project Site.
   1. Comply with requirements of Section 01 7419.

3.04 PROTECTION

A. Protect Work until Substantial Completion.

END OF SECTION 32 0523
SECTION 32 1723

PAVEMENT MARKINGS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Parking restriping.
      a. Includes markings and accessibility symbols, for accessible spaces as indicated.
   2. Fire lane “No Parking.”
   3. Curb marking and red curbs.

B. Related Sections:
   1. Section 09 9100: Painting
   2. Section 32 0118: Paving Repair
   3. Section 32 1726: Tactile Warning Surfacing

1.02 REFERENCES


1.03 SUBMITTALS

A. Product Data: Manufacturer’s product data on traffic paint products and material.

B. Shop Drawings: Indicating location, extent, color, and texture of markings.

C. Samples: Color samples of paint products.

1.04 PROJECT CONDITIONS

A. Do not install markings when adverse weather conditions are forecasted.

1.05 REGULATORY REQUIREMENTS

A. Accessible Parking Spaces Serving Particular Building or Facility:
   1. When serving more than one accessible entrance, locate on shortest accessible route to entrance or multiple accessible entrances per CBC Section 11B-208.3.1
   2. Provide minimum number of required accessible parking spaces in accordance with CBC Section 11B-208.2
   3. Provide a least one van-accessible parking space for every six, or fraction thereof, of accessible parking spaces in accordance with CBC 11B-208.2.4
   4. Provide accessible parking spaces and access aisles comply with CBC Section 11B-502
      a. Dimension parking spaces to centerline of marked lines as follows:
         1) Mark parking spaces and access aisles according to CBC Figures 11B-502.2, 11B-502.3 and 11B-502.3.3

PAVEMENT MARKINGS

32 1723 - 1
2) Provide surfaces complying with CBC Section 11B-11B-302 and at same level with slopes not steeper than 1:48 in any direction per CBC Section 11B-502.4

5. Parking Space Dimensions:
   a. Parking Spaces: 9 feet by 18 feet minimum.
   b. Van Accessible Spaces: 12 feet by 18 feet minimum, with adjacent access aisle of 5 feet by 18 feet minimum.
   c. Place access aisles on either side of parking spaces, except locate on passenger side for van parking spaces.

6. Parking Space and Access Aisle Markings:
   a. Mark access aisles with blue painted borderline around their perimeter.
   b. Mark area within blue borderlines with hatched lines maximum of 36 inches on center with color contrasting to that of aisle surface.
      1) White on asphalt paving.
      2) Blue on concrete paving.
   c. Access aisle markings may extend beyond minimum required length per CBC Section 11B-502.3.3.
   d. Mark access aisles so as not to overlap vehicular way per CBC Section 11B-502.3.4.
   e. Provide vertical clearance of 8 feet-2 inches minimum for accessible parking spaces, access aisles, and vehicular routes serving them per CBC Section 11B-502.5.

PART 2 – PRODUCTS

2.01 MATERIALS

   A. Paint: Water emulsion-based Dura-Strip paint as manufactured by TMT-Pathway, or approved equal.

PART 3 – EXECUTION

3.01 PAVEMENT MARKINGS

   A. Application of Paint:
      1. Prior to application of paint, allow pavement to properly cure.
         a. Clean and prepare in accordance with paint manufacturer's written recommendations.
      2. Provide mechanical equipment to install paint in a uniform, straight or curved pattern, without holidays and other defects.
      3. Do not permit traffic until paint has completely cured.
      4. Install 2 coats in thickness recommended by manufacturer.

   B. Marking Width and Color: Unless indicated otherwise, marking width and color are as follows:

<table>
<thead>
<tr>
<th>Width</th>
<th>Color</th>
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</thead>
<tbody>
<tr>
<td>4 inches</td>
<td>White</td>
</tr>
<tr>
<td>4 inches</td>
<td>Blue</td>
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</table>

<table>
<thead>
<tr>
<th>Width</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 inches</td>
<td>Yellow</td>
</tr>
</tbody>
</table>
3. Striping:
   a. General  
      4 inches  Yellow
   b. Accessible  
      4 inches  Blue
   4. International Symbol of Accessibility  
      2 inches  White on blue background

3.02 PROTECTION

   A. Protect Work until Substantial Completion.

3.03 CLEANUP

   A. Remove and legally dispose of rubbish, debris, and waste materials off Project Site.

END OF SECTION 32 1723
SECTION 32 1726

TACTILE WARNING SURFACING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Cast In Place Detectable/Tactile Warning Surface Tiles (truncated domes) where indicated.

B. Related Sections:
   1. Section 32 0118: Paving Repair
   2. Section 32 0523: Concrete for Exterior Improvements; concrete for setting tactile warning tiles.

1.02 REFERENCES


B. ASTM International (ASTM):
   2. ASTM C 293 – Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading)

C. Federal Standard (FS):
1.03 QUALITY ASSURANCE

A. Provide cast in place detectable/tactile warning surface tiles and accessories as produced by single manufacturer with minimum of three years experience in manufacturing of cast in place detectable/tactile warning surface tiles.

B. Installer's Qualifications: Engage experienced installer certified in writing by detectable/tactile warning surface tile manufacturer as qualified for installation, who has successfully completed tile installations similar in material, design, and extent to that indicated for Project.
   1. Manufacturer's supervisor shall be present at initial pour.

1.04 SUBMITTALS

A. Product Data: Manufacturer's literature describing products, installation procedures and routine maintenance.

B. Shop Drawings: For products specified showing fabrication details, composite structural system, tile surface profile, and sound on cane contact amplification feature.
   1. Include plans of tile placement including joints, and material to be used as well as outlining installation materials and procedure
   2. Tile pattern shall be designed and shown between existing expansion joints with tile rib dimension used for cut size of panels.

C. Samples for Verification Purposes: Minimum of three samples, as Project Site mock-ups, of full cast in place detectable/tactile warning surface tiles of kind proposed for use.

D. Material Test Reports: From qualified accredited independent testing laboratory indicating that materials proposed for use are in compliance with requirements and meet properties indicated.
   1. Test reports shall be conducted on cast in place detectable/tactile warning surface tiles as certified by qualified independent testing laboratory.
   2. Do not include manufacturer’s MSDS sheets with this submittal.

E. Maintenance Instructions: Copies of manufacturer's specified maintenance practices for cast in place detectable/tactile warning surface tiles

1.05 PROJECT CONDITIONS

A. Environmental Conditions and Protection: Maintain minimum temperature of 40 degrees F in spaces to receive tiles for at least 24 hours prior to installations, during installation, and for not less than 24 hours after installation.
   1. Store tile material in spaces where they will be installed for at least 24 hours before beginning installation.
   2. Subsequently, maintain minimum temperature of 40 degrees F in areas where Work is completed.

B. Use of water for Work, cleaning, or dust control, shall be contained and controlled and shall not be allowed to come into contact with public.
   1. Provide barricades or screens to protect public.
C. Disposal of liquids or other materials of possible contamination shall be made in accordance with federal state and local laws and ordinances.

D. Cleaning materials shall have code acceptable low VOC solvent content and low flammability if used on Site.

E. Contractor shall coordinate phasing and flagging personnel operations as specified in Division 01.

1.06 DELIVERY, STORAGE AND HANDLING

A. Tiles shall be suitably packaged or crated to prevent damage in shipment or handling.
   1. Finished surfaces shall be protected by sturdy wrappings, and tile type shall be identified by part number.

B. Tiles shall be delivered to location at Project Site for storage prior to installation.

1.07 REGULATORY REQUIREMENTS

A. Tactile Warning Surfacing:
   1. Provide tactile warning surfaces which comply with CBC Section 11B-705.1
   2. Surfacing Color: 33538 “Yellow” conforming to FS 595B.
      a. Except for locations at curb ramps, islands, or cut-through medians where color used shall contrast visually with that of adjacent walking surfaces.
      b. Either light-on-dark, or dark-on-light in accordance with CBC Section 11B-705.1.1.3 and 11B-705.1.1.5.
   3. Surfacing shall differ from adjoining surfaces in resiliency or sound-on-cane contact in accordance with CBC Section 11B-705.1.1.4.

1.08 WARRANTY

A. Provide manufacturer's minimum 5 year warranty in writing for period of five years from date of final completion complying with DSA Bulletin 10/31/02, revised 04/09/08.
   1. Warranty includes defective work, breakage, deformation, fading and chalking of finishes, and loosening of tiles.

PART 2 – PRODUCTS

2.01 MANUFACTURERS/PRODUCTS

A. Provide detectable warning surface tile by one of following:
   1. Engineered Plastics, Inc. (Armor-Tile)
   2. ADA Solutions, Inc.
   3. Armorcast Products

B. Basis-of-Design Product: Vitrified Polymer Composite (VPC) Cast in Place Detectable/Tactile Warning Surface Tiles specified are based on Armor-Tile as manufactured by Engineered Plastics Inc.
   1. Existing engineered and field tested products which are subject to compliance with requirements, may be incorporated in Work and shall meet or exceed specified test criteria and characteristics.
A. Tiles: Made of homogeneous vitrified polymer composite (VPC) material with ultraviolet stabilized coating, to minimize color wear
   1. Provide with slip-resistant surface, incorporating “truncated domes” of same material.
   2. Nominal thickness of detectable warning tile shall be 1/8 inch, exclusive of height of truncated domes.
   3. Provide tiles complying with applicable requirements of CBC, Chapter 11B.

B. Vitrified Polymer Composite (VPC) cast in place detectable/tactile warning surface tiles shall be epoxy polymer composition with ultra violet coating employing aluminum oxide particles in truncated domes, conforming to following:
   1. Compressive Strength, ASTM D 695: Not to be less than 18,000 psi.
   2. Tensile Strength, ASTM D 638: Not to be less than 10,000 psi.
   3. Flexural Strength, ASTM C 293 or D 790: Not to be less than 24,000 psi.
   4. Water Absorption, ASTM D 570: Not to exceed 0.35 percent.
   5. Slip Resistance: 0.9 minimum for the combined wet/dry static co-efficient of friction when tested by ASTM C 1028
   6. Chemical Stain Resistance, ASTM D 543 or D 1038: To withstand without discoloration or staining -1 percent hydrochloric acid, urine, calcium chloride, stamp pad ink, gum and red aerosol paint.
   8. Accelerated Weathering, ASTM G 155: For 3000 hours shall exhibit following result-Delta E, <4.5: No deterioration, fading or chalking of surface of tile.
   9. Accelerated Aging and Freeze Thaw Test, ASTM D 1037 or C1026: Show no evidence of cracking, delamination, warpage, checking, blistering, color change, loosening of tiles, or other defects.
   10. Salt and Spray Performance of Tile, ASTM B 117: Not to show deterioration or other defects after 200 hours of exposure.

C. Pattern/Dimension: Pattern and dimensions of detectable warning surface tile shall incorporate an “in-line” dome pattern of truncated domes 0.2 inch in height, 0.9 inch diameter at base and 0.45 inch diameter at top of dome.
   1. Domes should be spaced no greater than 2.35 inches from center to center.
   2. Field area of detectable warning surface should consist of raised points no greater than 0.045 inches, to create a slip-resistant surface for wheelchair safety.

D. Color: Unless otherwise indicated, detectable warning surface tiles shall be Federal Color No. 33538 “Yellow”
   1. Color shall be integral with detectable warning device tiles and shall not be surface applied.
   2. Paints or other surface coatings shall not be used.

E. Sealants: Sealant shall be gray epoxy, two-component sealant, as manufactured by Sika, Bostik or approved equal.
   1. Sealant: As supplied by manufacturer.
PART 3 – EXECUTION

3.01 INSTALLATION

A. During concrete pouring and tile installation procedures, ensure adequate safety guidelines are in place and are in accordance with applicable industry and government standards.

B. Prior to placement of cast in place detectable/tactile warning surface tiles, review manufacturer’s shop drawings and layout drawing prepared by installation contractor to resolve issues related to pattern repeat, tile cuts, expansion joints, control joints, curves, end returns and surface interferences.
   1. Refer discrepancies to Architect.

C. Physical characteristics of concrete shall be consistent with Section 32 0523 specifications while maintaining a slump range of 4-7 to permit solid placement of cast in place detectable/tactile warning surface tiles.
   1. Overly wet mix will cause tiles to float, therefore suitable weights such as concrete blocks or sandbags (25 lb) shall be placed on each tile.

D. Concrete pouring and finishing operations require typical mason’s tools, however, 4’ long level with electronic slope readout, 25 lb. weights, and large non-marring rubber mallet are specific to installation of cast in place detectable/tactile warning surface tiles.
   1. Vibrating mechanism may be employed.
      a. Fix vibrating unit to soft wood base at least 1 foot square

E. Concrete shall be poured and finished true and smooth to required dimensions and slope prior to tile placement.
   1. Immediately after pouring concrete, use electronic level to check that required slope is achieved
   2. Place tile square and true to curb edge in accordance with approved shop drawings.
   3. Tiles shall be tamped or vibrated into fresh concrete to ensure that field level of tile is flush to adjacent concrete surface.
      a. Do not attempt to accomplish embedment process by stepping on tiles as this may cause uneven setting which can result in air voids under tile surface
   4. Shop drawings indicate that tile field level (base of truncated dome) is flush to adjacent surfaces to permit proper water drainage and eliminate tripping hazards between adjacent finishes.
      a. Tolerance for elevation differences between tile and adjacent surface is 1/16 inch.

F. Immediately after tile placement, tile elevation is to be checked to adjacent concrete.
   1. Tile elevation shall be set consistent with shop drawings to permit water drainage to curb as design dictates.
   2. Ensure field surface of tile is flush with surrounding concrete and back of curb so that no ponding of possible on tile at back side of curb

G. While concrete is workable, use 3/8 inch edging tool to create finished edge of concrete.
1. Use steel trowel to finish concrete around tile perimeter, flush to field level of Tile.

H. During and after tile installation and concrete curing stage, do not allow walking, leaning, or external forces placed on tile to rock tile, causing void between underside of tile and concrete.

I. Following tile placement, review installation tolerances to shop drawings and adjust tile before concrete sets.
   1. Suitable weights of 25 lb. shall be placed on each tile and additional weights at tile to tile assemblies as necessary to ensure solid contact of tile underside to concrete.

J. Following curing of concrete, remove protective plastic wrap from tile face by cutting plastic with sharp knife tight to concrete/tile interface.
   1. Where concrete bleeding occurs between tiles, soft brass wire brush will clean residue without damage to tile surface.

K. Individual tiles may be bolted together with 1/4 inch bolts or equivalent hardware to help ensure adjacent tiles are flush to each other during installation process.
   1. Place tape or sealant on underside of bolted edge to prevent concrete from rising up between tiles during installation
      a. Replace protective plastic wrap peeled back to facilitate bolting or cutting by taping to ensure tile surface remains free of concrete during installation process
   2. Replace sound-amplifying plates on underside of tile dislodged during handling or cutting and secure with construction adhesive
      a. Air gap created between plates and bottom of tile is important in preserving sound on cane audible properties of tiles.
   3. Applications of sealant shall be level to adjacent surface and straight line formed to tile edge.
      a. Mask off tile faces with duct tape to ensure clean definition of sealant to adjacent surfaces.

L. Pavement Markings: Refer to Section 32 1723 for coordination of pavement markings with tactile warning surface locations.

3.02 CLEANING AND PROTECTING

A. Protect panels against damage during construction period to comply with tactile tile manufacturer’s specification.

B. Protect tiles against damage from rolling loads following installation by covering with plywood or hardwood.

C. Clean tactile tiles not more than four days prior to date scheduled for inspection intended to establish date of substantial completion in each area of project.
   1. Clean tactile tile by method specified by tile manufacturer.

D. Comply with manufacturer's maintenance manual for cleaning and maintaining tile Surface.
   1. Perform recommended annual inspections for safety and tile integrity.
E. Remove and legally dispose of rubbish, debris, and waste materials off Project Site.

F. Protect Work until Substantial Completion.

END OF SECTION 32 1726