PROJECT MANUAL

Divisions 00-28

Steamboat Base Village Redevelopment

2305 Mount Warner Circle
Steamboat Springs, Co. 80487

BP4C-KIDS VACATION CENTER (KVC)
BP4D – GSQ INTERIORS BUILDING A, C, F,
ISSUE FOR PERMIT & ISSUE FOR CONSTRUCTION
JUNE 4, 2021

Project Number: 003.7835.000

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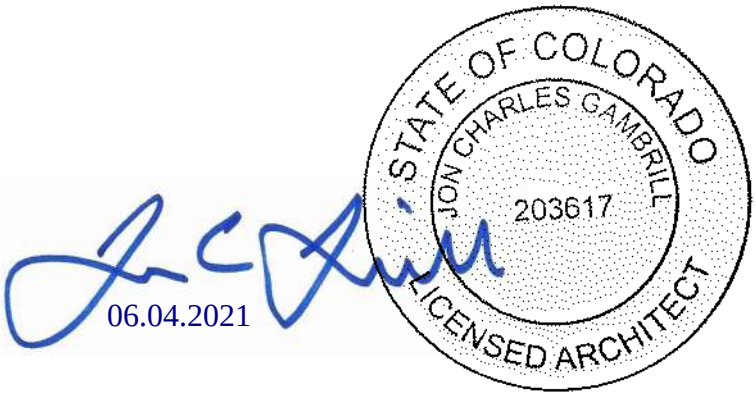

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SECTION 01 10 00 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work by Owner.
4. Work under separate contracts.
5. Specification and drawing conventions.
6. Miscellaneous provisions.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to the Work of all Sections in the Specifications. The Contract Documents are complementary, and what is required by one shall be as binding as if required by all.

B. Conflicts or discrepancies among the Contract Documents shall be resolved in the following order of priority:

1. Contract modifications (such as Change Orders and Bulletins) of later date take precedence over those of earlier date.
2. The Agreement.
3. Addenda of later date take precedence over those of earlier date.
4. The Supplementary Conditions.
5. The General Conditions.
6. Drawings and Specifications; Drawings govern Specifications for quantity and location. Specifications govern Drawings for quality and performance. In the event of ambiguity or conflicts, the greater quantity and the better quality shall govern.

1.3 PROJECT INFORMATION

A. Project Identification: BP4D Gondola Square interiors Building A, C, and F. - Issue for Permit and Construction. BP4C- KVC (Kids Vacation Center) Interiors Issue for Permit and Construction.

1. Project Location: 2305 Mt Warner Circle, , Steamboat Springs, CO. 80487.

B. Owner: Alterra Mountain Company Real Estate Development.

1. Owner's Representative: Mike Schmidt, Vice President of Development, MSchmidt@alterramtnco.com, 303.749.8262.

2. Owner Representative: Gregg Riker, Rikon Management, rikonutah@gmail.com, 801. 428.7672

C. Architect: Jon Gambrill, Principal in Charge, jon_gambrill@gensler.com, 303.595.8585.

1. Mechanical, Electrical, Plumbing, ME Engineers, Matt Edwards, Assoc. Principal. Matt.Edwards@me-engineers.com, 720. 898-3164

D. Project Web Site: A project Web site administered by Contractor will be used for purposes of managing communication and documents during the construction stage.

1. See Section 01 31 00 "Project Management and Coordination" for requirements for establishing, administering, and using the Project Web site.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents The work is to include the interior renovation of the Existing Gondola Square Buildings - A, C, and F to create business occupancy workspace.

B. The work also includes the interior renovation of a portion of the first floor of the existing Sheraton hotel into the Kids Vacation Center (KVC).

C. For both Projects, the work will include new partitions, ceilings, finishes, mechanical, electrical, and plumbing, Minor exterior renovation supporting the interior renovations is also included.

D. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 WORK BY OWNER

A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.

1. Salvage of all items that owner deems valuable prior to contractors starting work.

1.6 WORK UNDER SEPARATE CONTRACTS

A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.

1. Preceding Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract beginsBPA - Demolition Lower Gondola Building, Building B, and Stage
2. BP2B- Demolition KVC

1.7 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00

SECTION 01 13 00 - DELEGATED DESIGN REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Administrative and procedural requirements for portions of the Work the design of which is delegated to the Contractor.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1. AHJ: Authority Having Jurisdiction.

B. Definitions:

1. Delegated: Means transferred by the Architect to the Contractor.
2. Design: Means the complete planning, arrangement, and coordination of a discrete portion of the work, along with its graphic and written communication, including determination and engineering of its organization and structure in response to aesthetic requirements, functional requirements, dimensional and geometric limits, and the arrangement, performance, and other criterion indicated in the Contract Documents.
3. Engineering Services: Means structural engineering services performed for the design, fabrication, and installation of systems, assemblies, and components similar in material, design, complexity and extent to that indicated for the delegated design portion of the Work.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Portions of the Contract Documents may delegate the design of discrete portions of the Work to the Contractor, or may otherwise specify "delegated design requirements" in individual specification Sections.

B. The Contractor is professionally liable for delegated design work, including design, engineering, and conformance to specified performance requirements.

C. Drawings of delegated design portions of the Work are diagrammatic; they do not identify or imply solutions to engineering aspects of the portions of the Work that are required to be designed by the Contractor, and are intended to only indicate:

1. The design intent of final profiles, shapes and forms of the specified materials;
2. Relationships between adjacent components of the Work;
3. Location, identification, dimension and size of components, assemblies, accessories, and other components of the Work; and
4. Schematic joining and attachment details and diagrams of fasteners and connections.

D. Specifications for delegated design portions of the Work are performance based, and establish the minimum qualities and performance criteria for materials, fabrications, products, systems, assemblies, and methods of execution.

E. The Architect reviews and determines whether or not the Contractor's proposed delegated designed work:

1. Conform to the design intent of the delegated design portion of the Work being reviewed;
2. Conform to the specified graphic and specification requirements, including subsequent modifications; and
3. Is appropriately integrated into the adjacent components of the Work and, where applicable, the overall design of the project.

F. In the event of a dispute regarding the Contractor's proposed delegated design solutions and the design intent of the Contract Documents, the decision of the Architect is final.

1.4 PROCEDURAL REQUIREMENTS

A. Design Requirements: Proposed delegated design solutions shall demonstrate conformance to the original design intent of the Contract Documents, as determined by the Architect.

1. Unless otherwise defined by the Contract Documents, the appearance of exposed elements, including member sizes, profiles, and alignment of components shall be within the dimensional limits and section profiles indicated, and consistent throughout the Project where the delegated design component of the Work is to be installed.
2. Deviation from the profiles, layouts, dimensional locations, or arrangements indicated is not permitted without prior written consent from the Architect.
3. Deviations from the specifications are not permitted without prior written consent from the Architect.
4. Contractor-proposed delegated design solutions that exactly follow the details indicated on the Drawings do not relieve the Contractor from liability for the design, fabrication, and performance of the delegated design portions of the Work.

B. Engineering Requirements: Engineer delegated design portions of the Work shall;

1. Meet or exceed the specified performance performance and quality requirements;

2. Conform to the dimensional and graphic requirements of the Drawings;
3. Satisfy the requirements of the AHJ; and
4. Provide structurally sound, leak-proof, non-corroding, and weather tight assemblies, as applicable, that accommodate, resist, distribute, or transfer, as applicable, the minimum specified in-service loads, and thermal, seismic, and wind sway, or other types of movement, without incipient or catastrophic failure.

C. Regulatory Requirements: Delegated design items shall be engineered in conformance with the International Building Code and Insert building code having jurisdiction.

1.5 SUBMITTALS

A. General: Coordinate and process submittals for delegated design portions of Work in same manner as for other portions of Work.

B. Professional Engineer's qualifications.

C. Design Data: Submit structural engineering calculations demonstrating conformance to the requirements of the Contract Documents and of the AHJ.

1. Calculations must be legible and incorporate sufficient cross-references to shop drawings to make calculations readily understandable and reviewable.
2. At a minimum, structural calculations must contain:

    a. An analysis of framing members;
    b. Section property computations for framing members;
    c. An analysis of anchors, including anchors embedded in concrete; and
    d. The signature and seal of the professional structural engineer, licensed in the state of CO.e, and responsible for their preparation.

3. Test reports are not an acceptable substitute for calculations.

1.6 QUALITY ASSURANCE

A. Professional Structural Engineer's Qualifications: Must be legally licensed or otherwise qualified to practice in the state of CO.. The engineer shall have not less than 10 consecutive years' experience providing engineering services for delegated design work similar in material, design, complexity, and extent to this Project, as determined by the Architect, and whose Work products have resulted in installations with a record of successful in-service performance.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials, fabrications, products, components, and accessories required for a complete installation, whether or not such items are indicated on the Drawings or in the Specifications.

B. Provide anchors, attachments, inserts, fasteners, clips, bracing, framework, and similar items as required to meet specified design and performance requirements, and to securely attach delegated design Work to adjacent supports, or to adjoining work, whether or not such items are indicated on the Drawings or in the Specifications.

PART 3 - EXECUTION

3.1 DESIGN

A. Unless otherwise indicated or specified, maintain the design intent and conform to the performance requirements indicated on the Drawings and in the Specifications, as determined by the Architect.

1. In the interest of fabrication or erection methods, minor dimensional changes and detailing adjustments to the original design communicated in the Contract Documents may become necessary.
2. Obtain written approval from the Architect for proposed changes and adjustments before procurement, fabrication, manufacture, assembly, or installation, as applicable.

B. Engage a qualified professional structural engineer to design connection details and determine fastener types and sizes.

1. Fasteners or connections may neither conflict with nor require revision to the finish profiles indicated or the supporting work.
2. Connections may not impose eccentric loading, nor induce twisting or warping to the supporting structure.
3. Connections must be designed to accommodate potential and actual misalignment of adjacent work within tolerances specified in other Sections.

3.2 DELEGATED DESIGN SCHEDULE

A. Section 05 50 00 "Metal Fabrications," for metal items made from iron and steel, stainless steel, and non-ferrous metal shapes.

B. Section 05 52 13 "Pipe and Tube Railings," for railings fabricated from aluminum, stainless steel, and steel pipe and tubing.

C. Section 05 70 00 "Decorative Metal," for Custom Fabrications from non-ferrous and ferrous metals.

D. Section 08 44 13 "Glazed Aluminum Curtain Walls," for stock aluminum curtain wall systems.

E. Section 08 81 00 "Glazing," for all glazing.

F. Section 09 21 16.23 "Gypsum Board Shaft-Wall Assemblies," for light gauge metal framing of vertical shafts and horizontal duct enclosures.

G. Section 09 22 16 "Non-Structural Metal Framing," for light gauge metal framing of gypsum board, gypsum plaster, and portland cement plaster partitions and ceilings.

H. Section 09 51 13 "Acoustical Panel Ceilings," for ceiling suspension systems.

END OF SECTION 01 13 00

SECTION 01 14 00 - WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Existing utility interruptions.
2. Use of premises.
3. Occupancy requirements during construction.
4. Occupancy requirements prior to Substantial Completion.
5. Miscellaneous restrictions.

1.3 EXISTING UTILITY INTERRUPTIONS

A. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Owner not less than 5 days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

1.4 USE OF PREMISES

A. Access: At all times, provide the Architect and the Owner's representatives, easy and safe access to the Work wherever it is in preparation and progress. Provide such access so Architect may perform its functions. Provide access to any testing agencies to perform required testing.

B. Property Manager's Rules: Conform at all times to the Owner¢s requirements for protection of plant, materials, equipment, and noise levels. A copy of the Owner¢s rules will be furnished from the Owner upon written request.

C. Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

D. Use of Site: Confine operations at the site to areas permitted by law, ordinances, permits, and the Contract Documents. Do not unreasonably encumber the Site with any materials or equipment. Coordinate loading on floor or roof with Architect and/or Structural Engineer to assure that no surfaces exceed carrying capacity.

1. Coordinate with Owner for secured storage within the building, if applicable.
2. Protect and maintain common areas of the building that are in the path of travel for construction personnel and used for transporting materials and equipment to and from the construction site.

3. Limits: Confine constructions operations to Contract Limits.

    a. Limit site disturbance, including earthwork and clearing of vegetation, to 40 feet beyond building perimeter; 10 feet beyond surface walkways, patios, surface parking, and utilities; less than 12 inches in diameter; 15 feet beyond primary roadway curbs and main utility branch trenches; and 25 feet beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require staging areas in order to limit compaction in the constructed area.

4. Driveways and Entrances: Keep driveways, parking lots, loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

    a. Schedule deliveries to minimize use of driveways and entrances.
    b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

5. Do not block entrances, fire exits or lanes, or delivery routes.
6. Limit use of driveways and entrances to the following times:

    a. Work hours as defined by Owner.

E. On-Site Work Hours: Limit work in the existing building to normal business working hours, Monday through Friday, as defined by Owner, unless otherwise indicated.

1. Hours for Noise-Generating, Odor-Generating, and Dust-Generating Activities and Demolition: After business hours, or at such times as approved by the Owner.

a. Noise- and Odor-Generating activities include, but are not limited to, sprinkler work, concrete saw cutting, core drilling, spray painting, hammering, nailing, and similar work, which may cause noise, dust, or odors, thereby disturbing occupants.

F. Condition in Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations. Protect building and its occupants during construction period.

1.5 OCCUPANCY REQUIREMENTS DURING CONSTRUCTION

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
3. Schedule use of premises for Work and coordinate construction operations with the Owner to allow for Owner occupancy.
4. Schedule use of premises for Work and coordinate construction operations with the Owner to allow for use of site and premises by the public.
5. Keep premises orderly, clean and with a minimum of obstruction and inconvenience to the tenants and the public.
6. Relocate any stored products that interfere with public access, operations of the Owner or separate contractor. If necessary, obtain and pay for additional storage or work areas needed for operations.

1.6 OCCUPANCY REQUIREMENTS PRIOR TO SUBSTANTIAL COMPLETION

A. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will provide, operate, and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.7 MISCELLANEOUS RESTRICTIONS

A. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than 5 days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

B. Controlled Substances: Use of tobacco products and other controlled substances within the existing building on Project site is not permitted.

C. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

D. Employee Screening: Comply with Owner's requirements for drug and background screening of Contractor personnel working on Project site.

1. Maintain list of approved screened personnel with Owner's representative.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 14 00

SECTION 01 25 00 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Sections:

1. Section 01 60 00 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
2. Divisions 02 through 49 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

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

1. Substitution Request Form: Use facsimile of "Substitution Request" form provided in Document 00 60 00 "Forms."
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

    a. Statement indicating why specified product or fabrication, or installation cannot be provided, if applicable.
    b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, necessary to accommodate proposed substitution.
    c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
    e. Samples, where applicable or requested.
    f. Certificates and qualification data, where applicable or requested.
    g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
    i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES and local regulations.
    j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
    k. Cost information, including a proposal of change, if any, in the Contract Sum.
    l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
    m. 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.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 10 working days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Forms of Acceptance: Change Order, Construction Change Directive, or Bulletin for minor changes in the Work.
    b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

    a. Requested substitution is consistent with the Contract Documents and will produce indicated results.

b. Requested substitution provides sustainable design characteristics that specified product provided.
c. Substitution request is fully documented and properly submitted.
d. Requested substitution will not adversely affect Contractor's construction schedule.
e. Requested substitution has received necessary approvals of authorities having jurisdiction.
f. Requested substitution is compatible with other portions of the Work.
g. Requested substitution has been coordinated with other portions of the Work.
h. Requested substitution provides specified warranty.
i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience: Not allowed, unless otherwise indicated.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 01 25 00 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

A. Architect may issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on "Bulletin" form included in Document 00 60 00 "Forms."

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Bulletins with "Architect's Request for Contractor's Proposal" indicated, issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Bulletin after receipt of Bulletin, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals (Change Order Request): If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 01 25 00 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 26 00

SECTION 01 26 13 - REQUESTS FOR INTERPRETATION (RFI)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Requests for Interpretation.

1.3 DEFINITIONS

A. Requests for Interpretation (RFI): Contractor initiated written instrument related to the execution of the Work that is addressed to the Architect. The RFI shall be used by the Contractor as the means to ask questions related to the Work; subject to the conditions contained within this Section.

1.4 ACTION SUBMITTALS

A. Requests for Interpretation: Include a detailed, legible description of an item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI number, numbered sequentially.
7. RFI subject.
8. Reference to appropriate documents:

    a. Specification Section number and title and related paragraphs.
    b. Drawing number and detail references.
    c. Schedule.

d. Bulletin number.
e. Other Contract Documents, if any.

9. Field dimensions and conditions, as appropriate.
10. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
11. Contractor's signature.
12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

B. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in Adobe Acrobat PDF format.

1.5 INFORMATIONAL SUBMITTALS

A. RFI Log: Prepare, maintain, and submit a tabular log of RFI organized by the RFI number. Submit log weekly. Use software log that is part of Project Web site.

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.

1.6 QUALITY ASSURANCE

A. Authorship: Prior to the commencement of the RFI process, designate a full time "RFI Manager" whose duties shall include the responsibility for enforcing the Request for Interpretation provisions of this Section, to maintain an up-to-date log of all RFI, advise the Architect, in writing, of the status and disposition of all RFI at the progress meetings, and be a member of the Contractor's staff. The RFI Manager shall be experienced in administration and supervision of the type of Work indicated on the Contract Documents.

1. RFI Manager may be the Contractor's Job Superintendent.

2. Each RFI shall originate solely from the RFI Manager. An RFI submitted to the Architect by an entity, or individual, other than the RFI Manager shall be returned to the Contractor.

1.7 ADMINISTRATIVE REQUIREMENTS

A. Processing Time: Allow five working days for Architect's response for each RFI. RFI received by Architect after 3:00 p.m. will be considered as received the following business day.

1. Allow additional time if coordination with other work is required. Architect will advise Contractor when a RFI being processed must be delayed for coordination.
2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.

B. Architect's action on RFI that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Proposal Request according to Section 01 26 00 "Contract Modification Procedures."

1. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

C. Frivolous RFI:

1. RFI shall not be used for the following:

a. Request for approval of submittals.
b. Request approval of substitutions.
c. Requests for approval of Contractor's means and methods.
d. Request for adjustment in the Contract Time or the Contract Sum.
e. Requests for interpretation of Architect's actions on submittals.
f. Requests for coordination information already indicated in the Contract Documents, or to transfer coordination responsibility from the Contractor to the Owner or Architect.
g. Incomplete RFI or inaccurately prepared RFI.

2. The Owner reserves the right to assess the Contractor for the cost (based on time and materials) of a RFI response performed by the Architect, and any of its consultants, which is deemed by the Owner and the Architect or Construction Manager as being frivolous or unnecessary.
3. Frivolous RFI shall be removed from the RFI log.

1.8 COORDINATION

A. Coordination: Coordinate preparation and processing of RFI with performance of construction activities.

1. Submit RFI with such promptness as to cause no delays in the Work. No adjustments of Contract Time or Contract Sum will be granted because of failure to have an RFI submitted with sufficient time to allow for the orderly processing of a response by the Architect.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 CONTRACTOR'S ACTION

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, prepare and submit an RFI in the form specified.

B. Prior to submission of the RFI, coordinate the nature of the inquiry with the requirements of other Sections or trades as related thereto and responses to previous RFI.

C. Complete each blank on the RFI form.

D. In preparing each RFI, verify the applicable dimension(s), field conditions, Drawing requirements (small through large scale details), and/or Specification Section requirements pertaining thereto.

E. Each RFI shall be reviewed, and signed by the RFI Manager prior to transmitting to the Architect .

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

3.2 ARCHITECT'S[AND CONSTRUCTION MANAGER'S] ACTION

A. Architect's Action: Architect will review each RFI, determine action required, and respond.

1. Frivolous RFI will be returned without action.

B. RFI which fail to conform to requirements, (for example, is incomplete or contain numerous errors) shall be returned to the Contractor without a response. No adjustments for Contract Time or Contract Sum shall be granted for an RFI failing to conform to requirements.

END OF SECTION 01 26 13

SECTION 01 29 00 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Sections include the following:

1. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
2. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule.

1.3 DEFINITIONS

A. Site Visit: Architect's visits to the site at intervals necessary in the judgment of Architect to become generally familiar with the progress and quality of the Work completed and to determine in general if the Work completed is in accordance with the Contract Documents. Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work.

B. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:

    a. Application for Payment forms with Continuation Sheets.
    b. Submittals Schedule.
    c. Items required to be indicated as separate activities in Contractor's Construction Schedule.

2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

3. Sub schedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide sub schedules showing values correlated with each phase of payment.

4. Sub schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide sub schedules showing values correlated with each element.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one-line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:

    a. Project name and location.
    b. Name of Architect.
    c. Architect's project number.
    d. Project Manager's name and address.
    e. Contractor's name and address.
    f. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:

    a. Related Specification Section or Division.
    b. Description of the Work.
    c. Name of subcontractor.
    d. Name of manufacturer or fabricator.
    e. Name of supplier.

f. Change Orders (numbers) that affect value.
g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

1) Labor.
2) Materials.
3) Equipment.

4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum. Break down principal subcontract amounts into separate labor and materials items. Breakdown of subcontractor's schedule of values must be true and accurate.
5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

a. Differentiate between items stored on-site and items stored off-site. Include evidence of insurance or bonded warehousing if required.

7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Include separate line items under Contractor and principal subcontracts Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.

9. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.

10. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial 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: The date of each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
2. Include amounts of work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
4. Indicate separate amounts for work being carried out under Owner-requested project acceleration, if any.

E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and off-site.

1. Provide description of item(s) being stored.
2. Location of the bonded warehouse(s) where materials or equipment is stored.
3. Bill of sale made to Owner stating there will be no additional cost for transportation and delivery of the stored item(s).
4. Statement certifying that item, or any part thereof will not be installed in any construction other than Work under this Contract.
5. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

6. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
7. Provide summary documentation for stored materials indicating the following:

    a. Materials previously stored and included in previous Applications for Payment.
    b. Work completed for this Application utilizing previously stored materials.
    c. Additional materials stored with this Application.
    d. Total materials remaining stored, including materials with this application.

F. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

G. Waivers of Mechanic's Lien: With each Application for Payment, submit notarized waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.

1. Submit partial waivers on each item for amount requested, before deduction for retainage, on each item.
2. When an application shows completion of an item, submit final or full waivers.
3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
4. Submit final Application for Payment with or preceded by final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.

H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

1. List of subcontractors, principal suppliers, and fabricators.
2. Schedule of Values.
3. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
4. Products list (preliminary if not final).
5. Submittals Schedule (preliminary if not final).

6. List of Contractor's staff assignments.
7. List of Contractor's principal consultants.
8. Copies of building permits.
9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
10. Initial progress report.
11. Report of preconstruction conference.
12. Certificates of insurance and insurance policies.
13. Performance and payment bonds.
14. Data needed to acquire Owner's insurance.
15. Initial settlement survey and damage report if required.
16. Construction waste management program.

I. Application for Payment at Substantial Completion: After issuance of the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

1. Evidence of completion of Project closeout requirements, including, but not limited to:

    a. Transmittal of required Project Record Documents to Owner.
    b. Evidence of completion of demonstration and training.

2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

10. Occupancy permits and similar approvals or certifications by governing authorities and franchised services, assuring Owner's full access and use of completed work.

1.6 REVIEW OF APPLICATION FOR PAYMENT

A. Draft Copy: Submit draft (pencil) copy of the Application for Payment ten days prior to due date for review by Architect.

B. Upon receipt of the official Application for Payment and other documentation as required by the Architect, including the updated Schedule of Values and the updated Contractor's Construction Schedule if required, the Architect shall review the documents received to determine if they correspond to the agreements reached during the draft copy review meeting.

C. The Architect will rely on the accuracy and completeness of the information furnished by the Contractor. Issuance of a Certificate of Payment will not be deemed to represent that the Architect performed audits of the supporting data.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00

SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections

1. Section 23 05 01 / 26 05 01 'Mechanical Electrical Coordination" for additional requirements for coordination drawings and procedures.

1.2 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:

1. General project coordination procedures.
2. Coordination Drawings.
3. Project Web site.
4. Administrative and supervisory personnel.
5. Project meetings.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Section 01 32 00 "Construction Progress Documentation" for preparing and submitting the Contractor's Construction Schedule.
2. Section 01 73 00 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 01 77 00 "Closeout Procedures" for coordinating Contract closeout.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Prepare Coordination Drawings if limited space availability necessitates maximum utilization of space for efficient installation of different components or if coordination is required for installation of products and materials fabricated by separate entities or as specified in individual Sections.

1. Indicate relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.

B. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A in Document 00 60 00 "Forms." Include the following information in tabular form:

1. Name, address, and telephone number of entities performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

C. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in project meeting room, in temporary field office, on Project Web site, and by each temporary telephone. Keep list current at all times.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.

2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.
4. Arrange pipes, ducts, conduits, and other overhead systems in an orderly manner when indicated to remain exposed.

B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

1.5 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.

b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
f. Indicate required installation sequences.
g. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.

3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:

a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.

b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts, and electrical distribution equipment.
c. Fire-rated enclosures around ductwork.

7. Electrical Work: Show the following:

a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
d. Location of pull boxes and junction boxes dimensioned from column center lines.

8. Fire-Protection System: Show the following:

a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.

9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.

10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 33 00 "Submittal Procedures."

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.

2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.

3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.

b. Digital data files will be provided in the software and format that is used to prepare the Contract Documents. Translations to different programs or modifications to the drawing setup will be the responsibility of the Contractor.
c. Contractor shall execute a data licensing agreement in using the "Gensler Data Transfer Agreement".

1.6 PROJECT WEB SITE

A. The Contractor shall provide, administer, and use a Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. Project Web site shall include the following functions:

1. Project directory.
2. Project correspondence.
3. Meeting minutes.
4. Contract modifications forms and logs.
5. RFI forms and logs.
6. Task and issue management.
7. Photo documentation.
8. Schedule and calendar management.
9. Submittals forms and logs.
10. Payment application forms.
11. Drawing and specification document hosting, viewing, and updating.
12. Online document collaboration.
13. Reminder and tracking functions.
14. Archiving Function

B. Provide Project Web site user licenses for use of the Owner, Owner's Commissioning Authority, Architect, and Architect's consultants. Provide eight hours of software training online for Project Web site users.

C. On completion of Project, provide one complete archive copy of Project Web site files to Owner and to Architect in a digital storage format acceptable to Architect.

D. Provide one of the following Project Web site software packages under their current published licensing agreements:

1. Autodesk, BIM 360 Docs.
2. Procore Technologies.
3. Contractor specific web site software that meets the listed requirements.

E. Contractor, subcontractors, and other parties granted access by Contractor to Project Web site shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.

1.7 PROJECT MEETINGS

A. General: General Contractor will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
4. Notification: Inform participants three days prior to meetings not regularly scheduled.

B. Preconstruction Conference: a preconstruction conference before starting construction, at a time convenient to Owner, Construction Manager, if one is retained by Owner, and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; testing laboratory representatives; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Requirements in individual Specification Sections for preconstruction responsibilities.
    b. Tentative construction schedule.
    c. Project coordination
    d. Critical work sequencing and long-lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communication.
    g. Procedures for processing Requests for Interpretation (RFIs.)

h. Procedures for processing Bulletins.
i. Procedures for processing submittals.
j. Procedures for processing substitution requests.
k. Procedures for processing field decisions, proposal requests and Change Orders.
l. Procedures for testing and inspecting.
m. Procedures for processing Applications for Payment.
n. Distribution of the Contract Documents.
o. Preparation of Record Documents.
p. Use of the premises and existing building.
q. Work restrictions.
r. Working hours.
s. Owner's occupancy requirements.
t. Responsibility for temporary facilities and controls.
u. Procedures for moisture and mold control.
v. Procedures for disruptions and shutdowns.
w. Construction waste management and recycling.
x. Office, work, and storage areas.
y. Equipment deliveries and priorities.
z. First aid.
aa. Security.
bb. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFI.
d. Related Change Orders.
e. Purchases.
f. Deliveries.

g. Submittals.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: a project closeout conference, at a time convenient to Owner and Architect, but no later than 30 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of record documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Submittal of written warranties.
d. Requirements for preparing operations and maintenance data.
e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures for closeout documents.
j. Owner's partial occupancy requirements.
k. Installation of Owner's furniture, fixtures, and equipment.
l. Responsibility for removing temporary facilities and controls.

E. Progress Meetings: progress meetings at weekly intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Resolution of BIM component conflicts.
4) Status of submittals.

5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site utilization.
9) Temporary facilities and controls.
10) Work hours.
11) Hazards and risks.
12) Progress cleaning.
13) Quality and work standards.
14) Pending changes
15) Status of Change Orders.
16) Pending claims and disputes.
17) Documentation of information for payment requests.
18) Testing and inspection requirements.
19) Status of Request for Information.
20) Other business relating to the Work.

4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

    a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00

SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor's construction schedule.
2. Daily construction reports.
3. Material location reports.
4. Site condition reports.
5. Special reports.

B. Related Sections include the following:

1. Section 01 29 00 "Payment Procedures" for submitting the Schedule of Values.
2. Section 01 31 00 "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
3. Section 01 33 00 "Submittal Procedures" for submitting schedules and reports.
4. Section 01 40 00 "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.

2. Predecessor activity is an activity that must be completed before a given activity can be started.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.

D. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.

H. Major Area: A story of construction, a separate building, or a similar significant construction element.

I. Milestone: A key or critical point in time for reference or measurement.

J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

K. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format, unless indicated otherwise:

1. PDF electronic file.

B. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

C. Construction Schedule Updating Reports: Submit with each Application for Payment.

D. Site Condition Reports: Submit at time of discovery of differing conditions.

E. Special Reports: Submit at time of unusual event.

1.5 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from parties involved.
2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

C. Coordinate Contractor's construction schedule with Owner's construction schedule for Owner's own forces. Revise Contractor's construction schedule, if necessary, after a joint review and mutual agreement. The construction schedule shall then constitute the schedule to be used by Contractor, separate contractors, and Owner until subsequently revised.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of Final completion.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.

1. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 01 10 00 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion

D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered RFI.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and Contract Time.

E. Recovery Schedule: When periodic update indicates the Work is 10 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

F. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules. Coordinate with Architect regarding which project management software will be used on the Project.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's Construction Schedule using a time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Work.

    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.

2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.

4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:

    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and commissioning.
    j. Punch list and final completion.
    k. Activities occurring following final completion.

2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.

    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediately preceding and succeeding activities.

5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.
10. Dollar value of activity (coordinated with the Schedule of Values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
4. Changes in activity durations in workdays.
5. Changes in the critical path.
6. Changes in total float or slack time.
7. Changes in the Contract Time.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. Approximate count of personnel at Project site.
3. Equipment at Project site.
4. Material deliveries.
5. High and low temperatures and general weather conditions, including rain or snow accumulation.
6. Accidents.
7. Meetings and significant decisions.
8. Unusual events (refer to special reports).
9. Stoppages, delays, shortages, and losses.
10. Meter readings and similar recordings.
11. Tests and inspections, including name(s) of testing and inspection agency(ies).
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.

18. Partial Completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare a detailed report. Submit with a Request for Interpretation (RFI). Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare, and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.
4. Notify Owner and Architect a minimum of one week prior to issuance of updated schedule of all anticipated significant revisions to the Construction Schedule.

B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post electronic copies of the updated project schedule on the project website.
2. Post copies in Project meeting rooms and temporary field offices.
3. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 32 00

SECTION 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

A. Action Submittals: Written and graphic information and physical samples that require Architect's and Commissioning Agent's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.

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

C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.3 ACTION SUBMITTALS

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

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.

3. Format: Arrange the following information in a tabular format:

    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal category: Action, informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled dates for purchasing.
    h. Scheduled dates for installation.
    i. Activity or event number.

4. Architect reserves the right to withhold 10 percent of each payment request, in addition to retainage fee if any, until the submittal schedule is received and accepted by the Architect.

1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. Architect's Digital Data Files: Electronic copies of Drawings of the Contract Drawings and Project Manual will not be provided by Architect.

B. Architect's Digital Data Files: At Contractor's written request, electronic copies of Drawings of the Contract Drawings and Project Manual will be provided by Architect for Contractor's use in preparing submittals and Project record documents.

1. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
2. Execute and submit the Data Transfer Agreement form included in Document 00 60 00 "Project Forms." Do not distribute digital data drawing files prior to transmitting to Architect copies of Data Transfer Agreement signed by each entity requesting the files.

C. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Submit all Action and Informational submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.

    a. Exception: Where samples for initial selection and samples for verification are both required, submit samples for verification after initial selection has been returned by Architect.

3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. Architect will document on submittal the date of receipt. Submittals received by Architect after 1:00 p.m. will be considered as received the following working day. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Allow 10 working days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination. Delaying submittals to facilitate coordination between submittals shall not constitute a delay of the Work nor shall it be the basis for an extension of time.

2. Concurrent Consultant Review: Transmit submittals directly to Architect's consultants, provide duplicate copy of transmittal to Architect. Allow 15 days for initial review of each submittal. Submittal will be returned to Architect before being returned to Contractor. Concurrent review of submittals is limited to the following:

3. If intermediate submittal is necessary, process it in same manner as initial submittal.
4. Allow 15 days for review of each resubmittal.

E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file with links enabling navigation to each item.

    a. Unique identifier, including revision number. Submittals shall be numbered with the Section number, followed by a dash, followed by a three-digit number, followed by a dash, and ending with a sequential submission number as indicated below. The numbering system shall be retained throughout all revisions.

        1) Section Number: Section number where submittal is specified.
        2) Three-Digit Number: Sequential number, beginning with "001," for each submittal transmitted to Architect for each Section.
        3) Submission Number: Use "0" for initial submittal, "1" for first resubmittal, "2" for second resubmittal, and so forth.
        4) Example: 061000-001-0 (Section 06 10 00, first submission of the Section, initial submittal).

2. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Construction Manager.
3. Scanned Copies: Legible scanned PDF files of paper originals are acceptable. Scanned submittals that are not legible will be rejected.
4. Sheet Orientation: Orient PDF sheets to a "Ready-to-Read" orientation with majority of text horizontal to the sheet with no additional adjustments or formatting required by the viewer.
5. File Security: Do not set any permissions on the file. Protected documents will not be accepted.

6. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software.
7. Metadata: Include the following information in the electronic submittal file metadata:

    a. Title: Project title
    b. Author: Contractor's name.
    c. Subject: Submittal type (product data, shop drawing, report, etc.)
    d. Keywords: Number and title of appropriate Specification Section; manufacturer name; product name/model number.

8. File Size: Limit file size of each submittal as follows. Break larger PDF files into multiple packages where necessary to meet delivery restrictions. Identify split packages as "1 of #" and "2 of #" in the subject line.

    a. Email Delivery: 2 Megabytes.
    b. FTP Delivery: 100 Megabytes.

F. Options: Identify options requiring selection by Architect.

G. Deviations and Additional Information: On an attached separate document, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are stamped with Architect's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED
4. Costs of compensation for Architect's additional services and expenses made necessary for review of submittals exceeding the limits set forth below shall be at the Contractor's expense.

    a. Reviews of Each Submittal: Two, including initial review.

I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals with Architect's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS AS NOTED

K. The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples or similar submittals until the respective submittal has been reviewed by Architect and returned to Contractor with Architect's action stamp marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS AS NOTED

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project. Do not post zipped files.

    a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

2. Submit electronic submittals via email as PDF electronic files. Do not post zipped files.

    a. Architect, through Construction Manager, will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."
4. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

    a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

5. Systems Submittals: Identify submittals for systems such as fire alarms and fire protection systems, on the transmittal and act upon the system singularly as a combined submittal. If resubmission is required, resubmit entire system submittal,

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

    a. Manufacturer's catalog cuts.
    b. Manufacturer's written recommendations.
    c. Manufacturer's product specifications.
    d. Standard color charts.
    e. Mill reports.
    f. Standard product operating and maintenance manuals.
    g. Compliance with recognized trade association standards.
    h. Compliance with recognized testing agency standards.
    i. Application of testing agency labels and seals.
    j. Notation of coordination requirements.
    k. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:

    a. Wiring diagrams showing factory-installed wiring.
    b. Printed performance curves.
    c. Operational range diagrams.
    d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:

    a. PDF electronic file.
    b. Paper copies.

C. LEED Submittals: Information required to document LEED credits as defined in other Division 01 Sections and in individual Specification Sections. Include "LEED Criteria Worksheet" in Document 00 60 00 "Forms" for every submittal for the Project.

1. Submit Product Data in the following format:

    a. PDF electronic file.

D. Shop Drawings: Prepare and submit Project-specific information, drawn accurately to scale. Do not reproduce, digitally or otherwise, the Contract Documents and submit as Shop Drawings. Do not use, copy, or reproduce title blocks, dimensions, notes, keynotes, symbols schedules or details from Contract Drawings, digital or otherwise. Use of the Contract Drawings shall be limited to reproduction, digitally or otherwise, of the exterior wall layout, interior partition layout, grid lines, doors, and windows. Do not base Shop Drawings on standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

    a. Identification of products.
    b. Fabrication and installation drawings.
    c. Roughing-in and setting diagrams.
    d. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
    e. Shopwork manufacturing instructions.
    f. Templates and patterns.
    g. Schedules.
    h. Design calculations.
    i. Compliance with specified standards.
    j. Notation of coordination requirements.
    k. Notation of dimensions established by field measurement.
    l. Relationship and attachment to adjoining construction clearly indicated.
    m. Seal and signature of professional engineer if specified.

2. Submit Shop Drawings in the following format:

    a. PDF electronic file.

E. Samples: Submit physical units of materials or products for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
3. Identification: Attach label on unexposed side of Samples that includes the following:

a. Generic description of Sample.
b. Product name and name of manufacturer.
c. Sample source.
d. Number and title of applicable Specification Section.
e. Specification paragraph number and generic name of each item.

4. Submit corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
5. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

    a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

6. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

    a. Number of Samples: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line.
    b. Architect will return submittal with options selected.

7. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

    a. Number of Samples:

        1) Submit three sets of Samples.
        2) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

3) Submit at least three sets of paired units that show approximate limits of variations if variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample.

b. Architect will retain one Sample set; remainder will be returned. Mark up and retain one returned Sample set as a Project record sample.

8. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:

a. Generic description of Sample.
b. Product name or name of manufacturer.
c. Sample source.

9. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.

a. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.

F. Product Schedule or List: Prepare and submit a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:

a. PDF electronic file.

G. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 29 00 "Payment Procedures."

H. Coordination Drawing Submittals: Comply with requirements specified in Section 01 31 00 "Project Management and Coordination."

I. Subcontract List: Prepare and submit a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Submit on the form included in Document 00 60 00 "Forms," "Subcontractors and Major Material Suppliers List."

1. Submit subcontract list in the following format:

a. PDF electronic file.

J. Contractor's Construction Schedule: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation" for action required.

K. Construction Photographs and Videos: Comply with requirements in Section 01 32 00 "Construction Progress Documentation."

L. Daily Construction Reports: Comply with requirements specified in Section 01 32 00 "Construction Progress Documentation."

M. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 40 00 "Quality Requirements."

N. Certified Surveys: Comply with requirements specified in Section 01 73 00 "Execution."

O. Closeout Submittals: Comply with requirements specified in Section 01 77 00 "Closeout Procedures."

P. Operation and Maintenance Data: Submit written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Section 01 77 00 "Closeout Procedures." Section 01 78 23 "Operation and Maintenance Data."

Q. Qualification Data: Submit written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names, and addresses of architects and owners, and other information specified.

R. Welding Certificates: Prepare and submit written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

S. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, where required, is authorized by manufacturer for this specific Project.

T. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.

U. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements.

V. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements.

W. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

X. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

Y. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.
5. Description of product.
6. Test procedures and results.
7. Limitations of use.

Z. Preconstruction Test Reports: Prepare and submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.

AA. Compatibility Test Reports: Prepare and submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

BB. Field Test Reports: Prepare and submit reports, written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.

CC. Manufacturer's Field Reports: Prepare and submit written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

DD. Manufacturer's Instructions: Submit written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

EE. Insurance Certificates and Bonds: Prepare and submit written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

FF. Material Maintenance Submittals: Comply with requirements specified in individual Sections for quantity and disposition of delivery of extra stock.

GG. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally-signed PDF electronic file digitally signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Section 01 77 00 "Closeout Procedures."

C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, coordinated, checked, and approved for compliance with the Contract Documents.

3.2 ARCHITECT'S [AND CONSTRUCTION MANAGER'S] ACTION

A. General: Architect will not review submittals that have not been properly transmitted, reviewed by Contractor, or do not bear Contractor's approval stamp and will return them without action.

B. Action Submittals: Architect will review submittal, make marks to indicate corrections or revisions required, and return it to Contractor. Architect will stamp each submittal with an action stamp as illustrated at the end of this Section, and will mark stamp appropriately to indicate action, as follows:

1. "NO EXCEPTIONS TAKEN": No further review of Submittal required.
2. "MAKE CORRECTIONS AS NOTED. Resubmittal not required unless Contractor cannot comply with corrections noted.": Incorporate corrections in Work. If Contractor cannot comply with corrections as noted, revise to respond to exceptions and resubmit.
3. "REVISE AS NOTED AND RESUBMIT": Revise as noted and resubmit for further review.
4. "RESUBMIT PROPERLY Submittal not reviewed for reasons noted."
5. "NOT REVIEWED Submittal not required by Contract Documents.": Remove from submittal log.
6. "RECEIVED FOR CLIENT'S RECORD ONLY. Submittal not reviewed."

C. Informational Submittals: Architect will review each submittal and will not return it or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

E. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

F. Submittals not required by the Contract Documents will not be reviewed and may be discarded or returned marked "NOT REVIEWED."

G. Substitution items received as product data, shop drawing, or sample submittals required by individual Sections will be returned to Contractor without review. Comply with requirements in Section 01 25 00 "Substitution Procedures" for submission of substitution request.

H. Submittals will not be considered complete without the required LEED supporting documentation that is required for the submission of the Project to USGBC and LEED Criteria Worksheet.

1. Architect reserves the right to reject any submittal that is missing the required LEED-related documentation.
2. Adjustments to the Construction Schedule will not be allowed for failure of the Contractor to submit all required LEED-related documentation as part of the first submission, or in an otherwise timely manner.
3. Increase of the Contract Sum will not be allowed in order to meet the specified LEED-related requirements.

END OF SECTION 01 33 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Sections:

1. Section 01 73 00 "Execution" for repair and restoration of construction disturbed by testing and inspecting activities.
2. Divisions 02 through 49 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site, unless indicated otherwise. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five unless noted otherwise within the specifications. previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

K. Professional Engineer: Engineer currently licensed to practice in the State of Colorado.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.

1. Indicate manufacturer and model number of individual components.
2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

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

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Testing Agency and Inspection Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

G. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

H. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

I. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. .

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Fabricator Qualifications: A firm experienced and expert in producing products similar to those indicated for this Project and with a three-year record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a three-year record of successful in-service performance.

E. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a five-year record of successful in-service performance.

F. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

G. Professional Engineer Qualifications: A professional engineer who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.

H. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersede building codes and similar regulations governing the Work, nor interfere with local trade-union jurisdictional settlements and similar conventions.

I. Testing Agency Qualifications: An NRTL, an NVLAP-accredited, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented by ASTM E 329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities..

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor responsibilities include the following:

a. Provide test specimens and assemblies representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Fabricate and install test assemblies and mockups using installers who will perform the same tasks for Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish specified in individual Sections, to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

a. Allow seven days for initial review and each re-review of each mockup.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed, unless otherwise indicated.

1.9 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of the types of testing and inspecting they are engaged to perform.

2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

    a. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
7. Provide quality assurance and control services required due to changes in the Work proposed by or made by the Contractor.
8. Provide quality control services for Work done contrary to the Contract Documents, without prior notice, when so specified, or without proper supervision.
9. Overtime expenses and schedule delays accruing as a result of executing quality control services shall be the Contactor's responsibility and shall not be charged to the Owner.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."

D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents. Architect retains the right to require the use of a different testing agency for retesting ad reinspecting.

F. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.
7. Attend Project progress meetings as requested by Architect.

G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Delivery of samples to testing agencies or arranging for pick-up of test samples after normal business hours.

6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit schedule concurrently with Contractor's Construction Schedule as specified in Section 01 32 00 "Construction Progress Documentation."

1. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.10 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

B. Special Tests and Inspections: Conducted by a qualified testing agency special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, as listed in the drawings, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.

5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.
7. .

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority¢s, reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for Section 01 73 00 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 42 00 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

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

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "As Required": As required by regulatory bodies, by referenced standards, by existing conditions, by generally accepted construction practice or by the Contract Documents. In the event of ambiguity or conflicts, the most stringent requirements shall apply.

J. "By Others" refers to work that is not a part of the Contract.

K. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

L. "NIC": "Not in Contract" means the work or the item indicated is not a part of the Contract and will be provided by the Owner.

M. "Day": Unless stated otherwise, "day" means a calendar day.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents, except comply with standards having different revision dates as referenced in the codes as indicated on Drawings.

C. Copies of Standards: Each entity engaged in construction on Project must be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source and make them available on request.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 42 00

SECTION 01 60 00 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Sections:

1. Section 01 25 00 "Substitution Procedures" for requests for substitutions.
2. Section 01 42 00 "References" for applicable industry standards for products specified.
3. Section 01 77 00 "Closeout Procedures" for submitting warranties for contract closeout.
4. Divisions 03 through 49 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.3 DEFINITIONS

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

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

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

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

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

1.4 ACTION SUBMITTALS

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

1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Form of Approval: As specified in Section 01 33 00 "Submittal Procedures."
    b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 01 33 00 "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

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

1. Each contractor is responsible for providing products and construction methods compatible with products and construction methods of other contractors.
2. If a dispute arises between contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products are undamaged and properly protected.
5. Store products to allow for inspection and measurement of quantity or counting of units.
6. Store materials in a manner that will not endanger Project structure.
7. Store products that are subject to damage by the elements, under cover in a 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 and liquids from freezing.
10. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

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

1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: Forms are included with the Specifications. Prepare a written document using appropriate form properly executed.
3. Refer to Divisions 03 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements Section 01 77 00 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. Components, materials, or parts required to be supplied in quantity within a Section shall be of the same manufacture, shall be interchangeable, and shall be the same with regard to function, texture, pattern, and color.

B. Except for building equipment in service areas, no manufacturers' labels or name plates shall be visible on any component, unless required by local authorities having jurisdiction.

2.2 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged, and unless otherwise indicated, that are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: Unless custom products or nonstandard options are specified, provide products of both quality and type that have been used successfully in similar situations on equal quality projects.
3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.

4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.
6. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.

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

1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:

    a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
    b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.

4. Manufacturers:

    a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.
    b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.

5. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product[**s**]" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
6. Visual Matching Specification: Where Specifications require matching an established Sample, provide a product (and manufacturer) that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches satisfactorily.

    a. If no product available within specified category matches satisfactorily and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.

7. Visual Selection Specification:

    a. Standard Range: Where Specifications include the phrase "as selected by Architect from manufacturer's standard range" or similar phrase, Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that does not include premium items.
    b. Full Range: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

8. Allowances: Refer to individual Specification Sections and "Allowance" provisions in Division 01 for allowances that control product selection and for procedures required for processing such selections.

2.3 COMPARABLE PRODUCTS

A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.

2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)
END OF SECTION 01 60 00

SECTION 01 73 00 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Construction layout.
2. Field engineering and surveying.
3. Installation of the Work.
4. Cutting and patching.
5. Coordination of Owner-installed products.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.

B. Related Sections include the following:

1. Section 01 31 00 "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
2. Section 01 33 00 "Submittal Procedures" for submitting surveys.
3. Section 01 77 00 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

4. Section 02 41 19 "Selective Demolition" for demolition and removal of selected portions of the building.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 QUALITY ASSURANCE

A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Exterior curtain-wall construction.
    d. Sprayed fire-resistive material.
    e. Equipment supports.
    f. Piping, ductwork, vessels, and equipment.
    g. Noise- and vibration-control elements and systems.
    h. .

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Section 01 81 13 "Sustainable Design Requirements."

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Before construction, verify the location and points of connection of utility services.

B. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping, and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

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

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

D. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

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

3.2 PREPARATION

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

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

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

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for interpretation to Architect according to Section 01 26 13 "Request for Interpretation."

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect [and Construction Manager] promptly.

B. General: Engage a land surveyor professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect [and Construction Manager].

3.4 FIELD ENGINEERING

A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect [and Construction Manager] before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

B. Benchmarks: Establish and maintain a minimum of [two] <Insert number> permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

3.5 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated. Where indicated to remain exposed, arrange overhead systems in an orderly manner.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.

F. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.

G. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

K. Protect adjacent property and adjoining work, including sealant bond surfaces, from spillage or blow-over of coatings, paints, sprayed fire-resistive material, and other spray-applied products. Cover adjoining and nearby surfaces, including live plants and grass, if there is possibility of spray-applied products being deposited on surfaces.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

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

C. Temporary Support: Provide temporary support of work to be cut.

D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 14 00 "Work Restrictions."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering, and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill. Avoid cutting steel reinforcement.

a. Locate steel reinforcement using Ground Penetrating Radar or Ferroscan prior to cutting or drilling reinforced concrete and masonry. If existing steel reinforcement is in proposed cut or hole location, contact Architect before proceeding with the Work.

4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.

5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

6. Proceed with patching after construction operations requiring cutting are complete.

H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.

a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, prepare substrate, and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Ceramic Tile: Provide ceramic tile and grout to match existing. Remove and replace tile damaged as a result of Work of this Contract. Comply with TCNA's "Handbook for Ceramic Tile Installation" for installation method to match existing. Lay tile in grid pattern to match existing. Make joints between existing and new tile same width so patches are not apparent in finished work.
6. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted. Comply with Section 01 74 19 "Construction Waste Management and Disposal."

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

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.9 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 01 73 00

SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition and construction waste.
2. Recycling nonhazardous demolition and construction waste.
3. Disposing of nonhazardous demolition and construction waste.

B. Related Requirements:

1. Section 02 41 19 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.
2. Section 04 20 00 "Unit Masonry" for disposal requirements for masonry waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:

1. Demolition Waste:

a. Asphalt paving.
b. Concrete.
c. Concrete reinforcing steel.
d. Brick.
e. Concrete masonry units.
f. Wood studs.
g. Wood joists.
h. Plywood and oriented strand board.
i. Wood paneling.
j. Wood trim.
k. Structural and miscellaneous steel.
l. Rough hardware.
m. Roofing.
n. Insulation.
o. Doors and frames.
p. Door hardware.
q. Windows.
r. Glazing.
s. Metal studs.
t. Gypsum board.
u. Acoustical tile and panels.
v. Carpet.
w. Carpet pad.
x. Demountable partitions.
y. Equipment.
z. Cabinets.
aa. Plumbing fixtures.
bb. Piping.
cc. Supports and hangers.
dd. Valves.
ee. Sprinklers.

ff. Mechanical equipment.
gg. Refrigerants.
hh. Electrical conduit.
ii. Copper wiring.
jj. Lighting fixtures.
kk. Lamps.
ll. Ballasts.
mm. Electrical devices.
nn. Switchgear and panelboards.
oo. Transformers.

2. Construction Waste:

a. Masonry and CMU.
b. Lumber.
c. Wood sheet materials.
d. Wood trim.
e. Metals.
f. Roofing.
g. Insulation.
h. Carpet and pad.
i. Gypsum board.
j. Piping.
k. Electrical conduit.
l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:

1) Paper.
2) Cardboard.
3) Boxes.
4) Plastic sheet and film.
5) Polystyrene packaging.
6) Wood crates.
7) Plastic pails.

1.4 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 10 days of date established for commencement of the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use Form CWM-7 for construction waste and Form CWM-8 for demolition waste. Include the following information:

1. Material category.
2. Generation points of waste.
3. Total quantity of waste in tons.
4. Quantity of waste salvaged, both estimated and actual in tons.
5. Quantity of waste recycled, both estimated and actual in tons.
6. Total quantity of waste recovered (salvaged plus recycled) in tons.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Waste Management Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to ASTM E 1609 and requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition site-clearing and waste generated by the Work. Use Form CWM-1 for construction waste and Form CWM-2 for demolition waste. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use Form CWM-3 for construction waste and Form CWM-4 for demolition waste. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.

2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Reclamation Programs: Research and prepare a plan to work with manufacturers who have programs to receive used materials. Known reclamation programs are available from, but not limited to, the following manufacturers:

1. Carpet:

    a. Reentry Program by Interface.
    b. Antron, In vista.
    c. CON-tinuum by Constantine & Covanta.
    d. Local carpet and carpet cushion reclamation centers may be found on http://www.carpetrecovery.org/.

2. Ceiling Panels: Armstrong World Industries, Inc.
3. Resilient Flooring: ReUse Program by Tarkett.

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 01 50 00 "Temporary Facilities and Controls."

B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
2. Comply with Section 01 50 00 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

A. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

B. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

C. Plumbing Fixtures: Separate by type and size.

D. Lighting Fixtures: Separate lamps by type and protect from breakage.

E. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum 4-inch size.

B. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 1-1/2-inch 4-inch size.

C. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

D. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

E. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

F. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

G. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.

H. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

I. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by Carpet Reclamation Agency or carpet recycler.

J. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

K. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

3.7 ATTACHMENTS

A. Form CWM-1 for construction waste identification.

B. Form CWM-2 for demolition waste identification.

C. Form CWM-3 for construction waste reduction work plan.

D. Form CWM-4 for demolition waste reduction work plan.

E. Form CWM-7 for construction waste

F. Form CWM-8 for demolition waste.

END OF SECTION 01 74 19

SECTION 01 77 00 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for contract closeout.

1.2 ACTION SUBMITTALS

A. Contractor's List of Incomplete Items (Punch List): Initial submittal at Substantial Completion.

B. Certified List of Incomplete Items: Final submittal at Final Completion.

1.3 CLOSEOUT SUBMITTALS

A. Certificate of Insurance: For continuing coverage.

B. Project Record Documents:

1. Record Drawings.
2. Record Specifications.
3. Record product data.
4. Miscellaneous record submittals.

C. Operation and maintenance manual(s).

D. Warranties.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.5 SUBSTANTIAL COMPLETION PROCEDURES

A. Submittals Prior to Substantial Completion: Complete the following a minimum of 5 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Prepare and submit a list of incomplete items (punch list), indicating the value of items on the list, and reasons why the Work is not complete.
2. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, final certifications, and similar documents.
3. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
4. Prepare and submit Project Record Documents, operation and maintenance manuals, and similar final record information.
5. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Owner. Label with manufacturer's name and model number where applicable.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

6. Submit test/adjust/balance records.

B. Procedures Prior to Substantial Completion: Complete the following prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 01 79 00 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.

8. Terminate and remove temporary facilities from Project sire, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

C. Inspection: Submit a written request for inspection for Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.6 FINAL COMPLETION PROCEDURES

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Submit a final Application for Payment.
2. Submit copy of Contractor's original Substantial Completion inspection list with Architect's annotations of items to be completed or corrected (punch list), endorsed and dated by Architect. Copy shall be certified by Contractor and state that each item has been completed or otherwise resolved for acceptance.

B. Inspection: Submit a written request for final inspection for acceptance a minimum of 5 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

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

1.7 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

1. Organize list of spaces in sequential order, proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

B. Submit list of incomplete items in MS Excel electronic file. Architect will return annotated electronic file.

1.8 PROJECT RECORD DOCUMENTS

A. General: Do not use Project Record Documents for construction purposes. Protect Project Record Documents from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

B. Record Drawings: Maintain and submit one set of blue- or black-line white prints of Contract Drawings and Shop Drawings.

1. Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up record prints.

    a. Give particular attention to information on concealed elements that cannot be readily identified and recorded later, and the locations of those items that need to be located for servicing.
    b. Accurately record information in a readily understandable drawing technique.
    c. Record data as soon as possible after obtaining it. Record and check the markup before enclosing concealed installations.
    d. Mark record prints completely and accurately.

e. Mark important additional information that was either shown schematically or omitted from original Drawings.
f. Note Change Order numbers, alternate numbers, and similar identification where applicable.

C. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications. Clearly mark copy to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Note related Change Orders, Record Drawings, and Product Data, where applicable.

D. Record Product Data: Submit one copy of each Product Data submittal. Mark one set to indicate the actual product installation where installation varies substantially from that indicated in Product Data.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Drawings, where applicable.

E. Miscellaneous Record Submittals: Assemble miscellaneous records required by other Specification Sections such as tests and inspections, and inspections by authorities having jurisdiction. Bind or file miscellaneous records and identify each, ready for continued use and reference.

1.9 OPERATION AND MAINTENANCE MANUALS

A. Assemble a complete set of operation and maintenance data indicating the operation and maintenance of each system, subsystem, and piece of equipment not part of a system. Include operation and maintenance data required in individual Specification Sections and as follows:

1. Operation Data:

a. Emergency instructions and procedures.
b. System, subsystem, and equipment descriptions, including operating standards.
c. Operating procedures, including startup, shutdown, seasonal, and weekend operations.

d. Description of controls and sequence of operations.
e. Piping diagrams.
f. Noise and vibration adjustments.
g. Effective energy utilization.

2. Maintenance Data:

a. Manufacturer's information, including list of spare parts.
b. Name, address, and telephone number of Installer or supplier.
c. Maintenance procedures.
d. Maintenance and service schedules for preventive and routine maintenance.
e. Maintenance record forms.
f. Sources of spare parts and maintenance materials.
g. Copies of maintenance service agreements.
h. Copies of warranties and bonds.
i. Cleaning.
j. Control sequence.
k. Fuels, lubricants, tool, and other related items.
l. Identification systems.

B. Organize operation and maintenance manuals into suitable sets of manageable size. Bind and index data in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, with pocket inside the covers to receive folded oversized sheets. Identify each binder on front and spine with the printed title "OPERATION AND MAINTENANCE MANUAL," Project name, and subject matter of contents.

1.10 SUBMITTAL OF PROJECT WARRANTIES

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

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

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

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 01 77 00

SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 01 33 00 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit on digital media acceptable to Architect. Enable reviewer comments on draft submittals.

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

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

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

E. Comply with Section 01 77 00 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

B. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.

    a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary, to provide essential information for proper operation or maintenance of equipment or system.
    b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.

4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.

    a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.

    b. If drawings are too large to be used as foldouts, fold, and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

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

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

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

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

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

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

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

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

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

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name, and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name, and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.

4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23

SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Record Drawings.
2. Record Specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 01 73 00 "Execution" for final property survey.
2. Section 01 77 00 "Closeout Procedures" for general closeout procedures.
3. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit copies of record Drawings as follows:

a. Final Submittal:

1) Submit record digital data files and three set(s) of record digital data file plots.
2) Plot each drawing file, whether or not changes and additional information were recorded.

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

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

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

1.4 RECORD DRAWINGS

A. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect through Construction Manager for resolution.
4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

    a. See Section 01 31 00 "Project Management and Coordination" for requirements related to use of Architect's digital data files.

B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:

    a. Project name.

b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

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

4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as annotated PDF electronic file paper copy.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.

3. Note related Change Orders, record Specifications, and record Drawings where applicable.

C. Format: Submit record Product Data as annotated PDF electronic file.

1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

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

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 39

SECTION 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Attendance Record: For each training module, submit list of participants and length of instruction time.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

a. Name of Project.
b. Name and address of videographer.
c. Name of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Date of video recording.

2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
4. At completion of training, submit complete training manual(s) for Owner's use prepared in same paper and PDF file format required for operation and maintenance manuals specified in Section 01 78 23 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

A. Pre Construction Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor has delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.

d. Operating instructions for conditions outside of normal operating limits.
e. Sequences for electric or electronic systems.
f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

a. Startup procedures.
b. Equipment or system break-in procedures.
c. Routine and normal operating instructions.
d. Regulation and control procedures.
e. Control sequences.
f. Safety procedures.
g. Instructions on stopping.
h. Normal shutdown instructions.
i. Operating procedures for emergencies.
j. Operating procedures for system, subsystem, or equipment failure.
k. Seasonal and weekend operating instructions.
l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:

a. Alignments.
b. Checking adjustments.
c. Noise and vibration adjustments.
d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

a. Diagnostic instructions.
b. Test and inspection procedures.

7. Maintenance: Include the following:

a. Inspection procedures.
b. Types of cleaning agents to be used and methods of cleaning.
c. List of cleaning agents and methods of cleaning detrimental to product.
d. Procedures for routine cleaning.
e. Procedures for preventive maintenance.
f. Procedures for routine maintenance.
g. Instruction on use of special tools.

8. Repairs: Include the following:

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

1.8 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 78 23 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

1. Owner will furnish Contractor with names and positions of participants.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a written a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 79 00

SECTION 01 81 19 - INDOOR AIR QUALITY (IAQ) MANAGEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Special requirements for Indoor Air Quality (IAQ) management during construction operations.

    a. Control of emissions during construction.
    b. Moisture control during construction.

2. Procedures for testing baseline IAQ. Baseline IAQ requirements specify maximum indoor pollutant concentrations for acceptance of the facility.

B. Related Sections:

1. Section 01 91 13 "General Commissioning" for coordination with commissioning activities.

2. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for cleaning of HVAC system including ductwork, air intakes and returns, and changing of filters.

1.3 REFERENCES

A. Definitions: Definitions pertaining to sustainable development: As defined in ASTM E 2114.

1. Adequate Ventilation: Ventilation, including air circulation and air changes, required to cure materials, dissipate humidity, and prevent accumulation of particulates, dust, fumes, vapors, or gases.

2. Hazardous Materials: Any material that is regulated as a hazardous material in accordance with 49 CFR 173, requires a Material Safety Data Sheet (MSDS) in accordance with 29 CFR 1910.1200, or which during end use, treatment, handling, storage, transportation or disposal meets or has components which meet or have the potential to meet the definition of a Hazardous Waste in accordance with 40 CFR 261.

    a. Hazardous materials include pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA) and the International Agency for Research on Cancer (IARC).

3. Indoor Air Quality (IAQ): The composition and characteristics of the air in an enclosed space that affect the occupants of that space. The indoor air quality of a space refers to the relative quality of air in a building with respect to contaminants and hazards and is determined by the level of indoor air pollution and other characteristics of the air, including those that impact thermal comfort such as air temperature, relative humidity and air speed.
4. Interior Final Finishes: Materials and products that will be exposed at interior, occupied spaces; including flooring, wallcovering, finish carpentry, ceilings, and sealants.
5. Packaged Dry Products: Materials and products that are installed in dry form and are delivered to the site in manufacturer's packaging; including carpets, resilient flooring, ceiling tiles, and insulation.
6. Wet Products: Materials and products installed in wet form, including paints, sealants, adhesives, special coatings, and other materials which require curing.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Preconstruction Conference: After award of Contract and prior to the commencement of the Work, schedule and conduct meeting with Owner and Architect to discuss the proposed IAQ Management Plan and to develop mutual understanding relative to details of environmental protection.

1.5 SUBMITTALS

A. Indoor Air Quality (IAQ) Management Plan: Not less than 10 days before the preconstruction conference, prepare and submit an IAQ Management Plan including, but not limited to, the following:

1. Procedures for control of emissions during construction.

    a. Identify schedule for application of interior finishes.

2. Procedures for moisture control during construction.

a. Identify porous materials and absorptive materials.
b. Identify schedule for inspection of stored and installed absorptive materials.

3. Revise and resubmit Plan as required by Architect.

a. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.

B. Product Data:

1. Submit product data for filtration media used during construction and during operation. Include Minimum Efficiency Reporting Value (MERV).

2. Submit air pressure difference maps for each mode of operation of HVAC.
3. Material Safety Data Sheets: Submit MSDSs for inclusion in Operation and Maintenance Manual for the following products.

a. Adhesives.
b. Floor and wall patching/leveling materials.
c. Caulking and sealants.
d. Insulating materials.
e. Fireproofing and firestopping.
f. Carpet.
g. Paint.
h. Clear finish for wood surfaces.
i. Lubricants.
j. Cleaning products.

C. Inspection and Test Reports:

1. Moisture control inspections.
2. Moisture content testing.
3. Moisture penetration testing.
4. Microbial growth testing.
5. Baseline Indoor Air Quality test report.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Minimum of 5 years¢ experience in performing the types of testing specified herein.

PART 2 - PRODUCTS

2.1 GENERAL ENVIRONMENTAL ISSUES

A. Mold and Mildew: Materials that have evidence of growth of molds or mildew are not acceptable, including both stored and installed materials. Immediately remove from site and dispose of properly.

B. Moisture Stains: Materials that have evidence of moisture damage, including stains, are not acceptable, including both stored and installed materials. Immediately remove from site and dispose of properly.

2.2 AIR FILTRATION MEDIA

A. Minimum Efficiency Reporting Value (MERV) as determined by ASHRAE 52.2:

1. MERV-8 for filtration media used at each return air grill, if used during construction.
2. MERV-13, for filtration media installed at the end of construction and prior to occupancy.

2.3 CLEANING PRODUCTS

A. Use low-toxic and lowest-emitting spot removers and cleaning agents for surfaces, equipment, and workers' personal use.

B. Use HEPA-filter equipped vacuum cleaners for the final cleaning.

PART 3 - EXECUTION

3.1 IAQ MANAGEMENT - EMISSIONS CONTROL

A. Seal return registers during construction operations.

B. Provide temporary exhaust during construction operations

C. To the greatest extent possible, isolate and/or shut down the return side of the HVAC system during construction. When ventilation system must be operational during construction activities, provide temporary filters.

D. Source Control:

1. Provide low and zero VOC materials as specified.
2. Do not use products in combination with or in contact with other products that can be identified as combining to form toxic fumes or sustained odors.

E. Pathway Interruption: Isolate areas of work as necessary to prevent contamination of clean or occupied spaces. Provide pressure differentials and/or physical barriers to protect clean or occupied spaces.

F. Housekeeping: During construction, maintain project and building products and systems to prevent contamination of building spaces.

G. Do not permit use of tobacco products inside the building, and within 25 feet of building entrance during construction.

H. Temporary Ventilation: Provide an ACH (air changes per hour) of 1.5 or more and as follows:

1. Provide minimum 48-hour pre-ventilation of packaged dry products prior to installation. Remove from packaging and ventilate in a secure, dry, well-ventilated space free from strong contaminant sources and residues. Provide a temperature range of 60 deg F minimum to 90 deg F maximum continuously during the ventilation period. Do not ventilate within limits of Work unless otherwise approved by Architect.
2. Provide adequate ventilation during and after installation of interior wet products and interior final finishes.
3. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2 during construction and during Owner occupancy. Coordinate with Work of Division 23, Heating, Ventilating, and Air Conditioning (HVAC).

    a. Replace filters during construction as necessary to protect equipment and indoor air quality.

I. Scheduling: Schedule construction operations involving wet products prior to packaged dry products to the greatest extent possible.

1. Do not use solvents within interior areas that may penetrate and be retained in absorptive materials such as concrete, gypsum board, wood, cellulose products, fibrous material, and textiles.

J. Inspect ductwork for refuse, contaminants, moisture, and other foreign contamination prior to commissioning by Owner. Notify Owner of satisfactory inspection prior to beginning of commissioning.

3.2 IAQ MANAGEMENT - MOISTURE CONTROL

A. Housekeeping:

1. Keep materials dry. Protect stored on-site and installed absorptive materials from moisture damage.
2. Verify that installed materials and products are dry prior to sealing and weatherproofing the building envelope.
3. Install interior absorptive materials only after building envelope is sealed and weatherproofed.

B. Inspections: Document and report results of inspections; state whether or not inspections indicate satisfactory conditions.

1. Examine materials for dampness as they arrive. If acceptable to Architect, dry damp materials completely prior to installation; otherwise, reject materials that arrive damp.
2. Examine materials for mold as they arrive and reject materials that arrive contaminated with mold.
3. Inspect stored and installed absorptive materials regularly for dampness and mold growth. Inspect weekly, after each rain event,

    a. Where stored on-site or installed absorptive materials become wet, notify Architect. Inspect for damage. If acceptable to Architect, dry completely prior to closing in assemblies; otherwise, remove and replace with new materials.

4. Site Drainage: Verify that final grades of site work and landscaping drain surface water and ground water away from the building.
5. Weatherproofing: Inspect moisture control materials as they are being installed. Include the following:

    a. Air Barrier: Verify air barrier is installed without punctures and/or other damage. Verify air barrier is sealed completely.
    b. Flashing: Verify correct shingling of the flashing for roof, walls, windows, doors, and other penetrations.
    c. Insulation Layer: Verify insulation is installed without voids.
    d. Roofing: In accordance with ASTM D 7186.

6. Plumbing: Verify satisfactory pressure test of pipes and drains is performed before closing in and insulating lines.
7. HVAC: Inspect HVAC system as specified in Section 01 91 13 "General Commissioning." And, inspect HVAC to verify the following:

    a. Condensate pans are sloped and plumbed correctly.
    b. Access panels are installed to allow for inspection and cleaning of coils and ductwork downstream of coils.
    c. Ductwork and return plenums are air sealed.
    d. Duct insulation is installed and sealed.
    e. Chilled water line and refrigerant line insulation are installed and sealed.

C. Schedule:

1. Schedule work such that absorptive materials, including but not limited to porous insulations, paper-faced gypsum board, ceiling tile, and finish flooring, are not installed until they can be protected from rain and construction-related water.
2. Weatherproof as quickly as possible. Schedule installation of moisture-control materials, including but not limited to air barriers, flashing, exterior sealants, and roofing, at the earliest possible time.

D. Testing for Moisture Content: Test moisture content of porous materials and absorptive materials to ensure that they are dry before sealing them into an assembly. Document and report result of testing. Where tests are not satisfactory, dry materials and retest. If satisfactory results cannot be obtained with retest, remove, and replace with new materials.

1. Concrete: Moisture test prior to finish flooring application as specified in Division 09. and as specified herein Moisture test as per one or more of the following; unless otherwise indicated, acceptable upper limits for concrete are less than 4 percent top inch; less than 85 percent headspace RH; less than 3 lbs./1000 sq. ft./day:

    a. ASTM F 1869 - Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
    b. ASTM F 2170 - Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.

2. Wood: Moisture test as per ASTM D 4444 - Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters; unless otherwise indicated, acceptable upper limits for wood products are less than 20 percent at center of piece; less than 15 percent at surface.
3. Gypsum Board, Gypsum Plaster, Insulation, and Other Absorptive Materials: Moisture test with a Pinless Moisture Meter to assess patterns of moisture, if any.

E. Testing for Moisture Penetration:

1. Reference specification sections within the Project Manual for specific Moisture Penetration tests and requirements.

3.3 BASELINE INDOOR AIR QUALITY TESTING

A. After construction ends and prior to occupancy, conduct a baseline indoor air quality testing procedure that randomly selects sampling points for every 25,000 sq. ft., or for each contiguous floor area, whichever is larger, using testing protocols consistent with the EPA's "Compendium of Methods for the Determination of Air Pollutants in Indoor Air,".

B. Demonstrate that the chemical contaminant maximum concentrations listed below are not exceeded:

1. Carbon Dioxide (CO_2): Maximum concentration of 530 parts per million per ASHRAE 62.

a. This measurement is required only if the building is regularly occupied during the testing. Measured differential between indoor and outdoor conditions is based on occupancy type as defined by ASHRAE 62. Maximum concentration differential in parts per million = 10,300/ventilation rate per occupant, in cubic feet per minute, assuming an occupancy of 7 persons per 1000 sq. ft. of floor space.

2. Formaldehyde: 27 parts per billion.
3. Particulates (PM10): 50 micrograms per cubic meter per EPA National Ambient Air Quality Standard.
4. Ozone: 0.075 ppm, according to ASTM D 5149.
5. Total Volatile Organic Compounds: 500 micrograms per cubic meter per State of Washington IAQ Standard.
6. 4-Phenylcyclohexene (4-PH): 6.5 micrograms per cubic meter per State of Washington IAQ Standard.

C. For each building area where the maximum concentration limits are exceeded, conduct a partial building flushout, for a maximum of two weeks, then retest the indoor air quality levels to indicate the requirements are achieved.

END OF SECTION 01 81 19

SECTION 02 41 19 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.

B. Related Requirements:

1. Section 01 10 00 "Summary" for use of the premises and Owner occupancy requirements.
2. Section 01 14 00 "Work Restrictions" for restrictions on use of the premises due to Owner or tenant occupancy.
3. Section 01 32 00 "Construction Progress Documentation" for preconstruction photographs taken before selective demolition.
4. Section 01 50 00 "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
5. Section 01 73 00 "Execution" for cutting and patching procedures.
6. Section 01 74 19 "Construction Waste Management and Disposal" for disposal of demolished materials.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

B. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed, and salvaged, or removed and reinstalled.

1.3 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.4 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property for dust control and for noise control. Indicate proposed locations and construction of barriers.

B. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

1.6 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:

    a. All existing stored items, equipment, and storage bins and shelving. Owner shall empty the area prior to contractor executing the work.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. Hazardous materials will be removed by Owner before start of the Work.
2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.8 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. If available, review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate, and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

3.2 PREPARATION

A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 01 14 00 "Work Restrictions."

B. Existing Services/Systems to be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies.

2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

    a. Piping to be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    c. Equipment to be Removed: Disconnect and cap services and remove equipment.
    d. Equipment to be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    e. Equipment to be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    f. Ducts to be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    g. Ducts to be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
    h. Fire Suppression System Partial or Complete Removal: Arrange for bypass of area to be removed so that overall building fire suppression system remains in operation. If continuous operation is not possible, coordinate with local Fire authorities; maintain Firewatch during removal operations and until system can be restored to working order. Maintain fire extinguishers on the site.

C. Ballasts: If ballast is not labeled "No PCBs," or if the label is illegible, contact a ballast recycler for disposal.

D. Mercury-Containing Devices: Mercury-containing devices include thermostats, silent switches, mechanical switches and relays or contacts. Dispose of these devices with an appropriate recycler.

E. Nickel-Cadmium and Lead-Acid Batteries: Exit signs, emergency lighting units, alarm systems, smoke detectors and carbon-monoxide detectors may contain nickel-cadmium or lead-acid. Arrange with an appropriate recycler for disposal.

3.4 PROTECTION

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

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 50 00 "Temporary Facilities and Controls."

3.5 SELECTIVE DEMOLITION, GENERAL

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

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering, and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations, and for duration required by Authorities Having Jurisdiction hours after completion of flame cutting operations and other "hot work" as defined by NFPA 51B.
4. Maintain adequate ventilation when using cutting torches.
5. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
6. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
7. When cutting concrete, masonry, wallboard, and any other dust-producing materials, provide temporary barriers to prevent spread of dust into the rest of the building. Provide filters for mechanical systems and air ducts.
8. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 "Construction Waste Management and Disposal."

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

B. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction. and recycle or dispose of them according to Section 01 74 19 "Construction Waste Management and Disposal."

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 01 74 19 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

3.8 CLEANING

A. Refer to Section 01 73 00 "Execution" for progress cleaning.

END OF SECTION 02 41 19

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal fabrications and includes, but is not limited to, the following types of fabrications:

1. Supports for counter tops and vanities.
2. Aluminum framed entrance and storefront framing.
3. All-glass entrance and storefront framing.
4. Miscellaneous framing and supports.

B. Related Requirements:

1. Section 09 22 16 "Non-Structural Metal Framing" for reinforcements in metal-framed partitions for anchoring wall-mounted products.

1.2 ACTION SUBMITTALS

A. Shop Drawings: Submit shop drawings including plans, elevations, sections, details of installation, and attachments to other Work.

1. For installed products indicated to comply with performance requirements, include seal and signature of qualified professional engineer responsible for their preparation.
2. Include plans and elevations at not less than 1" to 1'-0" scale, and include details of sections and connections at not less than 3" to 1'-0" scale.

B. Delegated-Design Submittal: For installed products indicated to comply with performance requirements, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.4 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project for a minimum of 5 years, with a record of successful in-service performance, with sufficient production capacity to produce required units without causing delay in the Work.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of metal fabrications that are similar to those indicated for this Project in material, design, and extent.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

D. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 FIELD CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design metal fabrications indicated below.

B. Structural Performance:

1. Countertop and Vanity Framing: Provide countertop and vanity framing capable of withstanding the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections, or of exhibiting excessive deflections in any of the components making up the countertops and vanities:

    a. All deadloads.
    b. 500 pound live load placed on the countertop and vanity.
    c. Deflection at Midspan:

        1) Stone or Quartz Simulated Stone: L/720 times span or 1/8 inch, whichever is less.
        2) Solid Surfacing: L/360 times span or 1/4 inch, whichever is less.

2. Other Overhead Anchored Fabrications: Fabricate and install framing as required to sustain imposed loads and to limit deflections to L/720 between hangers.
3. Support Framing for decorative items: Provide framing for partial height items, full height items, floor to ceiling anchored items, and other items within 48 inches of the floor should be capable of withstanding a deflection not to exceed L/720 of the height when subjected to a positive and negative pressure of 5 psf.

2.2 METALS

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, blemishes, or roughness.

B. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so post-consumer recycled content plus one-half of pre-consumer recycled content is not less than 25 percent.

C. Ferrous Metals:

1. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M, or hot-formed steel tubing complying with ASTM A 501/A 501M.

3. Steel Pipe: ASTM A 53/A 53M, Type S - Seamless, Grade A suitable for close coiling or cold bending, standard weight (Schedule 40) minimum, unless otherwise indicated or required to satisfy performance requirements, black finish.

4. Slotted Channel Framing: Cold-formed metal channels with continuous slot and with flanged edges returned toward web complying with MFMA-4 and fabricated from steel complying with ASTM A 1011/A 1011M. Width, depth, and metal thickness as required to suit performance requirements.
5. Iron Castings: ASTM A 47, Grade 32510 malleable iron or ASTM A 48, Class 30, gray iron.
6. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.3 PAINT

A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer and compatible with finish paint systems indicated.

1. 94-258 Series Multi-Prime Fast Dry 2.8 VOC Universal Metal Primer; Pittsburgh Paints.
2. B50 Z Kem Kromik Universal Primer Fast Dry; Sherwin-Williams Co.
3. Series 37H Phenolic Alkyd Primer Chem-Prime; Tnemec.

2.4 MISCELLANEOUS MATERIALS

A. Fasteners: Zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, of type, grade, and class required by application indicated.

B. Nonshrink, Nonmetallic Grout: ASTM C 1107/C 1107M, factory-packaged, nonstaining, noncorrosive, nongaseous grout.

2.5 FABRICATION

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

1. Welded connections may be used where bolted connections are shown.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Weld corners and seams continuously along entire line of contact. Use full penetration welds. Use materials and methods that minimize distortion and develop strength of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. Finish exposed welds smooth and blended.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous. Make up threaded connections tight so that threads are entirely concealed.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices and fasteners to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Miscellaneous Framing and Supports: Provide steel framing and supports indicated and as necessary to complete the Work and which are not a part of the structural framework to comply with performance requirements.

1. Fabricate units from structural steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2. Countertop Framing: Fabricate countertop framing, using steel shapes and plates, and cold finished mild steel bars at exposed conditions, for support framing and plywood, to the thicknesses, sizes and shapes shown, and as required to produce work of adequate strength and durability. Use proven details of fabrication, as required to achieve proper assembly and alignment of the various components of the Work.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Provide anchorage devices and fasteners for securing metal fabrications to in-place construction. Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, with edges and surfaces level, plumb, and true. Drill holes for bolts to the exact diameter of the bolt. Provide screws threaded full length to the screw head.

1. Anchor supports for securely to, and rigidly brace from, building structure. Laser level framing.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Quality of Workmanship:

    a. At concealed connections: No improvement from mill finish, except preparation necessary for priming is required. Welds are not required to be ground.
    b. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness , pits, mill marks, nicks, or scratches shows after finishing and contour of welded surface matches that of adjacent surface. Defects and distortions shall not be visible to the eye nor show through painted or polished surfaces.

D. Touchup surfaces and finishes after erection. For materials exposed to view in the finished Project, clean field welds, bolted connections, and abraded areas and touchup paint with the same material as used for shop painting.

END OF SECTION 05 50 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe and tube railings.

1.2 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Sustainable Design Submittals: Refer to Division 01 Section "Sustainable Design Requirements."

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. For installed products indicated to comply with performance requirements and design criteria, submit shop drawings signed and sealed by the qualified professional engineer responsible for their preparation.

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

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Fabricator/Installer Qualifications: A firm experienced in producing handrails and railings similar to those indicated for this Project for a minimum of 5 years, with a record of successful in-service performance, with sufficient production capacity to produce required units without causing delay in the work.

1. Employ only experienced tradesmen for both fabrication and installation, who are capable of producing work of the highest standards of quality in the industry.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of handrails and railings that are similar to those indicated for this Project in material, design, and extent.

C. Source Limitations: Obtain each type of railing from single source from single manufacturer.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 STORAGE, DELIVERY AND HANDLING

A. Store railings in a dry, well-ventilated, weathertight place. Deliver and handle so as to prevent any type of damage to the fabricated work.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with pipe and tube railings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating railings without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.

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

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

3. Deflection Criteria: The larger deflections at the top from either the horizontal live loads or applicable wind loads shall be the lesser of 3/4-inchor h/90 for cantilever elements, and h/175 for simple span elements, where h is the distance from the floor level to the top of guardrail. Applied loads shall be allowable stress design loads.

D. Exterior Metal Fabrications: All exterior metal stairs shall be fabricated and installed to prevent buckling, opening up of joints and overstressing of welds and fasteners under the following temperature conditions:

1. Base fabrication on a temperature of +70 deg F at time of installation with allowance made for an exposed metal surface temperature range of -5 to +180 deg F
. Make all necessary adjustments and provisions for concealed expansion.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

F. Regulatory Requirements: Comply with the requirements of Part 1910 of the Occupational Safety and Health Standards (OSHA), the American Disabilities Act (ADA), and local regulatory requirements as applicable to stairs, handrails and the protection of openings; where regulatory requirements conflict the more stringent shall apply.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without pitting, seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes where exposed to view on finished units.

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

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.3 STEEL AND IRON

A. General: Provide steel and iron (ferrous metal) in the form indicated, complying with the following requirements.

B. Pipe: ASTM A 53/A 53M, Type S ÓÓ Seamless, Grade A, suitable for close coiling or cold bending, Standard Weight (Schedule 40) minimum, unless another grade and weight are required to suit performance requirements.

C. Tubing: ASTM A 500 (cold formed) Grade A or ASTM A 513, unless otherwise indicated or required to satisfy the performance requirements.

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

1. Welded Headed Studs: AWS D1.1 (Type A or B as selected by fabricator), ASTM A 108 Grades 1010 through 1020 inclusive and bearing the minimum mechanical properties for studs as selected by fabricator to suit performance requirements.

E. Cold Finished Steel Bars: ASTM A 108, grade as selected by fabricator.

2.4 FASTENERS

A. General: Provide the following:

1. Steel Railings: Plated fasteners complying with ASTM B 633, or ASTM F 1941, Class Fe/Zn 12 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of complying with the performance requirements.

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

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded [and as required at aluminum and stainless steel railings for color match, strength, and compatibility in fabricated items].

B. Shop Primers: Provide primers that comply with Section 09 96 00 "High-Performance Coatings."

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to comply with the performance requirements.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Shear, cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings. Weld connections continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

J. Form changes in direction as indicated on the Drawings.

K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Fabricate joints that will be exposed to weather in a watertight manner.

N. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

Q. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

R. Provide minimum 3/8 inch diameter weep holes or another means to drain entrapped water in hollow sections of railing members that are exposed to exterior or to moisture from condensation or other sources.

2.7 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

A. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

B. Primer Application: Apply shop primer to prepared surfaces of railings, except those with galvanized finishes and those to be field welded, unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint edges, corners, crevices, bolts, and welds.
2. Dry Film Thickness of Primer: 2.5 to 3.0 mils, dry film thickness. Apply paint thoroughly and evenly to dry surfaces, free from holidays and pinholes, in accordance with manufacturers directions.

C. Do not deliver primed railing work until primer has dried.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

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

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Adjust railings before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required to meet or exceed the performance requirements.

D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows.

1. Anchor posts to steel by welding directly to steel supporting members.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to meet or exceed the performance requirements.

1. Use type of bracket with predrilled hole for exposed bolt anchorage.

D. Secure wall brackets and railing end flanges to building construction as required to meet or exceed the performance requirements and the following:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed gypsum board assemblies, fasten brackets directly to steel framing or concealed reinforcements using self-tapping screws of size and type required to satisfy the performance requirements.

3.6 ADJUSTING AND CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.

C. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 96 00 "High-Performance Coatings."

3.7 PROTECTION

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

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 52 13

SECTION 05 70 00 - DECORATIVE METAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Decorative wall panels.
2. Decorative metal trim.
3. Decorative metal frames.
4. Blackened steel.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for non-decorative metal fabrications.

1.2 COORDINATION

A. Coordinate installation of anchorages for decorative metal items. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for decorative metal.

1. Include plans, elevations, component details, and attachments to other work.
2. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

C. Samples for Verification: For each type of exposed finish required.

1. Sections of linear shapes.
2. Samples of welded and brazed joints showing quality of workmanship and color matching of materials.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified fabricator and finisher.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Installer Qualifications: Fabricator of products.

C. Powder-Coating Applicator Qualifications: A firm experienced in successfully applying powder coatings of type indicated and employing competent control personnel to conduct continuing, effective quality-control program to ensure compliance with requirements.

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

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.3, "Structural Welding Code - Sheet Steel."
4. AWS D1.6, "Structural Welding Code - Stainless Steel."

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockups for each type of decorative metal specified in this Section. Coordinate with Architect for extent and location of mock-ups.

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

F. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store decorative metal in a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

B. Deliver and store cast-metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on shop drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design decorative formed metal items, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Decorative Coiled Wire Curtain, including anchors and connections, shall withstand the effects of gravity loads and the following loads and stresses without exceeding the allowable design working stress of materials involved and without exhibiting permanent deformation in any components.

2.2 METALS, GENERAL

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

2.3 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with strength and durability properties for each aluminum form required not less than that of alloy and temper designated below.

B. Extruded Bars and Shapes: ASTM B 221, Alloy 6063-T5/T52.

C. Extruded Structural Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.

D. Drawn Seamless Tubing: ASTM B 210 or ASTM B 483/B 483M, Alloy 6063-T832.

E. Plate and Sheet: ASTM B 209, Alloy 3003-H14.

2.4 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304.

B. Pipe: ASTM A 312/A 312M, Grade TP 304.

C. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.

D. Bars and Shapes: ASTM A 276, Type 304.

2.5 STEEL AND IRON

A. Tubing: ASTM A 500 (cold-formed).

B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

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

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

E. Steel Sheet, Cold Rolled: ASTM A 1008/A 1008M, either commercial steel or structural steel, exposed.

2.6 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Aluminum Items: Type 304 stainless-steel fasteners.
2. Stainless-Steel Items: Type 304 stainless-steel fasteners.
3. Uncoated-Steel Items: Plated steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 304 stainless-steel fasteners where exposed.
4. Class Fe/Zn 25 for electrodeposited zinc coating.
5. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work unless otherwise indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Post-Installed Anchors: Torque-controlled expansion type or chemical type.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 unless otherwise indicated.
2. Material for Locations Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.7 MISCELLANEOUS MATERIALS

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

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

B. Cleaner: Provide a liquid emulsifiable alkaline soak cleaner suitable for metal surfaces. Basis-of-Design Product: E-Kleen 111; Epi, 17000 West Lincoln Avenue, New Berlin, WI 53151, voice (262) 786-9330.

C. Deoxidizer/Activator: Provide a mixture or dry, granular, free-flowing acid salts which, when dissolved in water, are used to deoxidize and activate metal surfaces prior to plating or chemical conversion finishing. Basis-of-Design Product: E-Pik 211; Epi, 17000 West Lincoln Avenue, New Berlin, WI 53151, voice (262) 786-9330.

D. Black Oxide Finishing Agent for Steel: Provide an alkaline salt and oxidizing agent mixture containing penetrants, catalysts, activators, rectifiers and wetters which, when dissolved in water and heated, produce a black oxide finish on steel. Basis-of-Design Product: Ultra-Blak 400; Epi, 17000 West Lincoln Avenue, New Berlin, WI 53151, voice (262) 786-9330.

E. Gloss Acrylic Lacquer: Provide a lacquer sealer designed to produce a hard, dry, clear finish. Basis-of-Design Product: E-Tec 520; Epi, 17000 West Lincoln Avenue, New Berlin, WI 53151, voice (262) 786-9330.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.8 FABRICATION, GENERAL

A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

B. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

C. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

E. Form simple and compound curves in bars, pipe, tubing, and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

F. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

G. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as needed to receive finish hardware, screws, and similar items unless otherwise indicated.

I. Comply with AWS for recommended practices in shop welding and brazing. Weld and braze behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed joints of flux, and dress exposed and contact surfaces.

1. Where welding and brazing cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.

2.9 WALL PANELS (MT##)

A. Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible.

B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended by metal wall panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.10 DECORATIVE METAL TRIM (MT##)

A. Fabricate from aluminum and steel shapes, sheet or plate of thickness, size, and pattern indicated. Roll, press, and grind metal to flatten and to remove burrs and deformations. Miter corners and connect with concealed splice plates.

B. Openness: 31 percent open area.

C. Frames: Fabricated in factory from aluminum shapes, finish as indicated.

2.11 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

2.12 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: Match Architect's sample.

2.13 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Directional Satin Finish: No. 4.

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

2.14 STEEL AND IRON FINISHES

A. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

B. Primer Application: Apply shop primer to prepared surfaces of items unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated ferrous-metal surfaces with primers specified in Section 09 91 23 "Interior Painting" unless indicated.

C. Powder-Coat Finish: Prepare, treat, and coat nongalvanized ferrous metal to comply with resin manufacturer's written instructions and as follows:

1. Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Treat prepared metal with iron-phosphate pretreatment, rinse, and seal surfaces.
3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils.

4. Color: As indicated in Finish Schedule by manufacturer's designations.

D. Blackened Steel Finish:

1. Prepare metal surfaces by cleaning and degreasing thoroughly. Clean metal in alkaline soak cleaner bath between +160 deg F and +180 deg F.
2. Rinse metal in overflowing cold water rinse tank to remove residual cleaner.
3. Deoxidize and activate metal surfaces with specified Deoxidizer/Activator or a comparable product. Submerge metal components in acid salts bath between +120 deg F and +180 deg F.
4. Rinse metal surfaces in overflowing cold water tank to remove residual activator.
5. Mix blackening solution with water in proportion recommended by blackening solution manufacturer, and heat to +285 deg F.
6. Immerse metal in blackening solution from five to twenty minutes. Do not exceed immersion time of twenty minutes. Maintain temperature of blackening solution at +285 deg F.
7. Rinse metal surfaces in overflowing cold water tank to remove residual blackening solution.
8. Remove from bath and allow to air dry.
9. Apply oil-rubbed finish (to match Architect's sample) to all exposed faces.

E. Plated finish to match Architect's sample.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.

B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.

C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.

D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.

F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.

1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude nonuniform oxidation and discoloration.

G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding and requirements for welding and for finishing welded connections in "Fabrication, General" Article. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.

H. Field Brazing: Comply with requirements for brazing and for finishing brazed connections in "Fabrication, General" Article. Braze connections that are not to be left as exposed joints but cannot be shop brazed because of shipping size limitations.

I. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING WALL PANELS

A. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

1. For flush paneling with revealed joints, install with variations in reveal width, alignment of top and bottom edges, and flushness between adjacent panels not exceeding 1/32 inch.

B. Anchor paneling to supporting substrate with concealed panel-hanger clips. Do not use face fastening unless otherwise indicated.

3.3 INSTALLING DECORATIVE METAL TRIM

A. Assemble trim and complete fabrication at Project site to the extent that it was not completed in the shop.

B. Install trim level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

C. Scribe and cut trim to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Anchor trim to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners. Use fine finishing screws for exposed fastening, countersunk and filled flush with trim using filler matching finish of items being installed.

E. Install with minimum number of joints possible, using full-length pieces (from maximum length of material available) to greatest extent possible. Do not use pieces less than 96 inches long except where shorter single-length pieces are necessary.

3.4 INSTALLING DECORATIVE COILED METAL CURTAIN

A. Install in accordance with manufacturer's written installation instructions.

B. Attach coiled wire fabric to structural framing using applicable hardware provided by manufacturer as indicated on approved shop drawings.

C. Provide necessary anchorage devices and fittings to securely fasten to on-site construction; including additional knife plates, embeds, framework, blocking, threaded rods, and anchors.

D. Provide for separation of dissimilar materials using bushings, grommets, or washers to prevent electrolytic corrosion.

E. Upon completion of final adjustments, provide tamper-resistant lock-tight material at mechanical fittings.

F. Provide for tension in coiled wire fabric as indicated on drawings, or as necessary to remove slack.

3.5 CLEANING AND PROTECTION

A. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.

B. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering at time of Substantial Completion.

C. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 70 00

SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Provide miscellaneous lumber for support or attachment of other construction, including blocking, nailers, and similar members.

B. Provide plywood panels for countertop underlayment and backing panels.

PART 2 - PRODUCTS

2.1 LUMBER AND PLYWOOD

A. Wood Panels: Comply with DOC PS 1 for plywood panels.

1. Concealed Plywood for Countertop Underlayment: DOC PS 1 "Construction and Industrial Plywood," Exterior grade, manufactured with no added urea-formaldehyde, in thickness as indicated but not less than 3/4 inch.
2. Telephone, Data, Security, and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D plugged, sanded both sides, fire-retardant treated, manufactured with no added urea-formaldehyde, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

B. Fire-Retardant-Treated Materials: Provide chemical fire retardant process tested and labeled by UL with flame spread and smoke developed ratings of 25 or less. Comply with performance requirements in AWPA U1, Use Category UCFA as a minimum for pressure treatment. Size wood before treatment so that minimum cutting will be required after treatment. Kiln dry lumber to a maximum 19 percent moisture content, kiln dry plywood to a maximum 15 percent moisture content, after treatment. Treat indicated items and wood members required to be treated by Building Code having jurisdiction at the site and wood members specified as fire-retardant-treated. Identify fire-retardant-treated wood with appropriate classification marking of UL.

C. Fasteners: Provide fasteners of size and type required to support miscellaneous wood carpentry and applied loads.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.

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

D. Install wood blocking and nailers where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

E. Install panel products to comply with applicable recommendations contained in APA Form No. E30, "APA Engineered Wood/Construction Guide," and local utility requirements, if any, for plywood backing panels utilized as indicated. Bolt countertop underlayment to miscellaneous steel framing. Secure plywood backing panels to wall using proper fastening devices for substrates encountered spaced 12 inches on center maximum at perimeter 1/2 inch from corners and three rows of three fasteners each in the backerboard field. Countersink fasteners flush with plywood surface. Butt adjacent panels without lapping.

END OF SECTION 06 10 53

Architectural Woodwork Standard, 2nd Edition (2014)**SECTION 06 40 23 - INTERIOR ARCHITECTURAL WOODWORK**

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes interior architectural woodwork:

1. Plastic-laminate cabinets.
2. Plastic-laminate countertops.
3. Wood paneling.
4. Closet and utility shelving.
5. Shop priming of interior woodwork to receive painted finish.
6. Shop finishing of interior woodwork to receive transparent finish.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for concealed countertop supports.
2. Section 05 70 00 "Decorative Metal" for metal trim.
3. Section 06 10 53 "Miscellaneous Rough Carpentry" for concealed blocking for millwork items.
4. Section 12 36 61 Simulated Stone Countertops for quartz countertops.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each material and product specified and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

1. Cabinet hardware and accessories.
2. Finishing materials and processes.

B. Shop Drawings: Submit shop drawings showing locations of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components. Elevations shall be drawn at a scale of not less than 1/2" = 1'-0" . Details shall be drawn at a scale of not less than 3" = 1'-0" .

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for plumbing, electrical, computer and telephone equipment and other items installed in architectural woodwork.

C. Samples: Submit samples of the following:

1. Three 12 inch by 12 inch sample sets containing a minimum of two or more samples of transparent finished wood-veneer and plastic laminate veneered panel products, fabricated from each core product, for each veneer specified and demonstrating the proposed full range of appearance characteristics to be expected in completed work. Include at least one face-veneer seam in each sample.
2. Lumber and panel products for transparent finish, for each species and cut, finished on one side and one edge. Furnish lumber in 12 inch lengths, furnish panel samples in 12 inch squares.
3. Lumber and panel products with shop-applied opaque finish, for each finish system and color, with exposed surface finished. Furnish lumber in 12 inch lengths, furnish panel samples in 12 inch squares.
4. Thermoset decorative-overlay surfaced panel products, for each type, color, pattern, and surface finish.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Instructions: Submit maintenance instructions for all countertop materials. Where countertop materials are recommended to be protected with hot pads, provide manufacturers recommended hot pad product properly sized for the hot equipment designed to be placed thereon.

1.4 QUALITY ASSURANCE

A. Single-Source Manufacturing and Installation Responsibility: Engage a qualified Manufacturer - acceptable to the Architect - to assume undivided responsibility for woodwork specified in this Section, including fabrication, finishing, and installation. The manufacturer shall have a minimum of 15 years successful experience in the custom fabrication and installation of architectural woodwork comparable to that shown and specified, be a member of the AWI, maintain an organized quality control program, perform its own in-house veneer lay-up work, and who retains facilities with sufficient capacity and quality to produce the required architectural woodwork without causing delay to the Project.

B. Quality Standard: Fabricate and install all architectural woodwork in accordance with the applicable requirements of Architectural Woodwork Standards, 2nd edition, published jointly by AWI, AWMAC, and WI, unless more stringent requirements are specified or shown.

C. Fire Performance Characteristics: Provide materials identical to those tested for the following fire performance characteristics per ASTM test methods indicated by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify treated lumber with classification marking of inspecting and testing organization in the form of separable paper label or, where required by authorities having jurisdiction, of imprint on lumber surfaces that will be concealed from view after installation.

1. Surface Burning Characteristics for Concealed Blocking, Furring, and Door Subframing: Not exceeding a flame spread of 25, and smoke developed of 50 when tested per ASTM E 84 for 30 minutes.
2. The fire performance finish requirements for all exposed interior wall and ceiling woodwork (including the paneling but not limited to paneling) substrates in fully sprinklered spaces shall be as follows which has been taken from the IBC [2012] [2015] [2018], Table 803.9. Footnotes to Table 803.9 that are pertinent to the project are also made a part of this specification.

Use Group	Interior Exit Stairways, Exit Ramps, and Exit Passageways	Corridors and Enclosures for Exit Access Stairways, and Exit Access Ramps	Rooms and Enclosed Spaces
A-1, and A-2	Class B	Class B	Class C
A-3	Class B	Class B	Class C
B, E, M, R-1	Class B	Class C	Class C
S	Class C	Class C	Class C

Class B: Flame spread 26-75, smoke developed 0-450 when tested in accordance with ASTM E 84.
Class C: Flame spread 76-200, smoke developed 0-450 when tested in accordance with ASTM E 84.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to fit to other construction, verify actual dimensions of other construction by accurate field measurements before fabrication of woodwork; and indicate measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being enclosed and indicate measurements on shop drawings.
2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

1.8 PREINSTALLATION COORDINATION MEETING

A. Meet at the Project site, prior to installation of architectural woodwork, to review the substrate preparation, installation and coordination with other trades, special details and conditions, and other topics related to the architectural woodwork. The preinstallation meeting shall include the Architect, the Contractor, architectural woodworker, and any subcontractors affected by the architectural woodwork installation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWS quality standard for each type of woodwork and quality grade specified.

B. Wood Panel Products:

1. Medium-Density Fiberboard (moisture resistant): A moisture-resistant, medium density fiberboard (MDF) panel manufactured from wood fiber complying with ANSI A208.2, Grade 155, having a minimum 48 pcf density except that minimum for screw holding capacity on face and edge shall be 275 poundsand 225 poundsrespectively; an ASTM E 84 Class C flame spread rating, minimum 3/4 inches thick, edged and faced as specified, fabricated with binder containing no added formaldehyde.

    a. Roseburg Forest Products; FSC Certified Medex.
    b. Arauco North America; Moisture Resistant Trupan.
    c. Uniboard, Canada; Uniboard NU Green MR50 MDF.

2. Medium-Density Fiberboard (fire rated): A fire rated, medium density fiberboard (MDF) panel manufactured from wood fiber complying with ANSI A208.2, Grade 130, having a minimum 50 pcf density except that minimum for screw holding capacity on face and edge shall be 250 poundsand 200 poundsrespectively; an ASTM E 84 Class A flame spread rating and a smoke developed index of not more than 200, minimum 3/4 inches thick, edged and faced as specified, fabricated with binder containing no added formaldehyde.

    a. Roseburg Forest Products; FSC Certified Medite FR.
    b. Arauco North America; Trupan Fire Rated MDF.
    c. Uniboard, Canada; Uniboard NU Green FR MDF Fire Resistant.

3. Hardboard: ANSI A135.4.
4. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1, made with adhesive containing no formaldehyde. Available Products:

    a. Roseburg Forest Products; SkyPly.
    b. Columbia Forest Products; Classic Core.

C. Thermoset Decorative Overlay (Melamine): Particleboard or medium-density fiberboard with surface of thermally fused, melamine-impregnated decorative paper complying with the recommendations of the Composite Panel Association's Technical Bulletin "Laminating Composite Panels."

1. Face Colors: As indicated in the Finish Schedule on the Drawings.
2. Manufacturers and Products:

    a. Roseburg Forest Products; Duramine.

D. Glass: Clear tempered float glass, complying with ASTM C 1036, Type I, Class 1, Quality q3, and ASTM C 1048 Kind FT, thickness as indicated.

1. Prior to tempering, cut glass to required sizes and profiles as determined by accurate measurement of supporting standoff hole locations.
2. Hole Cutting: Unless otherwise recommended by the glass manufacturer, comply with the requirements of ASTM C 1048, Article 7.8 for hole placement, minimum hole diameter, and dimensional tolerances of holes and this specification. Unless otherwise recommended by the glass manufacturer, locate holes not less than 4 inches from glass edges, hole diameter shall be at least 1/8 inch larger than the shank of the screw fastener and screw sleeve spacers used for the rosette assemblies. Chips and flakes at hole edges shall not be permitted, and the inner surfaces of holes shall be smooth polished to match glass panel edges.
3. Edge Treatment: All glass edges shall have an arrised edge profile (small bevel of width not exceeding 1/16 inch at an angle of approximately 45 degrees to the surface of the glass) with a polished (surface is reflective in appearance similar to the major surface of glass) surface.

E. High-Pressure Decorative Laminate[(PL##)]: Complying with NEMA LD 3 for Horizontal General Purpose Grade (HGS) typically and Vertical General Purpose Grade (VGS) where specified. Nominal thickness for HGS and VGS laminates to be 0.048 inches +/-0.005 inches and 0.028 inches +/- 0.004 inches, respectively. Where high pressure decorative laminate is indicated to be faced with aluminum, provide aluminum sheet goods specifically made for laminating to vertical MDF and particleboard substrates in sheet thickness of 0.025 inches +/- 0.002 inches.

1. Types: As indicated in the Finish Schedule on the Drawings.

    a. Provide factory applied protective peel coat to prevent surface damage during fabrication and handling of aluminum faced decorative laminates. Remove protective peel coat after installation in accordance with the manufacturer's recommendations. If the film is left in place after installation, exposure to direct sunlight for a prolonged period may cause a paste residue and create other problems.

2. Backing Sheets: Non-decorative, high pressure laminate, NEMA LD3, Grade, types and thickness to match face sheets and equalize pull.

F. Stone:

1. General: Provide stone of soundness (hardness and density), texture, graining finish, crystal patterning, color and tone matching the sample in the Architect's office (and subject to the Architect's approval). Stone shall be sound and free from defects that will impair strength durability, finish appearance, and is supplied from a single quarry source with sufficient capacity, to satisfy the total requirements of the Project. Waxing and sticking will not be permitted.
2. Specie, Finish and Thickness:

    a. Specie and Finish: As indicated in the Finish Schedule on the Drawings. Stone tops shall be sealed on all surfaces with materials compatible with the stone and that do not affect their sheen or color.
    b. Thickness: Minimum 3/4 inch.

G. Countertop Sealer:

1. Impregnator: Low viscosity, UV resistant, water vapor permeable, impregnator specifically formulated to penetrate stone and grout pore structures without changing the color or sheen of the stone to which it is applied and that provides an invisible barrier of protection from water, dirt, oil, grease, lipstick, wine, and hand cream lotion infiltration.

    a. .Basis of Design Product: S234 Impregnator for factory sealing of stone countertop units, if field finishing stone countertops use S232 Impregnator. Contact HMK Stone Care System, Hallandale, FL. (800) 424-2HMK, (415) 643-5603.
    b. Lithofin, Lithofin MM Stainstop Impregnator for factory sealing.
    c. Miracle Adhesives: Miracle 511 Pourous Plus for factory sealing.

2. Surface Protection Coating: No-rinse type, 100 percent natural vegetable soap cleanser, that is pH neutral (pH 7), vapor permeable and compatible with impregnator, and that emulsifies dirt and debris on the stone surface while repelling liquids. Will not change the color or sheen of the stone to which it is applied.

    a. Basis of Design Product: HMK P324 Liquid Stone Soap No Rinse.
    b. Lithofin, Surface protection coating complying with the above requirements and recommended by the impregnator manufacturer.
    c. Miracle Adhesives: Surface protection coating complying with the above requirements and recommended by the impregnator manufacturer.

3. Prepare countertop surfaces to receive sealer in accordance with the countertop sealer manufacturer's recommendations. Apply sealers and surface protection coatings in accordance with the countertop sealer manufacturer's instructions.

H. Adhesives, General: Use only low emitting VOC adhesives that leave no glue lines on finished surfaces of architectural woodwork. Do not use adhesives that contain urea formaldehyde.

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.

1. Do not use treated material that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber or panel products.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.
3. Treat only door subframing, blocking and furring items.

B. Fire-Retardant-Treated Lumber: Materials impregnated with fire-retardant chemical formulations to comply with AWPA U1, Use Category UCFA. Kiln-dry material after treatment to levels required for untreated woodwork.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials for a complete installation of architectural woodwork, except for items specified in Section 08 71 00 "Door Hardware."

B. Hardware Standard: Comply with BHMA A156.9 for items indicated by referencing BHMA numbers or items referenced to this standard.

C. Frameless Concealed Hinges for Cabinet Doors (European Type): Concealed all-metal furniture hinges adaptable or engineered for 35 mm hinge cup boring pattern, with minimum 155 degree opening angle, three-dimensional hinge having adjustments located in the steel hinge arm, steel or die-cast zinc hinge cups, mounting plates, and plastic insertion dowels to receive hinge screws. Automatic soft closing shall engage only in the last 10 degrees of swing. All hinge pins and linkages shall be hardened. Complying with BHMA A156.9, B01602. Bright nickel finish (US15).

1. Hinge Quantity: Provide hinge quantity as recommended by hinge manufacturer based on cabinet door width, weight, thickness, door material, and hinge cup selection.

2. Metal Furniture Hinge Products and Manufacturers: One of the following:

    a. Basis of Design: Grass Tiomos Series; Grass America, Inc.; Kernersville, NC.
    b. Blumotion Series; Blum USA; Stanley, NC.
    c. Salice; Silencia Series 200.

D. Hidden Gate Hinges: Full mortised, invisible hinges and specifically manufactured for door thickness indicated and fabricated from high strength plated brass or steel, heavy duty zinc alloy or brass castings, and non-removable riveted hinge pins. Each hinge shall be engineered for smooth performance with laminated link construction supplemented by anti-friction materials that reduce friction for smooth, free hinge operation. Complying with BHMA A156.9, B01501.

1. Hinge Quantity: Provide hinge quantity as recommended by hinge manufacturer based on cabinet door width, weight, thickness, door material, and hinge cup selection.
2. Metal Furniture Hinge Products and Manufacturers: One of the following:

    a. Basis of Design: "Soss" Hinges; Universal Industrial Products Company, Pioneer, OH.
    b. Vici Hinges 341.25.xxx; Hafele America; Archdale, NC.
    c. Soss Hinge 341.07.xxx; Hafele America Co.; Archdale, NC.

E. Wire Pulls: Back mounted, 4 inches long, 3/8 inches in diameter fabricated from satin finished stainless steel (US32D), complying with BHMA A156.9, B52011, unless otherwise indicated.

F. Catches: Magnetic, complying with BHMA A156.9, B03141 for single doors and B03161 for double doors.

1. For Single Doors:One of the following:

    a. CD41 Single Magnetic Cabinet Catch; Stanley Commercial Hardware.
    b. 900; Rockwood Manufacturing Company, Rockwood, PA.
    c. 246.94.701 housing x 246.94.702 counterpiece; Hafele America Co. Archdale, NC.

2. For Double Doors: One of the following:

    a. 901; Rockwood Manufacturing Company.
    b. CD45 Double Magnetic Cabinet Catch; Stanley Commercial Hardware.

G. Cabinet Shelf Rests: Nickel plated brass or steel, or stainless steel, minimum 6 mm diameter shelf support pegs in sockets, complying with BHMA A156.9, B04013. One of the following:

1. Hafele 282.01.701 x 282.50.704; Hafele America, Co.

2. K-10S with K-2 Sleeve; Brusso, Inc.
3. 331 Series Flat Top Shelf Support Pin with 325 Series Insert Grommet; Knape and Vogt.

H. Closet Rods and Flanges: 1-1/2 inch diameter, satin finished chrome plated steel or satin finished stainless steel with matching end flanges.

I. Adjustable Shelf Standards and Brackets for Wall-Hung Open-Shelving:

1. Standards: Model No. 87 ANO Extra Heavy Duty 87-187 Series; lengths as indicated, by Knape and Vogt.
2. Brackets: [Model No. 186 LL ANO for 8- and 10-inch] [Model No. 187 LL ANO for 12- to 24-inch] deep shelves by Knape and Vogt.
3. Shelf Rests: Model No. 210 ANO End Rest and Model No. 211 ANO Center Rest with Model No. 129 RUB Rubber Cushions.

J. Drawer Slides:

1. Pencil Drawer Slides: Similar to Accuride 2006 having 3/4 extension carburized steel ball bearing, side mounting, 45 pound capacity medium duty load rating, cold rolled steel slide members and ball retainers, bright electro zinc plate finish.

2. Drawers less than 4 inches deep: Similar to Accuride 3832EC "Easy Close" having full extension carburized steel ball bearing, side mounting, 100 pound capacity medium duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, detent-in, progressive action, positive stop, bright electro zinc plate finish.

3. Drawers greater than 4 inches but less than 8 inches deep: Similar to Accuride 3832EC "Easy Close" having full extension carburized steel ball bearing, side mounting, 100 pound capacity medium duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, detent-in, progressive action, positive stop, bright electro zinc plate finish.

4. Drawers greater than 8 inches deep: Similar to Accuride 3634EC "Easy Close"having full extension carburized steel ball bearing, rail mounting, 150 pound capacity heavy duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, detent-in, progressive action, positive stop, bright electro zinc plate finish.
5. Refuse Cabinets: Similar to Accuride 3600-201 having full extension carburized steel ball bearing, bottom mounting, 175 pound capacity heavy duty load rating, cold rolled steel slide members and ball retainers, cushioned in and outstops, progressive action, positive stop, bright electro zinc plate finish.
6. Accuride International, S.A. de C.V., Mexicali, B.C., C.P. 21395 Mexico.

K. Flipper Door Slides: For vertically mounted retracting cabinet doors up to 75 pounds and 72 inches tall, Model No. 1432, black color, with hinge carrier strip by Accuride, Inc.

L. Silencers: Provide rubber silencers on jamb and/or head and sill strike areas of all cabinet doors and drawers, 2 for paired doors, and 3 for single doors. Silencers shall be approximately 1/4-inch diameter, color compatible with adjacent finish.

M. Aluminum Slides for Sliding Glass Doors: Heavy duty track assembly consisting of upper guide, shoe-H bar, lower track and rollers; clear anodized finish:

N. Grommets for Cable Passage through Countertops: 2-1/2-inch OD, [brown] [black] [to receive plastic laminate] <Insert color>, metal grommets and matching metal caps with slot for wire passage.

O. Exposed Hardware Finishes: Unless otherwise specified above, or on the Drawings, all exposed portions of the woodwork hardware shall comply with BHMA A156.18 for BHMA finish number indicated.

1. Satin Stainless Steel: BHMA 630.

P. Stainless Steel Trim: Custom fabricate stainless steel trim shapes to the sizes, shapes and profiles shown from the following materials. Provide in standard commercial tempers and hardness, as required for fabrication, strength and durability from Type 304 alloy. Form exposed work true to line and level, with flush surfaces and accurate angles. Ease exposed edges to a radius of approximately 1/32 inch radius, unless otherwise shown. Miter exposed corner joints and machine fit to a hairline joint. All sheet goods shall be provided finished one side only. Finish designation shown on the Drawings are NAAMM nomenclature.

1. Sheet and Plate: ASTM A 666.
2. Bar Stock: ASTM A 276.
3. Pipe: ASTM A 312, Grade TP 304.
4. Tubing: ASTM A 554, Grade MT 304.

Q. Stainless Steel Trim Finish: Provide the following mechanical finish to the exposed surfaces of the fabricated work to the extent indicated (NAAMM nomenclature), with texture and reflectivity as required to match the Architect's sample.

1. No. 4 (bright directional polish).

R. Steel Reinforcing: Carbon steel shapes, tubes and plates complying with ASTM A 36 (shapes and plates), and ASTM A 500 or A 501 (for tubes).

1. Shop Primer for Concealed Steel Reinforcing: Provide fast curing, lead and chromate free, universal modified alkyd primer complying with performance requirements in FS TT-P-664.
2. Electrodes for Concealed Steel Reinforcing: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded.

S. Resilient Base: Refer to Section 09 65 13 "Resilient Wall Base and Accessories."

T. Hanging (Zee Clip) Strips: Extruded aluminum zee type interlocking clips; type, size and quantity for the condition of use.

U. Brushed Aluminum Trim Shapes: Custom fabricate aluminum trim shapes to the sizes, shapes and profiles shown from the following materials. Provide in standard commercial tempers and hardness, as required for fabrication, strength and durability. Form exposed work true to line and level, with flush surfaces and accurate angles. Miter exposed corner joints and machine fit to a hairline joint. Finish designations are NAAMM nomenclature.

1. Plate: Alloy 5005 and ASTM B 209.
2. Bar Stock: ASTM B 211.
3. Extrusions: Alloy 6063 and ASTM B 221.
4. Aluminum Trim Finishes: Provide the following finishes to the exposed surfaces of the fabricated work to the extent indicated (NAAMM nomenclature), with texture and reflectivity as required to match the Architect's sample.

    a. Class II, Clear Anodic Finish: Complying with AA-M10M32A31 for an Architectural Class II, medium satin, clear natural anodized finish.

V. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1.

W. Nails, Wire, Brads, and Staples: Select material, type, size, and finish required for each use.

1. ASTM F 1667 for driven fasteners such as nails, spikes and staples.
2. ASTM F 547 for nails used with wood and wood based products.

X. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

Y. Blind Splines: Specialty devices, as required for tight butt joining, types and size as recommended by woodwork fabricator.

Z. Covercaps: Where mortises of fastener heads, or draw downs are exposed (blind holes) in finished work, provide black plastic covercaps.

2.4 FABRICATION, GENERAL

A. General: Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to the maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting. The width of scribe and filler panels shall not exceed 1/2 inch, or 1/2 inch clear dimension from adjacent wall to outside face of cabinet door in a 90 degree position, whichever is greater.

1. Interior Woodwork Grade: Custom complying with the referenced quality standard.

B. Fabricate woodwork to dimensions, profiles, and details indicated.

1. Reinforcing shown is minimum. Provide additional steel and lumber reinforcing as required to sustain imposed loads and to ensure a rigid assembly.
2. Exposed surfaces shall be free from dents, tool marks, warpage, buckle, glue and open joints, or other defects affecting serviceability or appearance. Accurately fit all joints, corners and miters. Conceal all fasteners. Make threaded connections up tight so that threads are entirely concealed.

C. Shop cut openings to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.
2. Install glass to comply with applicable requirements in Section 08 80 00 "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.5 WOOD CABINETS FOR PLASTIC LAMINATE FINISH

A. AWS Type of Cabinet Construction: Flush overlay.

B. Laminate Cladding for Exposed Surfaces: High-pressure decorative of grade indicated.

1. Horizontal Surfaces Other Than Tops: HGS.
2. Postformed Surfaces: HGP.

3. Vertical Surfaces: VGS.
4. Edges: HGS unless otherwise indicated.
5. Colors, Patterns, and Finishes: As indicated on the Drawings and in the Finish Schedule.

C. Materials for Semiexposed Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, Grade VGS.

1. Drawer Sides and Backs: Solid-hardwood lumber.
2. Drawer Bottoms: Hardwood plywood.

D. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

2.6 PLASTIC LAMINATE COUNTERTOPS

A. General: Comply with AWS Section 11 and as follows.

B. High-Pressure Decorative Laminate Grade: HGS.

C. Colors, Patterns, and Finishes: As indicated on the Drawings and in the Finish Schedule.

D. Edge Treatment: Same as laminate cladding on horizontal surfaces unless otherwise indicated.

E. Core Material at Sinks: Particleboard or exterior-grade plywood.

2.7 FLUSH WOOD PANELING

A. Core Material:

1. Opaque Finished Paneling: Medium density fiberboard.
2. Transparent Finished Paneling: Medium density particleboard or medium density fiberboard.

B. Veneered Surfaces:

1. Veneer Types:

a. Opaque Finished Paneling: Exposed MDF.
b. Transparent Finished Paneling: As indicated on the Drawings and in the Finish Schedule.

2. Transparent Finished Panel Matching:

a. Matching of Adjacent Veneer Leaves: Book matched, unless otherwise indicated.
b. Veneer Matching With Panel Face: Center balance match, unless otherwise indicated.
c. Panel Matching Method: Match panels to one another within each separate area by the following method:

1) Blueprint sequenced matched panels and components.

C. Edge Detail: Edge veneer banded with continuous hardwood strips matching face veneer. Panel joints to be flush type unless otherwise shown.

2.8 CLOSET AND UTILITY SHELVING

A. General: Comply with AWS Section 10 and as follows.

B. Shelf Material: Medium density fiberboard where indicated to be painted; medium density particle board where indicated for plastic laminate or melamine veneer.

C. Cleats: 3/4-inch solid lumber or thermoset decorative panel.

D. Finishes: As shown and scheduled on the Drawings.

2.9 SHOP FINISHING

A. Production finish architectural woodwork at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Priming of interior architectural woodwork with field applied opaque finish required to be performed at fabrication shop are specified in this Section. Refer to Section 09 91 23 "Interior Painting" for finishing opaque finished architectural woodwork.

C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative overlay.
2. Gluing of face veneers shall, where possible, be by the hot plate method; glued surfaces shall be in close contact throughout. Glue stains will not be permitted.

3. Grain of all transparent finished wood shall run in the direction shown, or if not shown, as accepted on the shop drawings.

D. Exposed Surfaces:

1. Plastic Laminate Finish: Gluing of plastic laminate surfacing materials shall be by the hot plate method, glued surfaces shall be in close contact throughout. Glue stains shall not be permitted.

E. Unexposed Wood Finish: Shop-applied alkyd type primer-sealer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming before installation.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with requirements of the AWS for the same grade specified in this Section for type of woodwork involved.

1. Install woodwork level, plumb, true, with no distortions, and with no variations in flushness of adjoining surfaces. Shim as required with concealed shims.
2. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

B. Anchor woodwork to blocking built in or directly attached to substrates. Secure to blocking with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

C. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.

1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.

D. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets without sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.
3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches on center with No. 10 wafer-head screws sized for 1-inch penetration into wood blocking, or hanging strips or with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

E. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Calk space between backsplash and wall with silicone sanitary sealant specified in Section 07 92 00 "Joint Sealants."

2. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches on center and to walls with adhesive.

4. Man-Made Stone Tops: Dry fit the fire slate. A minimum of 10 percent of the area to be covered should be in direct contact with the fireslate with particular emphasis of eliminating gaps on the contact perimeter greater than 0.25 inches in span and depth. Adjustment of the fire slate material shall be in accordance with the written instructions of the fireslate manufacturer. Field apply sealer to the fire slate in accordance with the sealer manufacturer's instructions.

F. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips, by blind nailing on backup strips, splined connection strips, and associated trim and framing. Do not use face fastening, unless otherwise indicated. Space panels so that reveals are parallel and of widths indicated.

G. Built-In Desks and Credenzas: Install without distortion so that doors, and drawers, fit openings properly and are accurately aligned. Adjust hardware to center doors, and drawers, in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean woodwork on exposed and semiexposed surfaces. Touchup shop-applied finishes to restore damaged or soiled areas.

1. Man-made stone top surfaces shall be cleaned with soap and water followed with a clean water rinse.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer, that ensures that woodwork will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 06 40 23

SECTION 07 84 13 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

1. Floors.
2. Roofs.
3. Walls and partitions.
4. Smoke barriers.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each type of through penetration firestop system product indicated.

B. Through-Penetration Firestopping Schedule: Submit a Through-Penetration Firestopping Schedule indicating the type of through-penetration firestop system to be installed for each penetration. Indicate each kind of construction condition penetrated and kind of penetrating item. Include firestop design designation of testing and inspection agency acceptable to the authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

    a. Engineering judgment shall include both project name and contractor's name who will install firestop system as described in document

1.3 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified or licensed, by firestop system manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements. A manufacturer's willingness to sell its firestop system materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

1. The installer must have no less than 3 years of experience with fire stop installation.

B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multi-component materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.6 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.

D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Architect, Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.

2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.

D. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

E. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

1. Sealant shall have a VOC content of 250 g/L or less.
2. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

3. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Provide non-hardening resilient firestop material at penetrations, sleeves and passthroughs in acoustic construction assemblies.

1. Acceptable Products:

a. Specified Technologies, Inc.; Elastomeric Sealant ES100
b. Johns Manville; Firetemp CI Caulk.
c. 3M; Fire Barrier 2001 Silicone RTV Foam.
d. Hilti; Flexible Firestop Sealant CP 606.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and nonsag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to nonsag grade for both opening conditions.

K. Gypsum Products: The use of gypsum products for through-penetration firestopping is strictly prohibited.

2.4 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

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

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without damaging substrate or disturbing firestop system's seal with substrates.

3.3 INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and installations comply with requirements.

3.5 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 07 84 13

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes sealants for the following applications:

1. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

   a. Control and expansion joints in unit masonry.
   b. Joints between different materials listed above.
   c. Perimeter joints between materials listed above and frames of doors and windows and louvers.
   d. Other joints as indicated.

2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
   d. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
   e. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   f. Other joints as indicated.

3. Interior joints in the following horizontal traffic surfaces:

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

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each joint-sealant product indicated and the following:

1. Written certification from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use(s) indicated as verified through manufacturer¢¢s in-house testing laboratory.

a. Complete instructions for handling, storage, mixing, priming, installation, curing and protection of each type of sealant.

2. Laboratory and field test results confirming joint preparation (cleaning/priming), chemical compatibility, and proper adhesion for specified joint sealant for each of the joint profiles and substrate materials included in the design of this Project.

B. Samples: Submit samples of each type and color of exposed joint sealant required. Provide fully cured joint sealant samples in 3/4 inch wide joints 12 inches long formed between two strips of material to be sealed as they will appear on the Project.

1.3 INFORMATIONAL SUBMITTALS

A. Warranties: Submit specified warranties.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of joint sealant, and each type of structural silicone adhesive, from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 FIELD CONDITIONS

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

1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.

2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Written warranty, signed by Installer agreeing to repair or replace elastomeric joint sealant work which has failed to provide a weathertight system within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Manufacturer's Warranties: Written warranties (weatherseal and stain resistance), signed by elastomeric sealant manufacturer agreeing to furnish elastomeric joint sealants to repair or replace those that fail to provide airtight and watertight joints, or fail in adhesion, cohesion, abrasion-resistance, stain-resistance, weather resistance, or general durability or appear to deteriorate in any other manner not clearly specified in the manufacturer's data as an inherent quality of the material within specified warranty period.

1. Warranty Period:

a. For Polyurethane Sealants: 5 years from date of Substantial Completion.
b. For Silicone Sealants: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as stated by sealant manufacturer's published data, and as substantiated by the manufacturer for each application through testing.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

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. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Colors: For fully concealed joints, provide manufacturer's standard color of sealant which has the best overall performance characteristics for the application shown. For exposed joints provide color as selected manufacturers standard colors

E. Manufacturer's Representative: Do not use elastomeric sealant produced by a manufacturer who will not agree to send a qualified technical representative to the Project site when requested, for the purpose of rendering advice concerning the proper installation of manufacturer's materials.

2.2 ELASTOMERIC JOINT SEALANTS

A. Two Part Polyurethane Sealants for Vertical Applications (Non-Sag):

1. Typical Exterior Wall Joints (Two-Part Polyurethane Sealants):

a. Properties:

1) Standards: Comply with ASTM C 920, Type M, Grade NS, Class 25 or Class 50; use NT, M, A and O.
2) Performance: Non-stain, non-bleed, non-streaking to sealed and adjacent substrates. The minimum peel adhesion value after 7 day immersion shall not be less than 13 pli when tested in strict accordance with ASTM C 794 Adhesion in Peel.

b. Products and Manufacturers: One of the following:

1) BASF Master Builders; MasterSeal NP 2.
2) Pecora Corporation; Dynatrol II.
3) Tremco an RPM Co,; 240FC.

2.3 LATEX JOINT SEALANTS

A. Latex Sealant: Non-elastomeric, one part, non-sag, paintable latex sealant that is recommended for exposed applications on the interior. Complying with ASTM C 834, Type OP (opaque sealants):

1. Products: Provide one of the following:

a. Pecora Corporation; AC-20 + Silicone.
b. DAP Products Inc.; Alex Plus Acrylic Latex Caulk Plus Silicone.
c. BASF; MasterSeal NP 520.
d. Tremco, an RPM Co.; Tremflex 834.

2.4 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: One of the following preformed, compressible, resilient, nonstaining, nonwaxing, nonextruding backings of flexible plastic foam complying with ASTM C 1330, and of type indicated below. Select shape and density of cylindrical sealant backings in consultation with the manufacturer for proper performance in specific condition of use in each case.

1. Type C: Closed-cell polyethylene foam material with a surface skin, which is nonabsorbent to liquid water and gas, non-outgassing in unruptured state; one of the following:

a. HBR Closed Cell Backer Rod; Nomaco, Inc.
b. MasterSeal 920; BASF Master Builders.
c. Mile High Foam; Backer Rod Mfg., Inc.

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

2.5 MISCELLANEOUS MATERIALS

A. Primer: Material recommended, as verified through compatibility and adhesion testing, by joint sealant manufacturer for the substrates indicated to be sealed.

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

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and which will not stain nor mar the finish of surfaces adjacent to joints to which it is applied.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:

1. Remove foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), existing joint sealants, existing backer rods, existing waterproofing materials, existing water repellent treatments, oil, grease, water, surface dirt, and frost.
2. Clean concrete, masonry, unglazed surfaces of tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
3. Remove laitance and form-release agents from concrete.

4. Clean metal, glass, porcelain enamel, glazed surfaces of tile, and other nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming (Elastomeric Sealants Only): Prime joint substrates with primers selected through the preconstruction compatibility and adhesion testing. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Joint Priming (Elastomeric Sealants Only): Prime joint substrates where recommended in writing by joint sealant manufacturer, based on prior testing and experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration beyond bond areas or onto adjoining surfaces.

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

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

1. Silicone Glazing Sealants: Refer to Section 08 80 00 "Glazing" for installation.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:

1. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

    a. Do not leave gaps between ends of sealant backings. Trim for tight fit around obstructions or elements penetrating the joint.
    b. Do not stretch, twist, puncture, or tear sealant backings.

c. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry sealant backings.

2. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and back of joints.
3. Install weeps and vents into joints at the same time sealants are being installed. Unless otherwise shown on the drawings, or directed by the Architect, locate weeps and vents spaced as recommended by the sealant manufacturer and the window and curtain wall fabricator and erector. Do not install weeps and vents at outside building corners. Do not install vents at horizontal joints immediately below shelf angles, sills, and through wall flashings.

D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.

1. Apply sealants in the depth shown or, if none is shown, apply in accordance with the manufacturer's recommendations and the following general proportions and limitations:

a. Apply elastomeric sealants in sidewalk, pavement and similar horizontal joints to a depth equal to 75% of the joint width, but not less than 3/8 inch and not more than 3/4 inch.
b. Apply elastomeric sealants, in joints not subject to traffic or other abrasion, to a depth equal to 50% of the joint width, but not less than 1/4 inch and not more than 1/2 inch.
c. Apply non-elastomeric sealants to a depth approximately equal to the joint width.
d. Fill horizontal traffic bearing joints slightly recessed to avoid direct contact with wheel, and pedestrian traffic. Fill horizontal traffic bearing joints with slope grade polyurethane sealants to a depth approximately equal to the joint width.

2. Pour self-leveling sealants to a depth approximately equal to the joint width.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform, beads to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces. Tool exposed surfaces of sealants to the profile shown, or if none is shown, tool slightly concave.

1. Use masking tape to protect adjacent surfaces of recessed tooled joints.
2. Provide a slight wash on horizontal joints where horizontal and vertical surfaces meet.

3. Against rough surfaces or in joints of uneven widths avoid the appearance of excess sealant or compound by locating the compound or sealant well back into joint wherever possible.

3.4 FIELD QUALITY CONTROL

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

1. Perform 10 tests for the first 1000 feet of joint length for each type of exposed exterior wall sealant and joint substrate.
2. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

B. Field adhesion testing of sealants shall take place in the presence of a qualified technical representative of the sealant manufacturer.

1. Test Method: Test joint sealants by hand-pull method described below:

   a. Make knife cuts from one side of joint to the other, followed by two cuts approximately 3 inches long at sides of joint and meeting cross cut at one end. Place a mark 1 inch from cross-cut end of 3 inch piece.
   b. Use fingers to grasp 3 inch piece of sealant between cross-cut end and 1 inch mark; pull firmly at a 90-degree angle to the joint in the direction of side cuts and hold the sealant in this position for 10 seconds; following the 10 second time duration pull sealant at a 180 degree angle parallel to the joint and hold the sealant in this position for 10 seconds. Pull sealant away from joint to the distance recommended by sealant manufacturer for testing adhesion.
   c. For joints with dissimilar substrates, check adhesion to each substrate separately. Do this by extending cut along one side, checking adhesion to opposite side, and then repeating this procedure for opposite side.

2. The sealant manufacturer¢s qualified technical representative shall record test results, and observations of joint and sealant conditions, in a field adhesion test log.
3. Repair joint sealants pulled from test area as recommended by sealant manufacturer.
4. The sealant manufacturer shall provide written documentation of changes in product and/or application method required to address sealant failure, observe and document retesting as required by the Architect, and provide a written statement of compliance with applicable warranties.

C. Sealants not evidencing adhesive failure from testing will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

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

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

3.7 JOINT SEALANT SCHEDULE

A. Exterior joints in the following vertical surfaces and nontraffic horizontal surfaces:

1. Perimeter joints between storefronts, balcony door, aluminum window, metal framing and adjacent materials: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
2. Control and expansion joints in cast-in-place concrete: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
3. Control and expansion joints in unit masonry: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
4. Joints between different materials listed above: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.
5. Perimeter joints between materials listed above and frames of doors and windows and louvers: Silicone Sealants for Vertical Applications (Non-Sag), Typical Exterior Wall Joints.

B. Exterior joints in the following horizontal traffic surfaces:

1. Control, expansion, and isolation joints in cast-in-place concrete slabs: Two-Part Polyurethane Sealant for Paving Applications.

2. Control and Expansion Joints in paving units, including steps and ramps: Two-Part Polyurethane Sealant for Paving Applications.
3. Control and expansion joints in joints between precast concrete tee flanges and shapes: Two-Part Polyurethane Sealant for Paving Applications.
4. Around perimeters of parking garage and balcony deck drains: Two-Part Polyurethane Sealant for Paving Applications.
5. Joints between different materials listed above: Two-Part Polyurethane Sealant for Paving Applications.

C. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

1. Control and Expansion Joints on Exposed Interior Surfaces of Exterior Walls: Latex sealant.
2. Perimeter Joints of Exterior Openings Where Indicated: Latex sealant.
3. Vertical Control and Expansion Joints in Stone and Tile Surfaces: Latex sealant.
4. Horizontal Control and Expansion Joints in Stone and Tile Flooring Surfaces: Two-Part Polyurethane Sealant for Paving Applications.
5. Vertical Control Joints on Exposed Surfaces of Interior Unit Masonry and Concrete Walls and Partitions: Latex sealant.
6. Joints on Underside of Precast Beams and Planks: Latex sealant.
7. Perimeter Joints between Interior Wall Surfaces and Frames of Interior Doors, Windows, and Elevator Entrances: Latex sealant.
8. Perimeter Joints between Scalloped, Bent, or Warped Interior Wallboard Surfaces and Straight Trim: Latex Sealant.
9. Joints between Plumbing Fixtures and Adjoining Walls, Floors, and Counters: Mildew resistant silicone sealant.
10. Joints between Glass, and between Glass and Adjacent Substrates: Butt glazing sealant.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes

1. Hollow metal doors and frames.
2. The integration of a security system into the hollow metal door and frame work is required. The Contractor shall be responsible for the total and complete coordination of the security system components into the Work.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each product indicated. Include material descriptions, core descriptions, label compliance, sound and fire-resistance ratings, and finishes for each type of door and frame specified.

B. Shop Drawings: Submit door and frame schedule using same reference designations indicated on Drawings. Include opening size(s), handing of doors, frame throat dimensions, details of each frame type, elevations of door design types, details of construction, location and installation requirements of door hardware and reinforcements, hardware group numbers, details of joints and connections, fire label requirements including fire rating time duration, maximum temperature rise requirements, and smoke label requirements.

1. Indicate routing of electrical conduit and dimensions and locations of cutouts in doors and frames to accept electric hardware devices.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

A. Hollow Metal Door and Frame Standard: Comply with the applicable provisions and recommendations of the following publications by Hollow Metal Manufacturers Association (HMMA) Div. of National Association of Architectural Metal Manufacturers (NAAMM), unless more stringent requirements are indicated in the Contract Documents:

1. HMMA "Hollow Metal Manual."
2. HMMA 861 "Guide Specifications for Commercial Hollow Metal Doors and Frames."

B. Manufacturer Qualifications: A firm experienced in manufacturing hollow metal doors and frames similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palleted, wrapped, or crated to provide protection during transit and Project site storage.

B. Inspect doors and frames, on delivery, for damage. Tool marks, rust, blemishes, and other damage on exposed surfaces will not be acceptable. Remove and replace damaged items as directed by Architect. Store doors and frames at building site in a dry location, off the ground, and in such a manner as to prevent deterioration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 or UL 10C "Standard for Positive Pressure Fire Tests of Door Assemblies." Fire classification labels at all doors with fire ratings greater than 20 minutes shall indicate the temperature rise developed on the unexposed surface of the door after the first 30 minutes of fire exposure.

1. Provide metal labels permanently fastened on each door which is within the size limitations established by the labeling authority having jurisdiction.

B. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257 or UL9.

C. Smoke-Control Door Assemblies: Provide assemblies with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

D. Thermally Rated Door Assemblies:Design, fabricate and install exterior door assemblies with the assembly U-factor maximum to comply with ASHRAE 90.1 and the IECC for the project specific geographic location of the building project when tested according to NFRC 100 (ASTM C 518).

2.2 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A 1011/A 1011M, CS (commercial steel), Type B, free of scale, pitting, or surface defects; pickled and oiled. Not less than 16 gauge, thick where frames are indicated to be built into exterior walls, hot dip galvanize after fabrication in compliance with ASTM A 153/A 153M, Class B.

B. Cold-Rolled Steel Sheets: ASTM A 1008/A 1008M, CS (commercial steel), Type B; free from scale, pitting, coil breaks, surface blemishes, buckles, waves, or other defects, exposed (matte) dull finish, suitable for exposed applications.

C. Inserts, Bolts, and Fasteners: Galvanized or cadmium plated steel.

1. Expansion Bolts and Shields: FS FF-S-325, Group III, Type 1 or 2.
2. Machine Screws: FS FF-S-92, carbon steel, Type III cross recessed, design I or II recess, style 2C flat head.

D. Hardware: Refer to Section 08 71 00 "Door Hardware."

2.3 DOORS

A. General: Provide flush-design doors, 1-3/4 inches thick, of seamless hollow construction, unless otherwise indicated. Construct doors with sheets joined at their vertical edges by continuous welding the full height of the door, or joined at vertical edges by 1 inch spot welds 6 inches on center, or intermittently welded seams. Voids between spot and intermediate welds shall be epoxy edge filled. Grind and finish all welds and edge fills flush to result in invisible seams on the door faces or vertical door edges.

1. For single-acting swing doors, bevel both vertical edges 1/8 inch in 2 inches.

B. Interior Door Core Construction: Doors shall be stiffened by continuous vertically formed steel sections which, upon assembly, shall span the full thickness of the interior space between door faces. These stiffeners shall be 20 gauge not more than 6 inches apart and spot welded to face sheets a maximum of 5 inches o.c. Place filler between stiffeners for full height of door.

C. Fire Door Cores: A continuous mineral fiberboard core permanently bonded to the inside face of the outer face sheet unless otherwise required to provide fire-protection and temperature-rise ratings indicated.

D. Hardware Reinforcement: Fabricate reinforcing from the same material as door to comply with the following. Offset reinforcement so that faces of mortised hardware items are flush with door surfaces.

1. Hinges and Pivots: 7 gauge thick by 1-1/2 inches wide by 9 inches.
2. Lock Front, Strike, and Flushbolt Reinforcements: 12 gauge thick by size as required by hardware manufacturer.
3. Lock Reinforcement Units: 14 gauge thick by size as required by hardware manufacturer.
4. Closer Reinforcements: 12 gauge thick one-piece channel by size as required by hardware manufacturer.
5. Other Hardware Reinforcements: As required for adequate strength and anchorage.
6. In lieu of reinforcement specified, hardware manufacturer's recommended reinforcing units may be used.
7. Exit Device Reinforcements: 12 gauge thick by 10 inches high by 4 inches wide centered on exit device case body, unless otherwise recommended by exit device manufacturer.

E. Electrical Requirements: Make provisions for installation of electrical items specified elsewhere; arrange so wiring can be readily removed and replaced.

1. Provide all cutouts and reinforcements required for hollow metal doors to accept security system components.
2. Doors with Electric Hinges and Pivots: Provide with metal conduit or raceway to permit wiring from electric hinge or pivot to other electric door hardware.

    a. Hinge Location: Center for doors less than 90 inches tall or second hinge from door bottom for doors greater than 90 inches; top or bottom electric hinge locations shall not be permitted.

F. Interior Hollow Metal Doors:

1. Typical Interior Doors: Flush design with 16 gaugethick cold-rolled stretcher-leveled steel face sheets and other metal components from hot- or cold-rolled steel sheets.

2.4 WELDED FRAMES

A. Fabricate hollow metal frames, formed to profiles indicated, with full 5/8 inch stops, and of the following minimum thicknesses.

1. Frame heads at all masonry openings shall be formed to extend to the lowest CMU horizontal mortar joint.

B. Provide frames either saw mitered and full (continuously) profile welded, or machine mitered and full profile welded, on back side at frame corners and stops with edges straight and true. Grind welds smooth and flush on exposed surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install doors and frames according to the referenced standards, the Architect reviewed shop drawings, and manufacturer's written recommendations and installation instructions.

B. Frames: Install frames where indicated. Extend frame anchorages below fills and finishes. Coordinate the installation of built-in anchors for wall and partition construction as required with other work.

1. Welded Frames:

a. Set masonry anchorage devices where required for securing frames to in-place concrete or masonry construction.

1) Set anchorage devices opposite each anchor location as specified and anchorage device manufacturer's written instructions. Leave drilled holes rough, not reamed, and free of dust and debris.

b. Placing Frames: Remove temporary spreader bars prior to installation of the frames. Set frames accurately in position; plumb; align, and brace securely until permanent anchors are set.

1) At concrete or masonry construction, set frames and secure in place with machine screws and masonry anchorage devices. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
2) Anchor bottom of frames to floors through floor anchors with threaded fasteners.
3) Field splice only at approved locations indicated on the shop drawings. Weld, grind, and finish as required to conceal evidence of splicing on exposed faces.
4) Remove spreader bars only after frames are properly set and secured.

2. At fire-rated openings, install frames according to NFPA 80.

C. Doors:

1. Fire-Rated Doors: Install with clearances as specified in NFPA 80.
2. Smoke Control Doors: Install according to NFPA 105.

D. Apply hardware in accordance with hardware manufacturer's instructions and Section 08 71 00 "Door Hardware." Drill and tap for machine screws as required. Do not use self tapping sheet metal screws. Adjust door installation to provide uniform clearance at head and jambs, and to contact stops uniformly. Adjust hardware items just prior to final inspection. Leave work in complete and proper operating condition.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items just before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

1. Finish Painting: Refer to Section 09 91 23 "Interior Painting" "

C. Remove and replace defective work, including doors or frames that are warped, bowed, or otherwise defective.

D. Institute protective measures required throughout the remainder of the construction period to ensure that the hollow metal doors and frames will be without damage or deterioration, at time of Substantial Completion.

END OF SECTION 08 11 13

SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes aluminum-framed entrances and storefronts.

1. Security system components may be incorporated into the door and frame openings of all aluminum-framed entrances and storefronts at the Owner's option. Cooperate with the Owner's security system contractors if the Owner chooses to incorporate security system components during the course of the Work.

1.2 ACTION SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each aluminum-framed entrance and storefront product specified.

B. Shop Drawings: Submit shop drawings showing scaled elevations, plans, and sections of the aluminum entrance and storefront work. Full-scale sections shall be prepared and submitted for details of the assemblies that cannot be shown in the elevations or sections. Include with shop drawings metal thickness of all metal components, glass thicknesses, metal finishes,, location and installation requirements of door hardware and reinforcements, and all other pertinent information as necessary or requested by the Architect to indicate compliance with the Contract Documents. Details of field connections, anchorage, and their relationship to the work of others shall be clearly indicated for the coordination of the work by other building trades. Details of fastening and sealing methods and product joinery shall be shown to ensure proper performance of the field installation. No work shall be fabricated until shop drawings for that work have been approved by Architect for fabrication.

1. Hardware Schedule: Organize schedule into sets based on hardware specified. Include name of item and manufacturer, and complete designation of every item required for each entrance door.
2. Indicate routing of electrical conduit and dimensions and locations of cutouts in doors and frames to accept electric hardware devices.
3. Show direction of coil coating applied to metal panel faces.

C. Samples: Submit samples of the following before any work is fabricated:

1. Three paired sets of samples for each exposed metal finish required. Sample finishes shall be on the specified alloy, temper, and thickness of metal required for the work. Where finishes involve color and texture variations, include sample sets showing the full range of variations expected. Furnish samples in either 12 inch lengths of patch fittings, rails, or 12 inch squares of sheet.

1.3 INFORMATIONAL SUBMITTALS

A. Structural Calculations: Submit, for information only, copies of structural calculations indicating complete compliance with the specified performance requirements. Calculations shall be prepared, signed and sealed by a Professional Engineer registered in the state wherein the work is to be erected.

B. Field Test Reports: Submit field testing reports.

C. Product Test Reports: Submit certified product test reports based on tests performed by an AAMA Accredited Laboratory clearly describing in written form, and in shop drawing form, compliance of each aluminum-framed entrance and storefront assembly (each swinging and sliding door) with requirements indicated based on comprehensive testing.

D. Pre-Construction Sealant Compatibility and Adhesion Testing: Submit test results.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Instructions: Submit copies of an assembled and bound maintenance manual, describing the devices and procedures to be followed in cleaning, adjusting, and maintaining the aluminum-framed entrance and storefront work. Include information for maintaining operable doors, operating hardware, and replacing weather stripping.

1.5 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Prior to the start of the aluminum-frame entrance and storefront work, and at the Contractor's direction, meet at the site and review the installation procedures and coordination with other work. Meeting shall include Contractor, Owner, aluminum-framed entrance and storefront installer, sealant installer, as well as any other subcontractors or material technical service representatives whose work, or products, must be coordinated with the aluminum-framed entrance and storefront work.

1.6 IDENTIFICATION, DELIVERY, STORAGE, AND HANDLING

A. Packaging of components shall be so selected to protect the components from damage during shipping and handling.

B. Storage on Site: Store aluminum-framed entrance and storefront components in a location and in a manner to avoid damage to the components. Keep handling on site to a minimum. Exercise particular care to avoid damage to finishes of metals.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so that the entrance and storefront work will be accurately designed, fabricated and fitted to the structure. Indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work. Use Contractor's lines and benchmarks as a basis for measurements.

B. Electrical System Roughing-in: Coordinate layout and installation of electrified door hardware with connections to, power supplies, fire alarm system and detection devices, access control system, security system, building control system.

1.8 WARRANTY

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer Qualifications: Award the fabrication of aluminum framed entrances and storefront components to a single firm specializing in the fabrication of aluminum framed entrances and storefront components who has successfully produced work similar in design and extent to that required for the project, in not less than three projects of similar scope to the satisfaction of the Architect, and whose work has resulted in construction with a record of successful in-service performance for a period of 5 years. The fabricator shall have sufficient production capacity, have organized quality control and testing procedures, and published written and illustrated installation manuals, to produce and properly install the aluminum framed entrances and storefront assemblies required without causing delay in progress of the Work. Other manufacturers capable of producing aluminum framed entrances and storefront systems meeting the performance requirements include the following:

1. Moduline Division of Oldcastle Building Envelope.
2. TRACO div. of Kawneer Company, Inc.
3. Wausau Window and Window Wall Systems.
4. YKK AP America Inc.
5. Graham Architectural Products Corp.

B. Source Limitations: Obtain aluminum framed entrances and storefronts from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design aluminum-framed entrances and storefronts.

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

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure, including, but not limited to, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

    a. Thermal stresses transferring to building structure.
    b. Glass breakage.
    c. Noise or vibration created by wind and thermal and structural movements.
    d. Loosening or weakening of fasteners, attachments, and other components.
    e. Failure of operating units.

C. Structural Loads:

1. Wind Loads: As indicated on Drawings.

D. Deflection of Framing Members Supporting Glass: At design wind load, as follows:

1. Deflection Normal to Wall Plane: Limited to **1/175 of clear span for spans of up to** 13 feet 6 inches**.**

2. Deflection Parallel to Glazing Plane: Limited to **amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than** 1/8 inch.

    a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

3. Cantilever Deflection: Limited to 2L/175 at unsupported cantilevers.

E. Water Penetration under Static Pressure: Test in accordance with ASTM E331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas, including entrance doors, when tested in accordance with a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

F. Water Penetration under Dynamic Pressure: Test in accordance with AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.

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G. Design Modifications:

1. Submit design modifications necessary to meet the performance requirements and field coordination.
2. Variations in details or materials shall not adversely affect the appearance, durability or strength of components.
3. Maintain the general design concept without altering size of members, profiles and alignment.

2.3 MATERIALS

A. Aluminum:

1. Sheet and Plate: ASTM B209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221.
3. Structural Profiles: ASTM B308/B308M.

B. Carbon Steel: For carbon steel components required to join, reinforce or support the assembly of aluminum components provide carbon steel conforming to ASTM A 36/A 36M for structural shapes, plates, and bars; ASTM A 1008/A 1008M for cold-rolled sheet and strip; or ASTM A 1011/A 1011M for hot-rolled sheet and strip.

C. Glass and Glazing Materials: As specified in Section 08 80 00 "Glazing."

D. Anchors and Fasteners:

1. Material:

a. Wet Zones: Series 300 stainless steel.
b. Dry Zones: Carbon steel complying with either ASTM F 3125 or SAE Grade 5.

2. Anchor and Fastener Metal Alloy Types, Designations and Standards: Alloys as selected by fabricator to prevent corrosion resistance with the components fastened. Do not use self-drilling, self-tapping type fasteners.

3. Do not use exposed anchors and fasteners, except for hardware application. For hardware application, use countersunk Phillips flat-head machine screws finished to match framing members or hardware being fastened, unless otherwise indicated.
4. Where fasteners are subject to loosening or turn out from thermal and structural movements, wind loads, or vibration, use self-locking devices.

E. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123 or ASTM A 153 requirements.

F. Concealed Flashing: Dead-soft, 0.018 inch thick stainless steel, complying with ASTM A 666, Type 304.

G. Weather Stripping:

1. Compressible Weatherstripping: Compressible weatherstripping gaskets fabricated from extruded multi-fingered PVC, silicone or neoprene, replaceable, held in adjustable depth extruded metal strips to be mortised into edge of door panels for minimum exposure, metal finish to match finish of door.
2. Sliding Weather Stripping: Wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing complying with AAMA 701 requirements, replaceable, held in adjustable depth extruded metal strips to be mortised into edge of door panels for minimum exposure.

2.4 HARDWARE

A. General: Provide hardware indicated and as scheduled in Section 08 71 00 "Door Hardware." Finish exposed parts to match butt or pivot finish, unless otherwise indicated.

2.5 SEALING MATERIALS

A. Concealed Sealing Materials: All sealing materials concealed within the entrances and storefronts shall be silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.

B. Exposed Sealing Materials: All sealing materials exposed at entrance and storefront perimeter joints in contact with adjacent cladding materials: Silicone, refer to Section 07 92 00 "Joint Sealants."

2.6 FABRICATION

A. General: Fabricate the entrances and storefronts to the designs, shapes, and sizes shown using the materials specified and shown to produce assemblies that meet or exceed the performance requirements. To the greatest extent possible, complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site.

1. Metal Wall Thickness: Provide shapes as shown and as required to suit the performance requirements but with wall thickness of not less than 1/8 inch.

2. Door Stile and Rail Dimensions:

   a. Bottomrails: Provide minimum 10 inch high one piece bottomrail unless otherwise indicated on the Drawings.
   b. Stiles and Top Rail Dimensions: As indicated on Drawings.
   c. Door Thickness: 1-3/4 inch.
   d. Preglaze door units to greatest extent possible, in coordination with installation and hardware requirements. Glazing, whether in factory or in field, shall be performed in accordance with Section 08 80 00 "Glazing."
   e. Fabricate all doors and frames to accommodate the swing direction shown.

3. Provide extruded aluminum entrance door inserts at door frames designed with bosses sized to receive selected door gasket.

B. Glazing Stops and Gaskets: Provide continuous interior glazing stops with concealed fasteners for all doors and frames. Provide stops with hairline joints at corners. Provide stops with beveled, not square, shouldered profile unless otherwise shown.

C. Glass Components: Provide holes and cutouts in glass to receive hardware and accessories before tempering glass. Drill, countersink, and chamfer holes using tooling, materials and methods which are selected and applied to prevent spalling of the cut glass surfaces at holes and cutouts. The internal surface of holes and cutouts shall be smooth with minimal roughness from drilling operations. Do not cut, drill, or make other alterations to glass after tempering.

1. Fully temper glass using horizontal (roller-hearth) process and fabricate so, when installed, roll-wave distortion is parallel with bottom edge of door or lite.
2. Heat Soaking: After tempering, expose 100% of all fabricated glass units to European Standard EN14179 heat soaking process to reduce the potential for inclusion related glass breakage.
3. Factory assemble components and factory install hardware to greatest extent possible.

D. Metal Components: Doors and frames shall be cut, reinforced, drilled and tapped in strict accordance with the printed door hardware manufacturer's templates and instructions. Provide solid stainless steel hardware reinforcements, securely fastened to doors and frames where door hardware is to be attached.

1. Security system components may be incorporated into the door and frame openings of all entrance doors and frames. Provide all cutouts required by the Owner's security system vendor and all prewiring for vendor provided security system devices. Wherever storefront and entrance framing components are to receive wiring provide unobstructed clear paths free of burrs and sharp objects with pull strings to facilitate wiring.

E. Joints in Metal Work: All exposed work shall be carefully fitted and matched to produce continuity of line and design, with all joints, being accurately fitted for hairline contact and rigidly secured. Where additional rigidity or strength is required to satisfy the performance requirements reinforce entrance components with aluminum or carbon steel shapes, bars, and plates.

F. Shop Assembly: As far as practicable, all fitting and assembly work shall be done in a fabrication shop.

1. For exterior entrances, provide weepholes and internal water passages in the glazing framing recesses as recommended by the respective glass and framing manufacturers to conduct infiltrating water to the exterior. Provide weep baffles secured to inside of frame behind weepholes.

G. Exposed Fasteners: Not permitted.

H. Protection of Metals: Wherever dissimilar metals are in contact, except in the case of aluminum in contact with galvanized steel, zinc, separate such surfaces with a coating of zinc rich primer, bituminous paint, or separation gaskets as the condition requires. Wherever aluminum comes in contact with concrete surfaces separate such surfaces with a coating of zinc rich primer, bituminous paint, or separation gaskets as the condition requires.

2.7 ALUMINUM FINISHES

A. General: As specified in Section 08 44 13 "Glazed Aluminum Curtain Walls."

2.8 COATINGS FOR CONCEALED METAL SURFACES

A. General: The following protective coatings shall be applied to surfaces of metals which are to be concealed in the construction:

1. Coating for Carbon Steel: Hot dip galvanized, complying with ASTM A 123.
2. Coating for Aluminum, Carbon Steel, and Bronze: Where aluminum or carbon steel surfaces are to be in contact with each other or in contact with dissimilar materials such as masonry or concrete, and where hot dip galvanizing of carbon steel is incompatible with component parts because of galvanic action or component fabrication tolerances provide one of the following:

    a. Bituminous Paint: Cold-applied, non-sagging, bituminous paint complying with ASTM D 1187. Apply in two coats for an overall minimum dry film thickness of 25 mils.
    b. Zinc Rich Primer: Organic zinc-rich primer, complying with SSPC-Paint 20.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate entrance and storefront work with the work of other Sections and provide items to be placed during the installation of other work at the proper time to avoid delays in the work.

B. Templates and Diagrams: Furnish templates, diagrams, and other data to fabricators and installers of related work, as necessary for coordinating entrance and storefront installation.

C. Place such items, including concealed overhead framing, accurately in relation to the final location of entrance and storefront components.

3.2 EXAMINATION

A. Examine the substrates, adjoining construction, and conditions under which the Work is to be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Before beginning installation of the entrance and storefront work examine all parts of the existing building structural frame and the existing building cladding indicated to support the entrance and storefront work. Ensure that the existing swing door thresholds, existing swing doors, swing door framing and subframes have been completely removed with all projecting anchors cut off flush. Notify Contractor in writing, of any dimensions, or conditions, found which will prevent the proper execution of the entrance and storefront work, including specified tolerances. Use Contractor's offset lines and bench marks as basis of measurements.

3.3 INSTALLATION

A. Entrance Doors: Doors shall be securely anchored in place to a straight, plumb and level condition, without distortion. Adjust doors to provide a tight fit at contact points for weathertight closure and to operate smoothly, without binding, with hardware functioning properly. Weatherstripping contact, and hardware movement, shall be field tested and final adjustment, and lubrication, made for proper operation and performance of doors.

1. Door Hardware: Refer to Section 08 71 00 "Door Hardware."
2. Install surface-mounted hardware according to manufacturer's written instructions using concealed fasteners to greatest extent possible.
3. Set, seal, and grout floor closer cases as required to suit hardware and substrate indicated.
4. Set sill members in a bed of polyurethane sealant to provide weathertight construction. Comply with requirements of Section 07 92 00 "Joint Sealants."

B. Install glazing to comply with requirements of Section 08 80 00 "Glazing," unless otherwise indicated.

C. Install perimeter sealant to comply with requirements of Section 07 92 00 "Joint Sealants," unless otherwise indicated.

D. Concealed Sealing Components: Apply sealant and gasket components that are integral to the entrance and storefront systems in strict accordance with the each component manufacturer's printed instructions. Before applying components remove all mortar, dust, dirt, moisture, and other foreign matter that will be deleterious to the intended performance of the component. Mask adjoining exposed surfaces to avoid spilling, dripping, dropping or other unintended contact of the sealing components onto adjacent exposed surfaces.

3.4 ERECTION TOLERANCES

A. The entrance and storefront systems shall be fabricated and erected to accommodate the dimensional tolerances of the structural frame and surrounding cladding while providing the following as installed tolerances.

1. Variation from theoretical calculated position as located in plan or elevation in relation to established floors lines, column lines and other fixed elements of the structure, including variations from plumb, level, straight and member size: +/- 1/4 inch max in any 20'-0" run, column-to-column bay, or floor-to-floor height.
2. Alignment: Where surfaces abut in line, and where they meet at corners, limit offset from true alignment to 1/32 inch.
3. Variation from angle, or plumb, shown: +/- 1/8 inch max in any 10'-0" run or story height, non-cumulative.
4. Variation from slope, or level, shown: +/- 1/8 inch max in any 20'-0" run or column-to-column bay, non-cumulative.

3.5 ANCHORAGE

A. Anchorage of the entrance and storefront work to the structure and surrounding cladding shall be in accordance with the accepted shop drawings.

3.6 WELDING

A. Weld with electrodes and by methods recommended by manufacturer of material being welded, and in accordance with AWS D1.1 for concealed steel members.

B. Welds and adjacent metal areas shall be thoroughly cleaned and coated with a single coat of bituminous paint.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing agency to perform field quality-control testing indicated. Conduct tests of each specified sample installation under the direction of the testing agency in the presence of the Owner, Architect, the Contractor, various component manufacturers and fabricators and the Installer for each system incorporated in the sample installation.

B. Water Spray Without Air Pressure Difference Test: After completing the installation of test areas indicated, but before the installation of interior finishes has begun, test fixed portions of the storefront system for water penetration according to AAMA 501.2 requirements.

C. Repair or remove and replace Work that does not meet requirements or that is damaged by testing; replace to conform to specified requirements.

3.8 REMOVAL OF DEBRIS

A. All debris caused by, or incidental to, the erection of the entrance and storefront work shall be removed from the site and disposed of legally.

3.9 CLEANING

A. Clean metal surfaces promptly after installation, exercising care to avoid damage to factory finished exposed surfaces.

B. Wash glass on both faces not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer. Remove excess glazing and sealant compounds, dirt, and other substances.

C. Immediately remove any deleterious material from surfaces of aluminum.

3.10 PROTECTION

A. Institute protective measures required throughout the remainder of the construction period to ensure that entrance and storefront work will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION 08 41 13

SECTION 08 42 29 – SLIDING DOOR ENTRANCES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes the following types of automatic entrances:
   1. Exterior and interior, single and bi-parting sliding automatic entrances.

B. Related Sections:
   1. Division 7 Sections for caulking to the extent not specified in this section.
   2. Division 08 Sections for “Aluminum-Framed Entrances and Storefronts” for entrances furnished and installed separately in Division 8 Section.
   3. Division 8 Section “Door Hardware” for hardware to the extent not specified in this section.
   4. Division 08 Section “Glazing” for materials and installation requirements of glazing for automatic entrances.
   5. Division 26 and 28 Sections for electrical connections including conduit and wiring for automatic entrance operators and access-control devices.

1.3 REFERENCES

A. References: Refer to the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   2. ICC/IBC - International Building Code.
   3. CUL – Approved for use in Canada.
   4. NFPA 70 - National Electrical Code.
   5. NFPA 101 - Life Safety Code.

B. American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA).
   1. ANSI/BHMA A156.10 (current year) American National Standard for Power Operated Pedestrian Doors.
   2. ANSI Z97.1 Standards for Safety Glazing Material Used in Buildings.

C. Underwriters Laboratories (UL).
   1. UL 325 Standard for Safety for Door, Drapery, Gate, Louver and window Operators and Systems.

D. American Association of Automatic Door Manufacturers (AAADM).

E. American Society for Testing and Materials (ASTM).
   1. ASTM B221 Standard Specification for Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.

2. ASTM B209 Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

F. American Architectural Manufacturers Association (AAMA).
1. AAMA 611 Voluntary Specification for Anodized Architectural Aluminum.

G. National Association of Architectural Metal Manufacturers (NAAMM).
1. Metal Finishes Manual for Architectural Metal Products.

H. International Code Council (IBC).
1. IBC: International Building Code Building Code.

1.4 DEFINITIONS

A. Activation device: Device that, when actuated, sends an electrical signal to the door operator to initiate the door operation.

B. Monitored Safety Devices: A tested system that works in conjunction with the automatic door control that detects the presence of a person or an object within a zone where contact could occur and provides a signal to stop the movement of the door.

C. AAADM: American Association of Automatic Door Manufacturers.

D. For automatic door terminology, refer to ANSI/BHMA A156.10 for definitions of terms.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide automatic doors that have been designed and fabricated to comply with specified performance requirements, as demonstrated by testing manufacturers corresponding systems.

B. Compliance:
1. ICC/IBC International Building Code
2. ANSI/BHMA A 156.10 American National Standard for Power Operated Doors Pedestrian Doors.
3. UL 325 Listed
4. NFPA 70 National Electrical Code.
5. NFPA 101 Life Safety Code
6. CUL Approved for use in Canada

C. Automatic Door equipment accommodates medium to heavy pedestrian traffic.

D. Automatic Door equipment accommodates up to the following weights for active leaf door:
1. Bi-Parting Doors: 220 lb (100 kg) per active breakout leaf.
2. Single Slide Doors 220 lb (100 kg) per active breakout leaf.

E. Operating Temperature Range: Capable of - Minus 35 Degrees F to plus 130 degrees F (minus 37 C to plus 55 degrees C) ambient.

F. Entrapment Force Requirements:

1. Power-Operated Sliding Doors: Not more than 30 lbf (133 N) required to prevent stopped door from closing.
2. Sliding doors provided with a breakaway device shall require no more than 50 lbf (222 N) applied 1 inch (25 mm) from the leading edge of the lock stile for the breakout panel to open.

1.6 SUBMITTALS

A. Comply with Division 01 – Submittal Procedures.

B. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles fabrication, operational descriptions and finishes.

C. Shop Drawings: For automatic entrances. Include plans, elevations, sections, details, hardware mounting heights, additional accessories and attachments to other work.

D. Samples: color samples of exposed finish as required.

E. Informational Submittals: Manufacturers product information and applicable sustainability program credits that are available towards a LEED rated product certification.
1. Credit MR 4.1 and 4.2: Manufacture's or fabricator's certificate indicating percentage of post-consumer recycled content by weight and pre-consumer recycled content by weight for each product specified under this section.

F. Manufacturers Field Reports: Submit manufacturer's field reports from AAADM certified technician of inspection and approval of doors for compliance with ANSI/BHMA A 156.10 after completion of installation.

G. Operating and Maintenance Manuals: Provide manufacturers operating, owners and maintenance manuals for each item specified as required in Division 01, Closeout Submittals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: 10 years minimum of documented experience in manufacturing door equipment similar to that indicated within this specification with a proven record of successful service performance. A manufacturer with company certificate issued by AAADM.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 5 years documented experience installing and maintenance of units similar in material, design, and extent to that indicated in this specification and whose work has resulted in construction with a record of successful in-service performance. Manufacturer's authorized representative who is trained and approved for installation and maintenance of units by AAADM required for this Project.

C. Source Limitations for Automatic Entrances: Obtain automatic entrances from single source from single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Power-Operated Door Standard: ANSI/BHMA A156.10 Current year.

F. Emergency-Exit Door Requirements: Comply with requirements of authorities having jurisdiction for automatic entrances serving as a required means of egress.

G. Pre-installation Conference: Conduct conference at site or a mutually agreed site if required.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings to receive automatic entrances by field measurements before fabrication.

1.9 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed sliding tracks that control automatic entrances. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of project.

C. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.

1.10 WARRANTY

A. Automatic Entrance Doors shall be free of defects in material and workmanship for a period of One (1) year from the date of substantial completion.

B. During the warranty period a factory trained technician shall preform service and affect repairs. A safety inspection shall be performed after each adjustment or repair and a completed inspection form submitted to the owner.

C. During the warranty period all warranty work shall be performed during normal working hours.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. dormakaba. • Reamstown, PA • 1-844-SPEC-NOW (1-844-773-2669) • Website: www.dormakaba.us • Email: specnow@dorma.com

B. Substitutions: Requests for substitution and product approval in compliance with the specification must be submitted in writing and in accordance with the procedures outlined in Division 1, Section

"Substitution Procedures". Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 SLIDING AUTOMATIC ENTRANCES

A. Model: DORMA ESA Series ESA 300 Bi Parting full breakout with two operable sidelites Automatic Door (Basis of Design)
   1. Sliding Automatic Door Configuration:
      a. Bi-Parting, full breakout door system.
         1) Configuration: Bi-parting, Two sliding leaves with Two breakaway sidelites.
         2) Traffic Pattern: Two –Way
         3) Emergency Breakaway Capability: Interior sliding leaves and sidelites.
         4) Mounting: Between jambs

B. Dimensions: Confirm door package dimensions as indicated on architectural drawings.

2.3 ALUMINUM DOORS AND FRAMES

A. Doors and Frames: Extruded Aluminum, Alloy 6063-T5
   1. Door panels shall have a minimum .125 inch (3.2 mm) structural wall thickness throughout entire extrusion length.
   2. Door construct shall be by means of interlocking corner shear block cross bolted.
   3. The sliding door system shall include two interlocks securing the leading stile of the sidelite and the butt stile of the sliding door together.
   4. Vertical Stiles shall be:
      a. Narrow stile: 2-5/8 inch
   5. Bottom Rails shall be standard size: 10 inch nominally.
   6. [Intermediate Muntin shall be 1-¾ inch
   7. Weather stripping shall meet AAMA 701-11 Class A, slide in type, replaceable nylon retained by the aluminum extrusions to reduce energy loss. The following types of weather-stripping are required: nylon pile weather stripping on the door bottoms; dual pile weather-stripping at sliding door lead edges; weather-stripping between the carrier and header on the sliding doors; dual pile weather-stripping at the interlock rails between the sliding door and sidelites; dual pile weather-weather-stripping between the sidelites doors and the door jambs.

B. Glass: Glazing shall comply with ANSI Z97.1 thickness as indicated.
   1. Glazing Active Door Panels 1/4" (6 mm) to 1 ¼" (32 mm) tempered unless otherwise specified.
   2. Glazing Sidelite Door Panels 1/4" (6 mm) to 1 ¼" (32 mm) tempered unless otherwise specified
   3. Glazing Installation: Review Division 8 Section for glazing requirements.

2.4 DOOR OPERATORS

A. Sliding Door Carrier Assemblies and Overhead Roller Tracks: Manufacturer's standard carrier assembly that allows vertical adjustment; consisting of delrin-covered, ball-bearing-center wheels

operating on a continuous roller track. Support doors from carrier assembly by adjustable cantilever and pivot assembly.

1. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.

B. Operator and Controller: a system with an electro-mechanical operator and microprocessor controller. Components consist of a DC permanent magnet motor, self-lubricating drive system and a wear-free digital rotary encoder all linked to a fully integrated digital microprocessor controller

1. Features:
   a. Power opening and closing.
   b. Drive System: belt
   c. Adjustable opening and closing speeds.
   d. Adjustable hold-open time between 0 and 30 seconds.
   e. Obstruction recycle.
   f. Intergraded access control capabilities.
2. Door Switches: Interior side mounted program switches consisting of:
   a. Main Switch-Auto-Close-Open, operates door in fully automatic mode, turns door off, or keeps it fully open.
   b. Exit Only Switch: on/off, only exit side activation device will initiate door opening.
   c. Partial Opening Switch: on/off Energy saving opening mode limits the width opening.
   d. Switch: keyed
3. Controller shall provide a means to verify presence sensor functionality and the connection between the controller and sensor(s) as required by the ANSI 156.10 standard. This closed loop monitoring system, upon detection of fault in the sensor or wiring shall cause automatic operation to cease.

2.5 ACTIVATION AND SAFETY

A. Provide controls in accordance with ANSI/BHMA standard for condition of exposure and for long-term, maintenance-free operation under normal traffic load. Only safety systems (sensors) that have been tested and approved should be used in conjunction with manufacturer systems and products.

B. Monitored Combination Motion/Presence Sensors: Self-contained units; consisting of both motion and presence sensors in a single housing; adjustable to provide detection field sizes and functions required by ANSI/BHMA A156.10.

1. Motion Sensor: K-band-frequency, doppler effect radar.
   a. Provide capability for switching between bidirectional and unidirectional detection.
   b. For one-way-traffic entrances, sensor on egress side shall not be active when doors are fully closed.
2. Presence Sensor(s): Active infrared sensor shall provide two over lapping zones that provide presence detection in the threshold while the door is in the open position.

C. Activation Device:

1. Access control activator: as selected by architect.

D. Safety beams are not acceptable.

2.6 ELECTRICAL

A. Electrical 120 VAC, 60 Hz, 5 Amp service.

B. Battery Back-up: (if required) Concealed in the door header case and capable of full operation including sensor capabilities for 200 cycles.

2.7 HARDWARE

A. General: Provide manufacturers standard hardware as required for proper door operation. Break away hardware are integral parts of the door design and are supplied by the manufacturer to comply with applicable codes.
   1. ESA 300 has a limit arm on all break away panels to prohibit doors from opening past 90 degrees.

B. Locking Hardware:
   1. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.
   2. Two-Point Locking for Sliding Doors: Mechanism in stile of active door leaf that automatically extends second lock-bolt into overhead carrier assembly.
      a. Thumb turn Interior key exterior. Lock indicators if required by code.

C. Automatic Locking for Sliding Door: Electrically controlled device mounted in header that automatically locks door against sliding when in closed position. Use battery back up to insure enhanced level of security.
   1. Include concealed, vertical-rod exit devices, UL 305, with latching into to overhead carrier assembly and released by Flush Mounted and that prevent emergency breakaway doors from swinging and that permit emergency egress.

D. Threshold:
   1. Sliding Door Threshold: ESA 300 Manufacturer’s standard threshold members and bottom-guide track system, with a 3/8” diameter pin in a polyethylene covered slot.
      a. Configuration: No threshold across door opening and recessed guide track system at sidelites.

2.8 ALUMINUM FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Painted Finish:
   1. Kynar paint finish, to match architects sample

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames with Installer present, for compliance with requirements for installation tolerances, wall and floor construction and other conditions affecting performance of automatic entrances.

B. Examine roughing in for electrical source power to verify actual locations of wiring connections.

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

3.2 INSTALLATION

A. General: Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure non-movement joints.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.
1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.
2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

C. Door Operators: Connect door operators to electrical power distribution system as specified in Division 26 Sections.

D. Glazing: Install glazing as specified in Division 08 Section Glazing according to automatic door manufactures instructions.

E. Sealants: Comply with requirements specified in Division 07 Section "Joint Sealants" to provide weathertight installation.

F. Signage: Apply signage on both sides of each door and each sidelight as required by ANSI/BHMA A 156.10

3.3 FIELD QUALITY CONTROL

A. Manufacturer’s representative shall provide technical assistance and guidance for installation of automatic doors.
1. Factory trained and AADM certified representative shall test and inspect each automatic door to determine compliance of the installed system to ANSI/BHMA A 156.10

3.4 ADJUSTING

A. Adjust door operators, controls, and hardware for smooth and safe operation and for weathertight closure; comply with requirements in ANSI/BHMA A156.10

3.5 CLEANING AND PROTECTION

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.
   1. Comply with requirements in Division 08 Section "Glazing" for cleaning and maintaining glass.

3.6 DEMONSTRATION

A. Engage a factory authorized representative to train Owner's maintenance personnel to adjust, operate, and maintain safe operation of automatic entrances.

END OF SECTION 084229

SECTION 08 71 00 - FINISH HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

Hardware for swinging, sliding, and folding doors except special types of unique and non-matching hardware specified in other sections.

1.02 RELATED WORK

A. Division 8 – Hollow Metal Doors and Frames
B. Division 8 – Flush Wood Doors
C. Division 8 – Overhead Sectional Doors
D. Division 8 – Metal Framed Storefronts
E. Division 8 – Glass & Glazing
F. Division 26 – Electrical
F. Division 28 – Fire Alarm/Detection, Security Access

1.03 REFERENCES

A. ADA - Americans with Disabilities Act of 1990 including Accessibility Guidelines as amended by the D.O.J. September 15, 2010, as adopted by the Authority Having Jurisdiction (AHJ).
B. ANSI A117.1 - Buildings and Facilities - Providing Accessibility and Usability for Physically Handicapped People.
C. ANSI/BHMA A156 (.1 through .21)
D. ANSI/DHI – A115.IG Installation Guide for Doors and Hardware.
E. FEMA P-361 – Safe Rooms for Tornados and Hurricanes.
F. NFPA 80 - Fire Doors and Windows.
G. NFPA 101 – Life Safety Code
H. IBC - International Building Code, as adopted by public Authority Having Jurisdiction (AHJ).
I. State and local Rules and Regulations for Barrier Free Facilities, as adopted by AHJ.

1.04 DOOR HARDWARE TYPES

A. Types of finish hardware required include, but is not necessarily limited to, the following:
   1. Pivot sets and intermediate pivots.
   2. Hinges.
   3. Lock cylinders.
   4. Keys, keying, and key control.
   5. Locksets, latchsets, and privacy sets.
   6. Exit devices.
   7. Closers.
   8. Mullions.
   9. Overhead, wall, and floor stops.
   10. Protection plates.
   11. Gasketing for exterior and interior doors, as required.
   12. Door holders.
   13. Door bottoms.
   14. Thresholds.

15. Silencers.

B. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of door hardware is indicated elsewhere in this section or in the Door Hardware Schedule at the end of this section. Refer to Part 2 Products for Manufacturer's identification and allowable substitutions.

1.05 SUBMITTALS

A. Under provisions of Division 1, submit the following:
   1. Product information: Manufacturer's published technical product data for all specified door hardware items indicating compliance with the requirements.
   2. Hardware Schedule:
      a. Hardware schedules are intended for the Contractor's coordination of the work. Review and acceptance by the Architect or Owner does not relieve the Contractor of his exclusive responsibility to fulfill the requirements as shown and specified.
      b. Submit hardware schedule in the manner and format as specified, complying with the actual construction progress schedule requirements for each draft. Include the following information:
         1) Explanation of all abbreviations, symbols, codes, at the like, including door handing.
         2) Type, style, function, size, and finish of each hardware item.
         3) Door and frame sizes and materials cross referenced to the Architect's marks in the door schedule.
         4) Room identification (name and number) on each side of door opening as indicated on the drawings.
         5) Product name, model number, description, and name of manufacturer of each item.
         6) Fastenings and other pertinent information.
         7) Locations of hardware cross referenced to architectural floor plans and door schedules.
         8) Mounting heights and locations of each type of hardware.
   3. Key Schedule:
      a. Require a qualified representative of the hardware supplier to personally meet with the Owner and Architect to obtain the Owner's written key requirements.
      b. Include a separate key schedule, showing clearly how the Owner's instructions on keying of locks has been fulfilled.
   4. Samples: Upon request, submit actual material samples of items indicated as for color selection.
   5. Templates: Hardware supplier will furnish hardware templates to the Contractor for each fabricator of doors, frames, and other work to be shop prepared or factory prepared for the installation of hardware. Upon request check shop drawings of such other work, to conform that adequate provisions are made for proper location and installation of hardware.
   6. Provide electrical operation technical sheets including product schematics, point to point diagrams, and electrical requirements of all electrified hardware. Completely coordinate with the general contractor, electrical engineer, electrician, security access subcontractor and the installer. Operational descriptions are for demonstration only – verify operational intent with the owner, architect and electrical engineer.

B. Under provisions of Division 1, submit the following:
   1. Product information.

2. Hardware schedule.
3. Manufacturer's published operation and maintenance data. Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
4. Tools and extra materials as required.
5. Manufacturer's warranties, revise to meet criteria as established within this section. Warranty periods shall commence upon acceptance of the building by the owner. Where warranties listed exceed the manufacturer's standard warranty, obtain in writing an extended warranty to meet the requirements above and as noted. If the manufacturer will not meet these requirements, and another approved manufacturer will comply, supply the alternate approved manufacturer.

1.06 QUALITY ASSURANCE

A. Acceptable Designs:
   1. Items specified in this section are products which are of acceptable design.
   2. Do not substitute products without Architect's written prior approval per Section 01 60 00. Requests for approval shall be submitted by factory authorized distributor firms representing the products proposed for substitution. Items that are noted to allow no substitution are matching existing materials and the owner's material inventory for servicing the facility.
B. Qualifications:
   1. Manufacturer: Manufacturers named in Part 2 of this section with not less than 5 years experience in manufacturing commercial door hardware of the type indicated.
   2. Hardware Supplier:
      a. A recognized architectural finish hardware supplier who has been furnishing hardware in the same state as the project for a period of not less than 5 years.
      b. Hardware supplier's organization shall include an experienced Architectural Hardware Consultant (AHC), certified by the Door and Hardware Institute (DHI), who is physically available, at reasonable times during the course of the work, for consultation about project's hardware requirements, to Owner, Architect and Contractor. Mail or telephone correspondence is not acceptable.
      c. Hardware supplier shall have local warehousing facilities and shall maintain an adequate parts inventory of items supplied for future service to the owner. Supplier will be a factory authorized distributor of all hardware specified.
   3. Installer: Company specializing in installing work of this section with not less than 5 years experience and acceptable to the manufacturers and the hardware supplier. Maintain regular work force of qualified personnel, trained, skilled, and experienced in installing door hardware and constant, competent supervision per the requirements of the General Contractor. The hardware installer shall meet with the representatives of the General Contractor and hardware supplier to jointly inventory all hardware items. Upon satisfactory inventory of products, the hardware installer accepts responsibility for all hardware items inventoried.
C. Regulatory and Operational Requirements:
   1. Provide hardware for all openings, whether specified or not, in compliance with NFPA Standard No. 80, proper operation and local building code requirements. Where required, provide only hardware which has been tested and listed by UL or FM for types and sizes of doors required and complies with requirements of door and door frame labels. Label hardware, as required, for compliance with pressure testing criteria as dictated in IBC.

2. Provide hardware which meets or exceeds handicap accessibility per local building code requirements. Conform to the Americans with Disabilities Act (ADA) of 1990 as amended by the D.O.J. September 15, 2010, as adopted by the Authority Having Jurisdiction (AHJ).

1.07 DELIVERY, STORAGE, HANDLING, AND PROTECTION

A. Deliver, store, handle, and protect products to project site under provisions of Section 01600 and as specified herein.
B. Require hardware supplier to:
   1. Tag each item or package separately, with identification related to final hardware schedule.
   2. Include manufacturer's basic installation instructions with each item or package.
   3. As material is received by hardware supplier from various manufacturers, sort and repackage in containers with each item clearly marked with appropriate opening numbers to match the approved hardware schedule. Two or more identical items may be packed in the same container.
   4. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.
   5. Inventory hardware jointly with representatives of the General Contractor, hardware supplier and the hardware installer until each is satisfied that count is correct. Refer to paragraph 1.6-B-3.
C. Protect hardware from theft by cataloging and storing in a secure and lockable area. Control the handling and installation of hardware items which are not immediately replaceable, so that the completion of the work will not be delayed by hardware losses, both before and after installation. Replace lost, missing, damaged, or stolen door hardware items at no additional cost to the Owner as required to meet schedule requirements.

1.08 SEQUENCING AND SCHEDULING

A. Coordinate work of this section with the work of other sections of work under provisions of Division 1
B. Furnish hardware templates to each fabricator of doors, frames, and other work to be shop or factory prepared for the installation of hardware.
C. Verify completeness and suitability of door hardware with the hardware supplier and the hardware installer.

1.09 MAINTENANCE MATERIALS

A. Under provisions of Division 1, furnish to Owner a complete set of special wrenches and tools applicable to each different or special hardware component as needed for Owner's continued adjustment, maintenance, removal, and replacement of door hardware.
B. Special tools and accessories shall be supplied by the hardware component manufacturer.

PART 2 PRODUCTS

2.01 MATERIALS AND FABRICATION

A. General:

1. Provide all door hardware for complete work, in accordance with the drawings and as specified herein.
2. Quantities listed, in any instance, are for the Contractor's convenience only and are not guaranteed.
3. Provide items and quantities not specifically mentioned to ensure a proper and complete operational installation. Match the quality and finish of items specified.
4. Provide miscellaneous hardware as listed in hardware groups.

B. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Door schedule indicates door and frame sizes, materials, required fire ratings, and other pertinent information. Furnish each item of hardware for proper installation and operation of door movement as indicated.

C. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable name plates), except in conjunction with required UL or FM labels and as otherwise acceptable to the Architect. Manufacturer's identification will be permitted on rim of lock cylinders and latch faceplates only.

D. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI A156 series standard for each type hardware item and with ANSI A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

E. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self tapping sheet metal screws, except as specifically indicated.
1. Screws: Furnish screws for installation, with each hardware item. Provide Phillips flat head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finishes of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
2. Concealed Fasteners: Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.

2.02 HINGES

A. Manufacturer:
1. Listed in Door Hardware Schedule: Stanley
2. Approved Substitutions: Hager, Bommer

B. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template produced units.

C. Screws: Furnish Phillips flat head or machine screws for installation of units, except furnish Phillips flat head or wood screws for installation of units into wood. Finish screw heads to match surface of hinges.

D. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
1. Steel Hinges: Steel pins.
2. Non-ferrous Hinges: Stainless steel pins.

3. Exterior doors: Non-removable pins.
4. Reverse bevel interior doors (lockable): Non-removable pins.
5. Interior doors: Non-rising pins.

E. Pin Tips: Flat button and matching plug, finished to match leaves.
F. Number of Hinges: Provide number of hinges indicated, but not less than 3 hinges per door leaf for doors 90" or less in height and one additional hinge for each 30" of additional height.
G. Butt type hinges and continuous hinges are to be warranted for a period of two years. Pivots shall be warranted for a period of two years.

2.03 LOCK CYLINDERS

A. Manufacturer:
   1. Listed in Door Hardware Schedule: Dorma
   2. Substitutions: Russwin, Corbin
B. Equip locks with 6-pin cylinders for standard keyed cylinders, Russwin D1 6-pin system, with construction keying for use during the construction phases.
C. Construct lock cylinder parts from brass/bronze, stainless steel, or nickel silver.

2.04 KEYS, KEYING, AND KEY CONTROL

A. Keys:
   1. Material: Provide keys of nickel silver only.
   2. Quantities: These quantities are to establish a maximum allowable quantity of cut keys to service the project and may not necessarily be assigned as noted. A lesser quantity of cut keys required will not result in any credits, nor a quantity of uncut keys to be issued unless noted otherwise.
      a. 3 change keys per each cylinder unit.
      b. 5 master keys per master.
      C. 20 construction keys.
   3. Deliver keys to the Owner's representative: Send masterkeys to Owner via U.S. registered mail direct from hardware supplier.
B. Keying:
   1. Comply with Owner's written instructions for masterkeying and, except as otherwise indicated, provide individual change keys for each lock which is not designated to be keyed alike with a group of related locks. Keying is to be provided by the owner as an extension of the existing masterkey system.
   2. Grandmaster key all cylinder items to coordinate with the Owner's instructions and existing Russwin D1 6-pin masterkey system. Permanently inscribe each key with the notation "DO NOT DUPLICATE".
C. Key Control:
   1. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by the system manufacturer, with capacity for 150% of the number of locks required for the project.
   2. Provide a hinged panel type cabinet, for wall mounting, Telkee AWC-150S or equal.
   3. Provide cylinder units with concealed key control and keys with visual key control.

2.05 LOCKSETS, LATCHSETS, AND PRIVACY SETS:

A. Manufacturer:

1. Listed in Door Hardware Schedule: Dorma M9000 Series
2. Approved Substitutions: Best 45H, Schlage L9000

B. Types: Locksets, latchsets, and privacy sets as indicated in Door Hardware Schedule.
C. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt. Provide dust-proof strikes for foot bolts, except where not available. At these locations, provide manufacturer's standard recessed strike. Provide roller type strikes where recommended by lock, latch or bolt manufacturer. If aluminum frames are specified, confirm with the aluminum frame supplier that the standard lock strikes will function. Provide the manufacturer's standard extended lip strikes if required. Strikes may be provided by the prefinished metal frame manufacturer.
D. Lock Throw: Provide 3/4" minimum throw of mortise type latches and deadbolts used. Cylindrical latches will be 1/2" minimum. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
E. Locks and latches shall be warranted for a period of five years.

2.06 EXIT DEVICES AND MULLIONS

A. Manufacturer:
1. Listed in Door Hardware Schedule: Dorma 9000
2. Substitutions: Precision 2000, Von Duprin 98

B. Provide risers, as needed, to prevent interference with door glazing kits.
C. Provide spacers as needed for proper application of removable mullions on narrow stop type frames.
D. Provide architecturally finished products.
E. Mullions shall be provided primed to be painted to match finish hardware.
F. Exit devices and related hardware shall be warranted for a period of five years.

2.07 CLOSERS:

A. Manufacturer:
1. Listed in Door Hardware Schedule: Best HD7016 Series
2. Approved Substitutions: Dorma 8616 Series, LCN 4040XP

B. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending on the size of the door, exposure to weather and anticipated frequency of use.
C. Provide manufacturer's standard through bolt attachment where door construction is not adequate for support.
D. Arms:
1. Provide parallel arms for all overhead closers, except as otherwise indicated. Provide drop plates as needed to prevent glazing interference.

E. Mount all closers to the maximum allowable degree of opening by the closer manufacturer's template. Where closer arms incorporate dead stop features, mount closers to the maximum degree of opening available before conflict with adjacent structures. If not apparent on the contract documents, verify the use of open space with the Architect or Owner's Representative to determine the maximum allowable degree of opening.
F. Access Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force. Fire protection has precedence over handicap compatibility, check with local jurisdiction.

G. Door closers and related hardware shall be warranted for a minimum period of twenty-five years. Electronic closers shall be warranted for a period of two years.

2.08 AUTOMATIC OPERATORS

A. Manufacturers:
   1. Listed in Door Hardware Schedule: Dorma
   2. Approved Substitutions: LCN, Stanley
B. Provide units which conform to the requirements of the Americans with Disabilities Act of 1990 (ADA) and as required by local jurisdiction.
C. At fire rated openings, provide units which are listed by Underwriter's Laboratories (UL) for use on such openings.
D. Automatic operators shall be warranted for a period of two years.

2.09 WALL AND FLOOR STOPS

A. Manufacturers:
   1. Listed in Door Hardware Schedule: Trimco
   2. Approved Substitutions: Rockwood, Hiawatha, Don-Jo
B. General: Except as otherwise indicated, provide stops (wall, floor or overhead) at each leaf of every swinging door leaf.

2.10 OVERHEAD STOPS

A. Manufacturer:
   1. Listed in Door Hardware Schedule: ABH
   2. Approved Substitutions: Rixson, Glynn Johnson
B. Mount stops to the maximum degree of opening available before conflict with adjacent structures, or, if adjacent structures are not considered, to the maximum allowable by stop manufacturer's template.
C. If not apparent on the contract documents, verify the use of open space with the Architect or Owner's Representative to determine the maximum allowable degree of opening.
D. Overhead stops in exterior doors must be manufactured from stainless steel, US32D finish.
E. Overhead stops shall be warranted for a period of two years.

2.11 PROTECTION PLATES

A. Manufacturers:
   1. Listed in Door Hardware Schedule: Trimco
   2. Approved Substitutions: Rockwood, Hiawatha, Don-Jo
B. Types: Armor Plates, Kick Plates, Mop Plates
C. Fasteners: Provide manufacturer's standard exposed Phillips head fasteners for door trim units; either machine screws or self tapping sheet metal type screws per manufacturer's recommendations for application to the specified door construction.
D. Sizes: Fabricate protection plates (armor, kick or mop) not more than 2" less than door width on stop side and not more than 1" less than door width on pull side, x the height indicated.
E. Plastic Laminate Plates: 1/8” thick. Finish as noted, beveled four edges (B4E).

2.12 GASKETS AND SWEEPS

A. Manufacturer:
   1. Listed in Door Hardware Schedule: National Guard Products
   2. Approved Substitutions: Pemko, Zero
B. General: Except as otherwise indicated, provide continuous weatherstripping at each edge of every exterior door leaf. Provide type, sizes and profiles indicated as drawn or scheduled.
C. Fasteners: Provide non-corrosive fasteners as recommended by the manufacturer for applications indicated.
D. Replaceable seal strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by the manufacturer.
E. Perimeter weatherstripping: Flexible, hollow neoprene bulb or loop insert, conforming to MIL R 6055, Class II, Grade 40.
F. Weatherstripping at Door Bottoms: Provide door bottoms consisting of contact type resilient insert and metal housing of design and size indicated.
G. Hot smoke seal, if required by IBC and subsequent UL testing procedures, will be supplied as an integral part of the door assembly by the door manufacturer.
H. Gaskets and sweeps shall be warranted for a period of three years.

2.13 SILENCERS

A. Manufacturers:
   1. Listed in Door Hardware Schedule: Trimco
   2. Approved Substitutions: Rockwood, Ives

2.14 FINISHES

A. Exposed surfaces of hardware shall be Powder Coated Black (622) unless otherwise indicated.
B. The designations used in the schedule and elsewhere to indicate hardware finishes are the industry recognized standard commercial finishes common to the product's manufacturer listed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Under provisions of Division 1, examine and verify that substrates and project site conditions are ready to receive work of this section.
B. Do not begin installation until finishes indicated to be field applied have been applied to doors, frames, and similar items requiring project site finishing and are thoroughly dry and cured.
C. Do not begin installation until unsatisfactory conditions are corrected in a manner acceptable to the installer. Beginning installation means installer accepts project site conditions and substrates as ready to receive work of this section.

3.02 INSTALLATION

A. General: The types and approximate quantities of door hardware required for this project are indicated at the end of this section.
B. Key Cabinet: Install in location as indicated on drawings or as directed by the Architect.

C. Heights: Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for /standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by the Architect.
D. Substrates: Adjust and reinforce attachment substrates as necessary for proper installation and operation of hardware.
E. Installation:
   1. Install each hardware item in compliance with the manufacturer's instructions, requirements of NFPA 80, NFPA 101, IBC, ADA, State Rules and Regulations for Barrier Free Facilities and recommendations of the DHI.
   2. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
   3. Drill and countersink units which are not factory prepared for fasteners. Space fasteners and anchors in accordance with industry standards.
   4. Where not factory machined, machine cut for hardware per template, as required.
   5. Cut and fit thresholds and floor covers to profile of door frames. Join units with concealed welds. Cut smooth openings for spindles, bolts, or similar items. Screw thresholds to substrate with the manufacturer's standard machine screws/expansion anchors (MS/EA) or as otherwise specified. Fill cavities of thresholds at sound rated openings with 1 inch thick (uncompressed thickness) low density fiberglass sill sealer insulation full width and length of the threshold. In addition to fastening requirements, set thresholds for exterior doors in a full bed of butyl-rubber or polyisobutylene mastic sealant.
   6. Do not install hardware which is incomplete or apparently improper for application. Notify the hardware supplier immediately of any such deficiencies. Failure to comply with this requirement indicates the hardware installer's acceptance of responsibility for proper application and performance.
   7. Where new hardware is to be installed on existing doors, ensure that the door and frame components can accept the new specified hardware. Notify the architect and the owner where hardware cannot be properly installed or if additional hardware is required for an operational application.
F. Cutting and Patching:
   Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division-9 sections.

3.03 ADJUSTING

A. Initial Adjustment:
   1. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Adjust resilient faced sound stops for continuous contact with door and threshold. Adjust weatherstripping and sweeps to completely seal doors with frames and to adjacent structures.
   2. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
B. Final Adjustment: Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and

finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

3.04 DEMONSTRATION

Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

3.05 CLEANING AND DEBRIS

A. Cleaning:
   1. Clean work under provisions of Division 1
   2. Clean adjacent surfaces soiled by work of this section.
B. Debris: Under provisions of Division 1, remove debris from project site and legally dispose of off-site.

3.06 MAINTENANCE

A. Approximately six months after the acceptance of hardware in each area, the hardware installer shall:
   1. Return to the project and re-adjust every item of hardware to restore proper function of doors and hardware.
   2. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures.
   3. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units.
   4. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware and submit to the Architect.

3.07 PROTECTION

Under provisions of Division 1, protect work of this section as required so that work will be without damage or deterioration at the time of completion and acceptance by the Owner.

3.08 DOOR HARDWARE SCHEDULE

List of Manufacturers

AB	ABH	Overhead Stops
BE	Best Access	Closers
DM	Dorma USA	Locks, Cylinders, Exit Devices, Operators
KD	Keedex	Weldable Lock Box
NA	National Guard	Gaskets, Thresholds
PR	Precision	Power Supplies, Power Transfers
RO	Rockwood	Decorative Pulls
SO	Soss	Invisible Hinges
ST	Stanley	Hinges, Wire Harnesses
TR	Trimco	Stops, Flat Goods

Finish Codes

Code	Description
600	Primed for Field Painting
622	Flat Black Coated
626/652	Satin Chrome Plated
630	Satin Stainless Steel (Operator Switches)
689	Painted Aluminum
693	Painted Black
BLK	Black
BPC	Black Powder Coat

Option List

Code	Description
D	Conventional Cylinder (Dorma)
RB-Kwy	Russwin D1 6-pin
MLR	Motorized Latch Retraction (Dorma)
MS	Touchbar Monitor Switch (Dorma)
LFSF	Electric Locking Trim, Fail Safe (Dorma)
B4E	Beveled 4 Edges - Kick and Mop Plates (Trimco)
CS	Countersunk Screws (Trimco)
MS/EA	Machine Screws/Expansion Anchors (NGP)
SMS-TEKS	Self Drilling Machine Screws (NGP)

SET #1 - Corridor/Open Office

Doors: 102, 112

4	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Passage Set	M9010 L110A	622	DM
1	Closer	HD7016 SPA	693	BE
1	Floor Stop	W1211	622	TR
3	Door Silencers	1229A	BLK	TR

SET #2 - Storage

Door: 205

4	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Passage Set	M9010 L110A	622	DM
1	Floor Stop	W1211	622	TR
3	Door Silencers	1229A	BLK	TR

SET #3 - Office

Doors: 125, 126A, 127, 128A

4	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Lockset	M9050D L110A RB-Kwy	622	DM
1	Floor Stop	W1211	622	TR
1	Coat Hook	3070-1	622	TR
3	Door Silencers	1229A	BLK	TR

SET #4 - IDF/IT Build

Doors: 114, 211

4	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Lockset	M9080D L110A RB-Kwy	622	DM
1	Closer	HD7016 JT	693	BE
1	Floor Stop	W1211	622	TR
1	Gasketing	5050 B Head & Jambs		NA

SET #4A - IDF

Doors: 212, 224

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
1	Lockset	M9080D L110A RB-Kwy	622	DM
1	Closer	HD7016 SPA	693	BE
1	Floor Stop	W1211	622	TR
1	Gasketing	5050 B Head & Jambs		NA

Modify existing door and frame to accept new hardware as specified.

SET #5 - Restroom - Automatic

Doors: 104, 105, 209, 210

4	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Pull Plate	1018-3	622	TR
1	Push Plate	1001-9	622	TR
*1	Operator/Switches	Specified in Section 087113		
1	Kick Plate	K6000 10" x 2" LDW B4E CS	BLK	TR
1	Floor Stop	W1211	622	TR
1	Gasketing	5050 B Head & Jambs		NA

SET #7 - AGR/Shower/Mother's Room

Doors: 116, 117, 214, C205

4	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Privacy w/Indicator	M9046 L110A	622	DM
1	Closer	HD7016 JT	693	BE
1	Floor Stop	W1211	622	TR
1	Gasketing	5050 B Head & Jambs		NA

SET #8 - Entrance - Card Access - Automatic

Doors: 100A, P.001B, P.001C

2	Continuous Hinges	661HD EPT	BLK	ST
*2	Power Transfers	EPT-12C		PR
*1	Exit Device	9600BB MLR MS	693	DM
*1	Exit Device	9600BB D MLR MS RB-Kwy	693	DM
2	Offset Pulls	RM4190 48" x 14XHD	BPC	RO
*1	Operator/Switches	Specified in Section 087113		
2	Door Stops	1214H	622	TR
2	Door Sweeps	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Card activation momentarily retracts latches, energizes exterior operator switch and allows access. Inside operator switch always active. Card reader by security access. Coordinate operation per 1.05-A-6. Mount pulls not to conflict with vertical rods. Verify threshold application.

SET #9 - Vestibule - Card Access - Automatic

Door: 100B, P.001A, P.001D

2	Continuous Hinges	661HD EPT	BLK	ST
*2	Power Transfers	EPT-12C		PR
*1	Exit Device	9600BB MLR MS	693	DM
*1	Exit Device	9600BB D MLR MS RB-Kwy	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
*1	Operator/Switches	Specified in Section 087113		
2	Door Stops	1214H	622	TR
*1	Console	CC402DTM		DM
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Modify existing doors and frame to accept new hardware as specified. Notify the architect of any installation issues. Card activation momentarily retracts latches, energizes exterior operator switch and allows access. Inside operator switch always active. Card reader by security access. Coordinate and locate remote switch as directed. Coordinate operation per 1.05-A-6. Mount pulls not to conflict with vertical rods. Gaskets by frame manufacturer.

SET #10 - Stair

Doors: 108A, 130

4	Hinges	CB168 4 1/2 X 4 1/2	BLK	ST
1	Exit Device	F9300B x YL11023	693	DM
1	Closer	HD7016 JT	693	BE
1	Floor Stop	W1211	622	TR
1	Gasketing	5050 B Head & Jambs		NA

SET #10A - Stair - Card Access

Doors: A301

2	Hinges	CB168 4 1/2 X 4 1/2 NRP	BLK	ST
*1	Electric Hinge	CECB168-12C 4 1/2 x 4 1/2	BLK	ST
*1	Exit Device	F9300B x YL11008D LFSF MS RB-Kwy	693	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Gasketing	5050 B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-12P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Device is fail safe per code. Must unlock on fire alarm. Card reader by security access.

SET #11 - Stair Exit - Card Access

Door: 108B

2	Hinges	CB199 4 1/2 X 4 1/2 NRP	BLK	ST
*1	Electric Hinge	CECB199-12C 4 1/2 x 4 1/2	BLK	ST
*1	Exit Device	9300B D MLR MS RB-Kwy	693	DM
1	Offset Pull	RM4190 48” x 14XHD	BPC	RO
1	Closer	HD7016 SPA	693	BE
1	Door Stop	1214H	622	TR
1	Gasketing	700 NGBL SMS-TEKS		NA
1	Door Sweep	200 NGBL SMS-TEKS		NA
1	Threshold	898 NDKB MS/EA		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-12P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Modify existing door and frame to accept new hardware as specified. Do not cut weatherstrip - template hardware accordingly. Verify threshold application. Card activation momentarily retracts latch and allows access. Card reader by security access.

SET #11A - Stair - Card Access

Doors: 208, 230

3	Hinges	CB168 4 1/2 X 4 1/2 NRP	BLK	ST
*1	Electric Hinge	CECB168-12C 4 1/2 x 4 1/2	BLK	ST
*1	Exit Device	F9300B x YL11008 D LFSF RB-Kwy	693	DM
1	Closer	HD7016 JT	693	BE
1	Floor Stop	W1211	622	TR
1	Gasketing	5050 B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-12P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Device is fail safe - must release on alarm. Card activation momentarily unlocks trim and allows access. Card reader by security access.

SET #12 - Existing Patio

Doors: 113B, 126B, 128B, 201A, 201B, 204B, 206A, 206B, 216A, 216B, 216C, 219B

3	Hinges	CB199 4 1/2 X 4 1/2	BLK	ST
1	Lockset	M9973D L110A RB-Kwy Less OS Trim	622	DM
1	Closer/Stop	HD7016 IS	693	BE

Modify existing door and frame to accept new hardware as specified. Balance reuse existing. Cylinder on exterior side to allow key access from the exterior - verify if acceptable to local jurisdiction.

SET #13 - Storage

Doors: 120A, A321, A321A, A305

8	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
2	Single Dummy	M9001 L110A	622	DM
2	Roller Latches	1559W A-STRIKE	622	TR
1	Floor Stop	W1211	622	TR
1	Overhead Stop	4420 SERIES	BLK	AB
2	Door Silencers	1229A	BLK	TR

SET #13A - Storage

Door: 120B,

8	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
2	Single Dummy	M9001 L110A	622	DM
2	Roller Latches	1559W A-STRIKE	622	TR
2	Overhead Stops	4420 SERIES	BLK	AB
2	Door Silencers	1229A	BLK	TR

SET #14 - Reception

Door: 101

4	Concealed Hinge	218	622	SO
1	Lockset	M9080D L110A RB-Kwy Less OS Trim	622	DM
1	Floor Stop	W1211	622	TR
3	Door Silencers	1229A	BLK	TR

Cylinder only on pull side - key serves as pull.

SET #15 - Existing Office - Card Access

Door: A201

1	Continuous Hinge	661HD	BLK	ST
1	Lockset	8856.134.Dorma L110A	693	AC
*1	Electric Strike	BES-F41148	630	BE
1	Mortise Cylinder	90X Series RB-Kwy	693	DM
1	Closer/Stop	HD7016 SDS DP70	693	BE
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2A		RC

Modify existing door and frame to accept new hardware as specified. Card activation momentarily releases strike and allows access. Card reader by security access. Balance reuse existing.

SET #16 - Break Room/Entrance - Card Access - Automatic

Doors: A302, A328A

1	Continuous Hinge	661HD	BLK	ST
1	Exit Device	9700BB D CD RB-Kwy	693	DM
1	Offset Pull	RM4190 48” x 14XHD	BPC	RO
*1	Electric Strike	BES-0162	630	DM
*1	Operator/Switches	Specified in Section 087113		
*1	Wire Harnesses	WH-6E		ST
*1	Wire Harnesses	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases strike, energizes exterior operator switch and allows access. Inside operator switch always active. Card reader by security access. Coordinate operation per 1.05-A-6. Balance reuse existing.

SET #17 - Existing Door

Door: A303, A400A, A400B

Reuse existing hardware.

SET #18 - Wellness/AGR/Shower

Doors: A309, A326

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Privacy w/Indicator	M9046 L110A	622	DM
1	Closer	HD7016 JT	693	BE
1	Floor Stop	W1211	622	TR
1	Gasketing	5050 B Head & Jambs		NA

SET #19 - Electrical - Card Access

Door: A312

3	Hinges	CB168 4 1/2 X 4 1/2 NRP	BLK	ST
1	Exit Device	9300BB x YL11003R D LD RB-Kwy	693	DM
*1	Electric Strike	BES-0162	630	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Gasket	5050B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases strike and allows access. Card reader by security access.

SET #20 - IDF/Storage - Card Access

Doors: A314, A317, A318, A327

7	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
2	Flush Bolts	3917-12	622	TR
1	Dust Proof Strike	3911	622	TR
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
2	Closers	HD7016 SPA	693	BE
2	Floor Stops	W1211	622	TR
1	Gasket	5050B Head & Jambs		NA
1	Astragal	139 A GBL		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Inactive leaf for movement of materials only. Apply astragal to inactive leaf. Card activation momentarily releases lever and allows access. Card reader by security access.

SET #20A - Storage - Card Access

Door: F208

5	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
2	Flush Bolts	3917-12	622	TR
1	Dust Proof Strike	3911	622	TR
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
2	Closers	HD7016 SPA	693	BE
2	Floor Stops	W1211	622	TR
1	Gasket	5050B Head & Jambs		NA
1	Astragal	139 A GBL		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Inactive leaf for movement of materials only. Apply astragal to inactive leaf. Card activation momentarily releases lever and allows access. Card reader by security access.

SET #21 - Existing Office

Door: A320A

1	Continuous Hinge	661HD	BLK	ST
1	Lockset	8856.134.Dorma L110A	693	AC
1	Mortise Cylinder	90X Series RB-Kwy	693	DM
1	Closer/Stop	HD7016 SDS DP70	693	BE

Modify existing door and frame to accept new hardware as specified. Notify the architect and owner of any installation issues. Balance reuse existing.

SET #22 - Restroom

Doors: A322, A323

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Pull Plate	1018-3	622	TR
1	Push Plate	1001-9	622	TR
1	Closer	HD7016 JT	693	BE
1	Kick Plate	K6000 10" x 2" LDW B4E CS	BLK	TR
1	Floor Stop	W1211	622	TR
1	Gasketing	5050 B Head & Jambs		NA

SET #22A - Restroom

Doors: C203, C204

4	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Pull Plate	1018-3	622	TR
1	Push Plate	1001-9	622	TR
1	Closer	HD7016 JT	693	BE
1	Kick Plate	K6000 10" x 2" LDW B4E CS	BLK	TR
1	Floor Stop	W1211	622	TR
1	Gasketing	5050 B Head & Jambs		NA

SET #23 - Vestibule - Automatic

Door: A328B

1	Continuous Hinge	661HD	BLK	ST
1	Push Bar	1741 Type N Mounting	622	TR
1	Offset Pull	RM4190 48” x 14XHD	BPC	RO
*1	Operator/Switches	Specified in Section 087113		
1	Floor Stop	W1211	622	TR

Gaskets by door manufacturer.

SET #24 - Storage - Card Access

Doors: A401, F209

2	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
1	Closer	HD7016 SPA	693	BE
1	Floor Stop	W1211	622	TR
1	Gasket	5050B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases lever and allows access. Card reader by security access.

SET #24A - Storage - Card Access

Door: C206

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
1	Closer	HD7016 SPA	693	BE
1	Floor Stop	W1211	622	TR
1	Gasket	5050B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases lever and allows access. Card reader by security access.

SET #25 - Office

Doors: A405, F202, F203, F204

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Passage Latch	M9010 L110A	622	DM
1	Closer	HD7016 JT	693	BE
1	Floor Stop	W1211	622	TR
3	Silencers	1229A	GREY	TR

SET #26 - Lockers - Card Access - Automatic

Doors: C201A, F201, F207A

1	Continuous Hinge	661HD EPT	BLK	ST
*1	Power Transfer	EPT-12C		PR
*1	Exit Device	9700BB D MLR MS RB-Kwy	693	DM
1	Offset Pull	RM4190 48” x 14XHD	BPC	RO
*1	Operator/Switches	Specified in Section 087113		
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-12P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Card activation momentarily retracts latch, energizes exterior operator switch and allows access. Inside operator switch always active. Card reader by security access. Coordinate operation per 1.05-A-6. Modify existing door and frame to accept new hardware as specified. Balance reuse existing.

SET #26A - Lockers - Card Access - Automatic

Door: C207

2	Continuous Hinges	661HD EPT	BLK	ST
*2	Power Transfers	EPT-12C		PR
*1	Exit Device	9800BB D LB MLR MS RB-Kwy	693	DM
*1	Exit Device	9800BB LB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
*1	Operator Set/Switches	Specified in Section 087113		
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Card activation momentarily retracts latches, energizes exterior operator switch and allows access. Inside operator switch always active. Card reader by security access. Coordinate operation per 1.05-A-6. Modify existing door and frame to accept new hardware as specified. Mount pulls not to conflict with vertical rods. Balance reuse existing.

SET #27 - Lockers/Office - Exit Only

Doors: C201B, C201C, C201D, K.157

1	Continuous Hinge	661HD	BLK	ST
1	Exit Device	9700BB	693	DM
1	Closer/Stop	HD7016 SDS DP70	693	BE

Exit only. Modify existing door and frame to accept new hardware as specified. Balance reuse existing.

SET #28 - Storage - Card Access

Door: C202

2	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
1	Closer	HD7016 JT	693	BE
1	Floor Stop	W1211	622	TR
3	Silencers	1229A	GREY	TR
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases lever and allows access. Card reader by security access.

SET #29 - Mechanical Access

Door: F207B

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Passage Latch	M9010 L110A	622	DM
1	Floor Stop	W1211	622	TR
3	Silencers	1229A	GREY	TR

SET #30 - Goldwalk Boiler Room

Door: GW100A

6	Hinges	CB179 4 1/2 X 4 1/2 NRP	652	ST
1	Set Auto Flush Bolts	3810 X 3810	626	TR
1	Dust Proof Strike	3911	630	TR
1	Lockset	M9080D L110A RB-Kwy	626	DM
1	Coordinator	3093	626	TR
1	Closer (inactive)	HD7016 SPA	689	BE
*1	Hold Open Closer	8916 EMF/PT	689	DM
2	Kick Plates	K0050 10" x 2" LDW B4E CS	630	TR
2	Floor Stops	W1211	630	TR
1	Gasket	5050B Head & Jambs		NA
1	Sweep	A605 A SMS-TEKS		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2A		RC

Astragal on inactive leaf by door manufacturer. Hold open must release on alarm. Mount stops not to pose a tripping hazard.

SET #31 - Goldwalk Boiler Room

Doors: GW100B, GQ100C, GW100D, GW100E

8	Hinges	CB179 4 1/2 X 4 1/2 NRP	652	ST
1	Set Auto Flush Bolts	3810 X 3810	626	TR
1	Dust Proof Strike	3911	630	TR
1	Lockset	M9080D L110A RB-Kwy	626	DM
1	Coordinator	3093	626	TR
*2	Hold Open Closers	8916 EMF/PT	689	DM
2	Kick Plates	K0050 10" x 2" LDW B4E CS	630	TR
2	Floor Stops	W1211	630	TR
1	Gasket	5050B Head & Jambs		NA
2	Sweeps	A605 A SMS-TEKS		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	DKPS-2A		RC

Astragal on inactive leaf by door manufacturer. Hold open must release on alarm. Mount stops not to pose a tripping hazard.

SET #32 - Goldwalk Storage

Door: GW101

8	Hinges	CB179 4 1/2 X 4 1/2	652	ST
1	Set Auto Flush Bolts	3810 X 3810	626	TR
1	Dust Proof Strike	3911	630	TR
1	Lockset	M9080D L110A RB-Kwy	622	DM
1	Coordinator	3094 Series	BLK	TR
2	Closers	HD7016 JT	689	BE
2	Kick Plates	K0050 10" x 2" LDW B4E CS	630	TR
2	Floor Stops	W1211	630	TR
1	Gasket	5050B Head & Jambs		NA
2	Sweeps	A605 A SMS-TEKS		NA

Astragal on inactive leaf by door manufacturer. Mount stops not to pose a tripping hazard.

SET #33 - Promenade Overhead Door

Doors: P.004B, P.005C

1	Mortise Cylinder	90X Series RB-Kwy	622	DM

Balance by door manufacturer.

SET #33A - Goldwalk Gate

Gate: GW101A

1	Weldable Lock Box	KBXMOR Series	600	KD
1	Lockset	M9080D L110A RB-Kwy	626	DM

Balance by the gate manufacturer.

SET #34 - Goldwalk Mechanical/Electrical

Doors: GW104, GW105, GW107

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	652	ST
1	Lockset	M9080D L110A RB-Kwy	626	DM
1	Kick Plate	K0050 10" x 2" LDW B4E CS	630	TR
1	Floor Stop	W1211	630	TR
1	Gasket	5050B Head & Jambs		NA

SET #34A - Storage

Door: A305

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Lockset	M9080D L110A RB-Kwy	622	DM
1	Floor Stop	W1211	622	TR
3	Silencers	1229A	BLK	NA

SET #34B - Goldwalk Mechanical/Electrical

Door: GW102

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	652	ST
1	Lockset	M9080D L110A RB-Kwy	626	DM
1	Closer	HD7016 SPA	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E CS	630	TR
1	Floor Stop	W1211	630	TR
1	Gasket	5050B Head & Jambs		NA
1	Sweep	A605 A SMS-TEKS		NA

SET #35 - Goldwalk Mechanical Exterior

Door: GW103

3	Hinges	CB199 4 1/2 X 4 1/2 NRP	BLK	ST
1	Lockset	M9080D L110A RB-Kwy	622	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Kick Plate	K0050 10" x 2" LDW B4E CS	630	TR
1	Gasketing	700 NGBL SMS-TEKS		NA
1	Sweep	200 NGBL SMS-TEKS		NA
1	Threshold	898 NDKB MS/EA		NA

Do not cut weatherstrip - template hardware accordingly. Verify threshold application.

SET #36 - Goldwalk Vestibule

Door: GW106

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	652	ST
1	Lockset	M9050D L110A RB-Kwy	626	DM
1	Closer	HD7016 SPA	689	BE
1	Kick Plate	K0050 10" x 2" LDW B4E CS	630	TR
1	Wall Stop	1270WV	630	TR
1	Gasket	5050B Head & Jambs		NA

SET #37 - Goldwalk - Retail - Card Access - Automatic

Door: GW300

1	Continuous Hinge	661HD EPT	BLK	ST
*1	Power Transfer	EPT-12C		PR
*1	Exit Device	9700BB D MLR MS RB-Kwy	693	DM
1	Offset Pull	RM4190 48” x 14XHD	BPC	RO
*1	Operator/Switches	Specified in Section 087113		
1	Sweep	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-12P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases strike, energizes exterior operator switch and allows access. Inside operator switch always active. Card reader by security access. Coordinate operation per 1.05-A-6. Gaskets by door manufacturer. Verify threshold application.

SET #38 - Mechanical/Electrical

Doors: P.005A, P.005B, P.002A, K.112B

3	Hinges	CB168 4 1/2 X 4 1/2 NRP	BLK	ST
1	Exit Device	F9300B x YL11003R D RB-Kwy	622	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA

SET #38A - Promenade Electrical

Door: P.002B

3	Hinges	CB199 4 1/2 X 4 1/2 NRP	BLK	ST
1	Exit Device	F9300B x YL11003R D RB-Kwy	622	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasketing	700 NGBL SMS-TEKS		NA
1	Sweep	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA

SET #39 - Promenade Dishwashing - Card Access

Doors: P.006, P.016

2	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
1	Closer/Stop	HD7016 IS	693	BE
1	Gasket	5050B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases lever and allows access. Card reader by security access.

SET #39A - Promenade Keg/Cold Room - Card Access

Doors: P.012, P.013

2	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
1	Closer/Stop	HD7016 IS	693	BE
1	Sweep	A607 A GBL SMS-TEKS		NA
1	Gasket	5050B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases lever and allows access. Card reader by security access.

SET #40 - Promenade Electrical/Mechanical

Doors: P.007, P.019, P.020

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
1	Lockset	M9080D L110A RB-Kwy	622	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA

SET #41 - Promenade ERV

Doors: P.008, P.014, P.003

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Lockset	M9080D L110A RB-Kwy	622	DM
1	Closer/Stop	HD7016 IS	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA

SET #42 - Promenade Stair

Door: P.010

3	Hinges	CB168 4 1/2 X 4 1/2 NRP	BLK	ST
1	Exit Device	F9300B x YL11023	622	DM
1	Closer/Stop	HD7016 IS	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA

SET #43 - Promenade Storage – Card Access

Door: P.011A

5	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
1	Set Auto Flush Bolts	3810 X 3810	622	TR
1	Dust Proof Strike	3911	622	TR
*1	Lockset	M9080D EU L110A RB-Kwy RX	622	DM
1	Coordinator	3094 Series	BLK	TR
2	Closer/Stops	HD7016 IS	693	BE
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2A		RC

Astragal on inactive leaf by door manufacturer. Card activation momentarily unlocks trim and allows access.

SET #44 - Promenade Storage - Card Access - Delayed Egress

Door: P.011B

4	Hinges	CB168 4 1/2 X 4 1/2 NRP	BLK	ST
*2	Electric Hinges	CECB168-12C 4 1/2 X 4 1/2	BLK	ST
2	Exit Devices	F9400B x YL11003R D LB MLR MS	693	TR
*2	Maglocks	BML-DE8310S	313	BE
1	Mortise Cylinder	90X Series RB-Kwy	622	DM
2	Closer/Stops	HD7016 IS	693	BE
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA
1	Gasket Set	A605 A GBL SET		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2A		RC

Maglocks are delayed egress - sounds alarm for 15 seconds then allows egress. Card reader (both sides) retracts latches, shunts maglocks and allows egress/access. Provide mounting brackets as required.

SET #45 - Promenade Lockers - Card Access - Delayed Egress

Door: P.015

8	Hinges	CB168 4 1/2 X 4 1/2 NRP	BLK	ST
2	Exit Devices	F9400B LB	693	TR
*1	Maglock	BML-DE8310S	313	BE
1	Mortise Cylinder	90X Series RB-Kwy	622	DM
2	Closers	HD7016 SDS	693	BE
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA
1	Astragal	139 SP GBL		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2A		RC

Double egress door. Maglock is delayed egress - sounds alarm for 15 seconds then allows egress. Card reader (secure sides) shunts maglock and allows egress. Locate maglock as directed. Provide mounting brackets as required. Mount astragal on either leaf.

SET #46 - Promenade IDF/IT - Card Access

Doors: P.017, P.018

2	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases lever and allows access. Card reader by security access.

SET #47 - Promenade Loading - Card Access

Door: P.004A

2	Hinges	CB168 4 1/2 X 4 1/2	BLK	ST
*1	Electric Hinge	CECB168-12C 4 1/2 X 4 1/2	BLK	ST
*1	Exit Device	F9300B x YL11003R D MLR MS	622	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-12P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Card activation momentarily retracts latch and allows access. Card reader by security access.

SET #48 - Promenade Loading – Card Access

Door: P.004E

2	Hinges	CB199 4 1/2 X 4 1/2 NRP	BLK	ST
*1	Electric Hinge	CECB199-12C 4 1/2 X 4 1/2	BLK	ST
*1	Exit Device	9300B D MLR MS RB-Kwy	693	DM
1	Offset Pull	RM4190 48” x 14XHD	BPC	RO
1	Closer/Stop	HD7016 SDS	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasketing	700 NGBL SMS-TEKS		NA
1	Sweep	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-12P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Card activation momentarily retracts latch and allows access. Do not cut weatherstrip - template hardware accordingly. Verify threshold application.

SET #49 - KVC Main Entry

Door: K.101A, K.162A

2	Continuous Hinges	661HD EPT	BLK	ST
*2	Power Transfers	EPT-12C		PR
*1	Exit Device	9800BB D LB MLR MS RB-Kwy	693	DM
*1	Exit Device	9800BB LB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
*2	Operators/Switches	Specified in Section 087113		
2	Sweeps	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Modify existing doors to accept new lockdown hardware as specified. Operators in section 087113. Coordinate operation with the owner, architect and security access. Verify threshold application. Balance reuse existing. Card reader by security access.

SET #49A - KVC Main Entry

Door: K.162C

2	Continuous Hinges	661HD EPT	BLK	ST
*2	Power Transfers	EPT-12C		PR
*1	Exit Device	9800BB D LB MLR MS RB-Kwy	693	DM
*1	Exit Device	9800BB LB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
2	Closer/Stops	HD7016 SDS DP70	693	BE
2	Sweeps	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Modify existing doors to accept new lockdown hardware as specified. Coordinate operation with the owner, architect and security access. Verify threshold application. Balance reuse existing.

SET #49B - KVC Main Entry

Door: K.162C

1	Continuous Hinge	661HD EPT	BLK	ST
*1	Power Transfer	EPT-12C		PR
*1	Exit Device	9700BB D MLR MS RB-Kwy	693	DM
1	Offset Pull	RM4190 48” x 14XHD	BPC	RO
1	Closer/Stop	HD7016 SDS DP70	693	BE
1	Sweep	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-12P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Modify existing door to accept new lockdown hardware as specified. Coordinate operation with the owner, architect and security access. Verify threshold application. Balance reuse existing.

SET #50 - KVC Vestibule

Doors: K.101A, K.114B, K.162D

2	Continuous Hinges	661HD EPT	BLK	ST
*2	Power Transfers	EPT-12C		PR
*1	Exit Device	9600BB D MLR MS RB-Kwy	693	DM
*1	Exit Device	9600BB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
*2	Operators/Switches	Specified in Section 087113		
2	Floor Stops	W1211	622	TR
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Operators in section 087113. Coordinate operation with the owner, architect and security access. Gaskets by door manufacturer. Alarms and card reader by security access.

SET #50A - KVC Vestibule

Door: K.162F

2	Continuous Hinges	661HD EPT	BLK	ST
*2	Power Transfers	EPT-12C		PR
*1	Exit Device	9600BB D MLR MS RB-Kwy	693	DM
*1	Exit Device	9600BB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
2	Closer/Stops	HD7016 SDS DP70	693	BE
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Coordinate operation with the owner, architect and security access. Gaskets by door manufacturer.

SET #50B - KVC Vestibule

Door: K.162E

1	Continuous Hinge	661HD EPT	BLK	ST
*1	Power Transfer	EPT-12C		PR
*1	Exit Device	9700BB D MLR MS RB-Kwy	693	DM
1	Offset Pull	RM4190 48” x 14XHD	BPC	RO
1	Closer/Stop	HD7016 SDS DP70	693	BE
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-12P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Coordinate operation with the owner, architect and security access. Gaskets by door manufacturer.

SET #51 - KVC Alternate Entry

Doors: K.101C, K.101D

2	Mortise Cylinders	90X Series RB-Kwy	622	DM

Balance hardware and emergency lockdown by sliding door manufacturer.

SET #52 - KVC Check In Area/Lounge

Door: K.158

4	Hinges	CB168 4 1/2 X 4 1/2 NRP	BLK	ST
*2	Electric Hinges	CECB168-12C 4 1/2 X 4 1/2	BLK	ST
*1	Exit Device	9400B D LB MLR MS RB-Kwy	693	DM
*1	Exit Device	9400B LB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
2	Closer/Stops	HD7016 SDS	693	BE
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA
1	Gasket Set	A605 A GBL SET		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Coordinate operation with the owner, architect and security access. Gaskets by door manufacturer. Card reader by security access.

SET #52A - KVC Vestibule

Door: K.126A

6	Hinges	CB168 4 1/2 X 4 1/2 NRP	BLK	ST
*2	Electric Hinges	CECB168-12C 4 1/2 X 4 1/2	BLK	ST
*1	Exit Device	9400B D LB MLR MS RB-Kwy	693	DM
*1	Exit Device	9400B LB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
2	Closer/Stops	HD7016 SDS	693	BE
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket	5050B Head & Jambs		NA
1	Gasket Set	A605 A GBL SET		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Coordinate operation with the owner, architect and security access. Gaskets by door manufacturer. Card reader by security access.

SET #52B - KVC Check In Area/Lounge

Door: K.102

6	Hinges	CB168 4 1/2 X 4 1/2	BLK	ST
2	Push Plates	1001-9	622	TR
*1	Electromagnetic Lock	BML-DE8310S	313	BE
1	Mortise Cylinder	90X Series RB-Kwy	622	DM
2	Closer/Stops	HD7016 SDS	693	BE
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasketing	5050 B Head & Jambs		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	DKPS-2A		RC

Double egress – locate delayed egress maglocks as directed. Verify delayed egress is acceptable to local jurisdiction. Coordinate operation with the owner, architect and security access. Card readers by security access.

SET #53 - Restroom/Shower

Doors:

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Privacy w/Indicator	M9046 L110A	622	DM
1	Closer	HD7016 JT	693	BE
1	Wall Bumper	1270WV	622	TR
1	Gasketing	5050 B Head & Jambs		NA

SET #54

NOT USED

SET #55 - Kitchen

Door: K.111B

6	Hinges	CB168 4 1/2 X 4 1/2	BLK	ST
2	Push Plates	1001-9	622	TR
2	Closers	HD7016 SPA	693	BE
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
2	Wall Bumpers	1270WV	622	TR
1	Gasketing	5050 B Head & Jambs		NA

Double egress – not locking, free egress both directions.

SET #56 - Kitchen

Door: K.111A

6	Hinges	CB168 4 1/2 X 4 1/2	BLK	ST
2	Push Plates	1001-9	622	TR
*1	Electromagnetic Lock	BML-DE8310S	313	BE
1	Mortise Cylinder	90X Series RB-Kwy	622	DM
*2	Operators/Switches	Specified in Section 087113		
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
2	Wall Bumpers	1270WV	622	TR
1	Gasketing	5050 B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2A		RC

Double egress – locate delayed egress maglock as directed. Verify delayed egress on kitchen door is acceptable to local jurisdiction. Coordinate operation with the owner, architect and security access. Card reader by security access.

SET #57 - KVC Entry

Door: K.114A

2	Continuous Hinges	661HD EPT	BLK	ST
*2	Power Transfers	EPT-12C		PR
*1	Exit Device	9600BB D MLR MS RB-Kwy	693	DM
*1	Exit Device	9600BB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
*2	Operators/Switches	Specified in Section 087113		
2	Floor Stops	W1211	622	TR
2	Sweeps	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Operators in section 087113. Coordinate operation with the owner, architect and security access. Card reader by security access. Gaskets by door manufacturer.

SET #58 - Storage/Laundry - Card Access

Doors: K.115, K.116, K.127. K.154, K.160, K.168

2	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
1	Closer	HD7016 JT	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Wall Bumper	1270WV	622	TR
3	Silencers	1229A	BLK	TR
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases lever and allows access. Card reader by security access.

SET #58A - Reception - Card Access

Door: K.154

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
*1	Electric Hinge	CECB179-12C 4 1/2 X 4 1/2	BLK	ST
*1	Electrified Lockset	M9080D EU L110A RB-Kwy RX	622	DM
1	Closer	HD7016 JT	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Wall Bumper	1270WV	622	TR
3	Silencers	1229A	BLK	TR
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-44P		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Card activation momentarily releases lever and allows access. Card reader by security access.

SET #59 - Classroom - Exit Device

Doors: K.117A, K.117B

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
1	Intruder Exit Device	9300B x TL1100808 D RB-Kwy	693	DM
1	Closer	HD7016 SPA	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
*1	Wall Magnet	EM-504-24120	693	DM
1	Gasketing	5050 B Head & Jambs		NA

Magnet must release on command from security access. Coordinate operation with the owner, architect and security access.

SET #60 - Workroom/Feel Better/Classroom

Doors: K.104, K110A, K.120, K121

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Intruder Lockset	M9072D L110A RB-Kwy	622	DM
1	Closer	HD7016 JT	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
*1	Wall Magnet	EM-504-24120	693	DM
1	Gasketing	5050 B Head & Jambs		NA

Magnet must release on command from security access. Coordinate operation with the owner, architect and security access.

SET #61 - KVC Exterior Entry

Door: K.126B

4	Hinges	CB199 4 1/2 X 4 1/2 NRP	BLK	ST
*2	Electric Hinges	CECB199-12C 4 1/2 X 4 1/2	BLK	ST
*1	Exit Device	9400B D LB MLR MS RB-Kwy	693	DM
*1	Exit Device	9400B LB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
2	Closer/Stops	HD7016 SDS	693	BE
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket Set	A605 A GBL SET		NA
1	Gasket	700 NGBL SMS-TEKS		NA
2	Sweeps	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Modify existing doors and frame to accept new hardware as specified. Coordinate operation with the owner, architect and security access. Do not cut weatherstrip – template hardware accordingly. Verify threshold application. Card reader by security access.

SET #61A - KVC Exterior Entry - Automatic

Door: K.150A, K.150B

4	Hinges	CB199 4 1/2 X 4 1/2 NRP	BLK	ST
*2	Electric Hinges	CECB199-12C 4 1/2 X 4 1/2	BLK	ST
*1	Exit Device	9400B D LB MLR MS RB-Kwy	693	DM
*1	Exit Device	9400B LB MLR MS	693	DM
2	Offset Pulls	RM4190 48” x 14XHD	BPC	RO
*2	Operators/Switches	Specified in Section 087113		
2	Kick Plates	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasket Set	A605 A GBL SET		NA
1	Gasket	700 NGBL SMS-TEKS		NA
2	Sweeps	200 NGBL SMS-TEKS		NA
1	Thermal Break Threshold	8426 GBL MS/EA		NA
*2	Wire Harnesses	WH-6E		ST
*2	Wire Harnesses	WH-12P		ST
*2	Wire Harnesses	WH-192		ST
*1	Power Supply	RPSMLR2		PR

Modify existing doors and frame to accept new hardware as specified. Coordinate operation with the owner, architect and security access. Do not cut weatherstrip – template hardware accordingly. Verify threshold application. Card reader by security access.

SET #62 - Office Storage

Doors: K.156A, K.156B

6	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
2	Dummy Trims	M9001 L110A	622	DM
2	Roller Latches	1559W A-STRIKE	622	TR
2	Overhead Stops	4020 Series	S4	AB
2	Silencers	1229A	BLK	TR

SET #63

NOT USED

SET #64 - Storage

Door: K.159

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Lockset	M9080D L110A RB-Kwy	622	DM
1	Wall Bumper	1270WV	622	TR
3	Silencers	1229A	BLK	TR

SET #65 - Lounge - Exit Device - Delayed Egress

Door: K.161

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
1	Exit Device	9300B x YL11023	693	DM
*1	Electromagnetic Lock	BML-DE8310S	313	BE
1	Mortise Cylinder	90X Series RB-Kwy	622	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Kick Plate	K6000 10” x 2” LDW B4E CS	BLK	TR
1	Gasketing	5050 B Head & Jambs		NA
*1	Wire Harness	WH-6E		ST
*1	Wire Harness	WH-192		ST
*1	Power Supply	DKPS-2		RC

Maglock is delayed egress. Coordinate operation with the owner, architect and security access. Card readers by security access.

SET #66 - Restroom

Doors: K.169, K.170

3	Hinges	CB179 4 1/2 X 4 1/2	BLK	ST
1	Pull Plate	1018-3	622	TR
1	Push Plate	1001-9	622	TR
1	Closer	HD7016 JT	693	BE
1	Kick Plate	K6000 10" x 2" LDW B4E CS	BLK	TR
1	Wall Bumper	1270WV	622	TR
1	Gasketing	5050 B Head & Jambs		NA

SET #67 - Lounge - Exit Device - Exit Only

Door: K.171

3	Hinges	CB179 4 1/2 X 4 1/2 NRP	BLK	ST
1	Exit Device	F9300B	693	DM
1	Closer/Stop	HD7016 SDS	693	BE
1	Gasketing	5050 B Head & Jambs		NA

Exit only.

SET #68 - Existing Doors - Card Access

Door: K.111C, K.112A

Provide electronic hardware as needed to allow card access. Card reader by security access. Balance reuse existing.

SET #D1 - Demountable Sliding Door – Non Locking

Doors: 106, 109, 110, 121, 122, 123, 217, 218, 219A, 220, 221, 222, A306, A307, A329, A330. K.151, K.153

All hardware by demountable partition manufacturer.

SET #D2 - Demountable Swinging Door – Non Locking

Doors: 113A, 204A, 215, 223, A304, A308, A316, K.152, K.155

All hardware by demountable partition manufacturer.

SET #D3 - Demountable Swinging Door - Locking

Doors: A315, A319, A320B

All hardware by demountable partition manufacturer.

* Requires electronic coordination

End of Section 08 71 00

Opening List

Opening	Hdw Set	Opening Label
100A	8	
100B	9	
101	14	
102	1	
104	5	
105	5	
106	D1	
108A	10	90
108B	11	
109	D1	
110	D1	
112	1	
113A	D2	
113B	12	
114	4	
116	7	
117	7	
120A	13	
120B	13A	
121	D1	
122	D1	
123	D1	
125	3	
126A	3	
126B	12	
127	3	
128A	3	
128B	12	
130	10	90
201A	12	
201B	12	
204A	D2	
204B	12	
205	2	
206A	12	
206B	12	
208	11A	90
209	5	
210	5	
211	4	
212	4A	
214	7	
215	D2	
216A	12	
216B	12	
216C	12	
217	D1	
218	D1	

219A	D1	
219B	12	
220	D1	
221	D1	
222	D1	
223	D3	
224	4A	
230	11A	90
A201	15	
A301	10A	90
A302	16	
A303	17	
A304	D2	
A305	13	
A306	D1	
A307	D1	
A308	D2	
A309	18	
A312	19	
A314	20	
A315	D3	
A316	D2	
A317	20	
A318	20	
A319	D3	
A320A	21	
A320B	D3	
A321	13	
A321A	13	
A322	22	
A323	22	
A326	18	
A327	20	
A328A	16	
A328B	23	
A329	D1	
A330	D1	
A400A	17	
A400B	17	
A405	25	
A406	D2	
C201A	26	
C201B	27	
C201C	27	
C202	28	
C203	22A	
C204	22A	
C205	7	
C206	24A	
C207	26A	
F201	26	
F202	25	
F203	25	
F204	25	

F205	D1	
F206	18	
F207A	26	
F207B	29	
F208	20A	
F209	24	
GW100A	30	45
GW100B	31	45
GW100C	31	45
GW100D	31	45
GW100E	31	45
GW101A	32	45
GW101B	33A	
GW102	34B	
GW103	35	
GW104	34	
GW105	34	
GW106	36	
GW300	37	
P.001B	8	
P.001C	8	
P.005A	38	
P.006	39	
P.007	40	
P.008	41	
P.010	42	90
P.011A	43	
P.011B	44	
P.012	39A	
P.013	39A	
P.014	41	
P.015	45	90
P.016	39	
P.017	46	
P.018	46	
P.019	40	
P.020	40	
P.002A	38	90
P.002B	38A	
P.003	41	
P.004A	47	
P.004B	33	
P.004C	33	
P.004D	33	
P.004E	48	
P.005B	38	
P.005C	33	
K.101A	49	
K.101B	50	
K.101C	51	
K.101D	51	
K.102	52B	
K.103	53	
K.104	60	

K.110A	60	
K.111A	56	
K.111B	55	
K.111C	68	
K.112A	68	
K.112B	38	90
K.114A	57	
K.114B	50	
K.115	58	
K.116	58	
K.117A	59	
K.117B	59	
K.120	60	
K.121	60	
K.123	53	
K.126A	52A	
K.126B	61	
K.127	58	
K.150A	61A	
K.150B	61A	
K.151	D1	
K.152	D2	
K.153	D1	
K.154	58A	
K.155	D2	
K.156A	62	
K.156B	62	
K.157	27	
K.158	52	
K.159	64	
K.160	58	
K.161	65	
K.162A	49	
K.162B	49B	
K.162C	49A	
K.162D	50	
K.162E	50B	
K.162F	50A	
K.164	53	
K.165	53	
K.166	53	
K.167	53	
K.168	58	
K.169	66	
K.170	66	
K.171	67	20

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

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

1. Windows.
2. Doors.
3. Glazed entrances.
4. Interior borrowed lites.
5. Storefront framing.

B. Related Requirements:

1. Refer to Section 08 41 13 "Aluminum-Framed Entrances and Storefronts," for requirements applicable to single subcontract responsibility for glazing.

1.2 ACTION SUBMITTALS

A. Product Data: Submit product data for each glass product and glazing material indicated.

B. Samples: Label samples to indicate product, characteristics, and locations in the Work. Furnish samples of the following:

1. Except for clear glass, submit samples of each glass type specified, in the form of 12 inch square Samples.
2. Submit samples of each glass type specified where production run variations and defects are expected.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Submit a letter from glass manufacturer certifying that he has reviewed the glazing details proposed for the Project, including the use of gaskets and sealants, and that each product to be furnished is recommended for the application shown.

B. Design Data: Submit the following from the glass manufacturer:

1. Thermal Stress Analysis: For each exterior glass unit type, each building elevation. The analysis shall clearly indicate all the expected service temperature ranges and the effects of partial and full shading on the glass. Append to the thermal stress analysis a statement from the glass manufacturer that based upon this analysis that the resulting thermal stresses will not reduce the specified "statistical probability of breakage."

2. Wind Load Analysis: For each glass unit type, each building elevation. The analysis shall clearly indicate that the statistical probability of breakage at the design wind pressure will not exceed the specified statistical probability of breakage.

C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. Material Certificates: Submit glass treatment certificates signed by manufacturer of the heat-soaked glass products certifying that products furnished comply with requirements.

D. Product Test Reports: Submit product test reports for each type of glazing sealant and gasket indicated.

E. Warranties: Submit special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.

B. Source Limitations for Glass and Glazing Accessories: Obtain glass and glazing accessories from one source for each product indicated below:

1. Primary glass.
2. Coated glass.
3. Heat-treated glass, including heat-strengthened, tempered, and heat-soaked glass.
4. Insulating glass.
5. Laminated glass.
6. Glazing gaskets.

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

D. Safety Glass: Comply with the applicable requirements of the laws, codes, ordinances and regulations of Federal and Municipal authorities having jurisdiction. Wherever requirements conflict, the more stringent shall be required. Obtain approvals from all such authorities. As a minimum, provide Category II materials complying with testing requirements in 16 CFR 1201 (Consumer Product Safety Commission "Safety Standard for Architectural Glazing Materials," as published in the Code of Federal Regulations) and ANSI Z97.1.

1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction. Locate permanent markings in one corner, and in the same location, of each glass lite in accordance with the requirements of the SGCC labeling guidelines. Markings shall have a nominal size of no greater than 1-inch in diameter, and be located with glass edge clearances, at the corner, by not more than 3/4-inch up and 3/4-inch over.

E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Glazing Manual" and "Laminated Glass Design Guide."
2. IGMA Publications: IGMA TM-3000, "Vertical Glazing Guidelines."

F. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council (IGCC) or of the Associated Laboratories, Inc. (ALI).

G. Sample Installations: Refer to Section 08 44 13 "Glazed Aluminum Curtain Walls" for requirements applicable to sample installations.

1. Representatives of glass and glazing materials manufacturers, together with Contractor's field supervisor for glazing, shall be present during construction and field testing (if any) of sample installations.
2. Prepare sample installations where shown and as required to match approved shop drawings and the Contract Documents in all respects before proceeding with the Work.
3. Accepted sample installations may remain as a portion of the completed Work.

H. Pre-Construction Testing:

1. Bow and Warp Distortion (Flatness) Tolerance Testing:

a. Prior to the visual observation by the Architect and Owner of the preconstruction glass mockups, measure each mockup lite for bow and warp in accordance with ASTM C 1048. Measure the lites on a vertical plane with an aluminum straight edge or fishing line.

1) Measure the mockup glass lites for compliance with the bow and warp tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances."

b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum bow and warp limits and certify that these non-conforming glass lites will not be incorporated into the Work.

1) Provide written documentation of the bow and warp readings in fractions of an inch or millimeters for each mockup glass lite to the Owner and Architect at the preconstruction glass mockup meeting. Provide additional written documentation as requested by the Owner and Architect.

2. Roll Ripple Distortion (Flatness) Tolerance Testing:

a. Prior to the visual observation by the Architect and Owner of the preconstruction glass mockups, measure each monolithic lite in the mockup containing low emissivity coated, unfritted, heat-treated glass having a 1/4-inch- thickness or greater using a LiteSentry or Osprey Series type optical scanning measurement device complying with ASTM C 1652 for digital grid scanning glass devices.

1) Measure the monolithic mockup glass lites for compliance with the flatness tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances."

b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum flatness limits and certify that these non-conforming glass lites will not be incorporated into the Work.

1) Provide written documentation of the flatness readings in fractions of an inch, in millimeters, and in millidiopters, for each mockup glass lite to the Owner and Architect at the preconstruction glass mockup meeting. Provide additional written documentation as requested by the Owner and Architect.

3. Color Tolerance Testing:

a. Prior to the visual observation by the Architect and Owner of the preconstruction glass mockups, measure each monolithic mockup glass unit using either an off-line, or on-line, spectrophotometer. Color measurement shall be taken from the uncoated side.

1) Tolerance limits for the color variation shall be as accepted on the visual mockup.

b. Document and record results for each glass unit. Tag each unit of glass that falls outside of the color variation limits and certify that these non-conforming glass units will not be incorporated into the Work.

I. Quality Control (Production) Testing: As a minimum, provide the following quality control (production) testing for the exterior glass units:

1. Bow and Warp Distortion (Flatness) Tolerance Testing:

a. During the production of the heat-treated glass lites, measure for bow and warp in accordance with ASTM C 1048. Measure the lites on a vertical plane with an aluminum straight edge or fishing line.

1) Measure the monolithic glass lites for compliance with the bow and warp tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.

b. During glass production, and once an hour, randomly select a single heat-treated glass lite and measure it. Document and record results. Tag each glass lite that falls outside of the maximum bow and warp limits and certify that these non-conforming glass lites were not incorporated into the Work.

c. Provide written documentation of the bow and warp readings in fractions of an inch or millimeters for each tested glass lite to the Owner and Architect, if requested. Provide additional written documentation as requested by the Owner and Architect.

2. Roll Ripple Distortion (Flatness) Tolerance Testing:

a. During the production of the heat-treated glass lites, measure each low emissivity coated, unfritted, monolithic glass lite having a 1/4-inch- thickness or greater using a LiteSentry or Osprey Series type optical scanning measurement device complying with ASTM C 1652 for digital grid scanning glass devices.

1) Measure the monolithic glass lites for compliance with the flatness tolerances under Article "Heat-Treated Float Glass," Paragraph "Flatness Tolerances," unless otherwise accepted by the Owner and Architect at the preconstruction glass mockup.

b. Document and record results for each glass lite. Tag each glass lite that falls outside of the maximum flatness limits and certify that these non-conforming glass lites were not incorporated into the Work.

1) Provide written documentation of the flatness readings in fractions of an inch, in millimeters, and in millidiopters, for each glass lite to the Owner and Architect, if requested. Provide additional written documentation as requested by the Owner and Architect.

3. Color Tolerance Testing: During production, test monolithic coated and coated insulating glass units for color compliance as follows:

a. Establish a color target selected from the accepted pre-construction glass mockup unit(s) and perform quality control color control checks using either an off-line, or on-line, spectrophotometer. Examples of acceptable off-line devices include Minolta 2500d/2600d; examples of acceptable on-line devices include Benchmodel Spectrophotometers. Color measurement shall be taken from the uncoated side.
b. Frequency: Test a minimum of one unit every hour.
c. Document and record results for each glass unit. Tag each unit of glass that falls outside of the color variation limits and certify that these non-conforming glass units will not be incorporated into the Work.

4. Insulating Glass Unit Testing Requirements: During production, test insulating glass units as follows:

a. Butterfly Unit Adhesion Pull Testing:

1) Adhesion Criteria: Comply with the pass/fail requirements of the sealant manufacturer's published guidelines and/or sealant manufacturer's certification audit requirements/recommendations. Minimum pull back to 30 degrees from horizontal with no adhesive failure.
2) Frequency: Test one minimum 4-by-6-inch- size unit each eight-hour shift and after each sealant drum change.
3) Test units shall be fabricated on the same production line and processing equipment and with the same spacers and sealant used in the production of the insulating glass units fabricated for the Project.

b. Desiccant Temperature Rise Testing:

1) Test Criteria: Comply with the desiccant manufacturer's written recommendations.
2) Frequency: Test a minimum of once every eight-hour shift and after each drum change.

c. Bow/Warp and Air Space Measurement Concave/Convex Testing:

1) Measure and record bow and warp once every hour on a vertical plane with an aluminum straight edge or with a laser.
2) Measure and record unit center air space a minimum of once an hour with a checking gage (FDR Designs, or equal) and visually inspect all units.

d. Skips and voids in the primary or secondary seals are prohibited and maximum gap at primary/secondary seal interface shall be 1 inch in length and 3/32 inch in width.
e. Document and record results. Provide additional documentation upon request by the Owner or Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting (using either breather or capillary tubes) and sealing.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.7 WARRANTY

A. Manufacturer's Special Warranty on Ceramic Frit-Coated-Glass Products: Written warranty, made out to Owner and signed by coated-glass manufacturer agreeing to furnish replacements for those coated-glass units whose coatings flake, peel, or crack within the specified warranty period indicated below. Upon notification of such deterioration within the warranty period, furnish replacement glass units for those glass units whose coatings have flaked, peeled or cracked at the convenience of the Owner.

1. Warranty Period: Five years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units whose hermetic seal has failed within specified warranty period indicated below. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass. Upon notification of such deterioration within the warranty period, furnish replacement glass units for failed glass units at the convenience of the Owner.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Refer to Finish Schedule on the Drawings Glass types indicated on the Drawings are keyed to the Part 3 Glass Schedule Articles at the end of this Section. The Contractor shall confirm the levels of heat-treatment required for each glass type scheduled as contained in "Performance Requirements" and "Quality Assurance" Articles.

2.2 PERFORMANCE REQUIREMENTS

A. General: Provide and install watertight and airtight glazing systems capable of withstanding thermal movement and wind and impact loads without failure of any kind, including loss or breakage of glass, failure of seal or gaskets, exudation of glazing sealants, and excessive deterioration of glazing materials.

B. Glass Design: Glass thicknesses and heat treatments indicated are minimum requirements. Glazing details shown are for convenience of detailing only and are to be confirmed by the Contractor relative to cited standards and final framing details. Confirm glass thicknesses and heat treatments, verified by analysis, as required to meet the performance and testing requirements specified in Section 08 44 13 "Glazed Aluminum Curtain Walls,"

C. Thermal and Optical Performance Properties: Provide insulating glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:

1. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2 inch wide interspace.

2. Center-of-Glass U-Values: NFRC 100 methodology using LBL WINDOW 6.3 computer program, expressed as Btu/ sq. ft. x h x deg F.
3. Solar Heat Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL WINDOW 6.3 computer program.
4. Visible Reflectance (Solar Optical) Properties: Center-of-glazing values, according to NFRC 300.

2.3 PRIMARY FLOAT GLASS

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Quality q3 (glazing select); Class 1, clear, Class 1, ultra clear low iron with visible light transmission of not less than 91 percent, or Class 2, tinted as indicated in schedules.

1. In order to reduce the possibility of glass color range rejection, the supplier of float (primary) glass products shall provide glass for the entire Project from a single facility using stockpiled batch run materials from a single source for the entire Project.

2. Float Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1036, all glass shall be supplied meeting the following quality standards:

   a. Point blemishes - seeds/stones with distortion, stain spots, dirt, surface damage - shall be limited to 0.060 inch maximum separated by 12 inches minimum.
   b. Glass scratch/rubs shall be rejected if detectable at 10 feet.
   c. Water blow-off stains, tag residue, and handprints will not be permitted.

2.4 HEAT-TREATED FLOAT GLASS

A. General: Heat-treat glass where the need is determined by thermal stress analyses, by wind load analyses, and where required to meet safety glazing requirements.

B. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of installed glass unit.

C. Sizes and Cutting: Prior to heat treatment, cut glass to required sizes as determined by accurate measurement of openings to be glazed, making allowance for required edge clearances. Cut and process edges in accordance with glass manufacturer's recommendations. Do not cut or treat edges in the field. Make all cuts for hardware, access, or glass-mounted trim or accessories before heat treating.

D. Heat-Strengthened Glass: Provide glass complying with ASTM C 1048 Kind HS. Surface compression range shall be between 4,000 psi and 7,000 psi for 1/4 inch thick glass.

1. Heat-Strengthened Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1048, all glass shall be supplied meeting the following quality standards:

    a. Chill cracks, roller marks, and picture framing shall not be permitted.
    b. Tracking/cloud and heat dimples shall be rejected if detectable at 10 feet.

E. Fully Tempered Glass: Provide glass complying with ASTM C 1048 Kind FT and meeting the requirements of ANSI Z97.1. Surface compression shall be equal to or greater than 10,000 psi. After tempering, heat-soak 100 percent of all fabricated glass units to European Union Standard EN14179 to reduce the potential for inclusion related glass breakage. Statistical heat soaking shall not be permitted.

1. The appearance of anisotropy, also known as 'leopard spots' • and 'quench patterns', is known to be associated with toughened (tempered) glass under certain polarized lighting conditions. This will not be considered a fault unless it is visible in a range of reasonably typical naturally occurring conditions. The Architect will determine the acceptable range(s) of anisotropy from glass sample submittals. Coatings applied to tempered glass products shall not exacerbate anisotropy to an unacceptable range(s).
2. Tempered Glass Quality Imperfection Limitations: In addition to the limitations included under ASTM C 1048, all glass shall be supplied meeting the following quality standards:

a. Chill cracks, roller marks, and picture framing shall not be permitted.
b. Tracking/cloud and heat dimples shall be rejected if detectable at 10 feet.

F. Flatness Tolerances: All heat-treated glass shall be fabricated to the following flatness tolerances. Verification of compliance for overall bow and warp shall be in accordance with ASTM C 1048. Verification of compliance for flatness shall be via an optical scanning device such as LiteSentry or Osprey Series.

1. Overall Bow and Warp: Not greater than the maximum bow and warp tolerances in any direction as listed in ASTM C 1048 Table 2. Localized warp limited to 1/32 inch in 12 inches.
2. Roll Ripple: The deviation from flatness at any peak (peak to valley deviation) shall not exceed 0.003 inches for 6 mmthick glass in the glass center, with leading and trailing edge deviation not to exceed 0.008 inches for 6 mmthick glass.

G. Millidiopter Criteria: Maximum +/- 120 millidiopters overall or the highest overall measurement from the approved visual mockup that is less than +- 120 millidiopter overall whichever is less when viewed outdoors.

2.5 COATED FLOAT GLASS

A. General: Provide coated glass complying with requirements indicated in this Article, under Paragraph "Insulating Glass," and in schedules.

1. Sputter-Coated Float Glass: Float glass with the coating(s) specified in schedules, deposited by magnetron sputtered vacuum deposition process after manufacture and heat treatment. Post-temperable glass coatings will not be permitted on glass thicknesses of greater than 1/4 inch Pyrolytic and wet chemical deposition glass coatings will not be permitted.
2. Coating Quality: The allowable range of defects in coatings applied to glass shall be as accepted through glass sample submissions. Installed coated glass products which are outside of the accepted sample range shall be subject to rejection by the Architect. [In order to reduce the possibility of glass rejection, the supplier of coated glass products shall provide glass coating production runs for the entire Project from a single coating facility.] All coated glass shall be provided from a single coating facility. The allowable range of defects are defined as follows:

a. The vision glass area is defined as the field of glass which is greater than 1 inch from the glass unit edge.

1) Pinholes: At an indoor viewing distance of 10 feet for non-reflective and reflective low emissivity coatings:

   a) Pinholes greater than 1/16 inch in diameter shall not be permitted in 80 percent of the central portion of the vision glass area and separated by greater than or equal to 12 inches. Pinholes larger than 3/32 inch are not allowed in the outer 20 percent of the perimeter vision glass area and separated by greater than or equal to 12 inches.
   b) No more than two readily apparent blemishes are allowed in a 3 inch diameter circle and no more than five readily apparent blemishes are allowed in a 12 inch diameter circle.

2) Scratches: At an indoor viewing distance of 10 feet for non-reflective and reflective low emissivity coatings, and 15 feet for reflective coatings:

   a) Scratches are allowed in 80 percent of the central glass area if not detectable at the viewing distance, and scratches less than or equal to 1 inch are allowed in the outer 20 percent area if not detectable at the viewing distance. Concentrated scratches or abraded areas are not allowed.
   b) Scuffs, rub marks, cup marks, or abraded areas shall not be permitted in any glass area.

3) Reflectance and Transmission Inspection: When viewed outdoors against a bright uniform opaque background at a distance of 10 feet for low emissivity coatings, color, reflectance and transmission will be permitted to have a slight variance subject to Architect's acceptance.

   a) Mottling and streaking of the coating shall not be permitted.
   b) Coating arcing will not be permitted.
   c) Water blow-off stains will not be permitted.
   d) Handprints will not be permitted.
   e) Roller marks shall not be permitted.
   f) Positive and negative air distortion shall not be permitted.
   g) Tag residue shall not be permitted.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Preassembled units, with dehydrated entrapped air, consisting of sheets of glass hermetically sealed at all edges with a black polyisobutylene primary and a black silicone secondary elastomeric sealant. The lites of glass shall be separated by dessicant containing black colored aluminum spacers. All insulating glass units shall be IGCC certified to comply with ASTM E 2190 and with requirements specified in this Article and in the Glass Schedule.

1. Provide Kind HS (heat-strengthened) float glass where needed to comply with "Performance Requirements" Article. Provide Kind FT (fully tempered) where safety glass is indicated.

B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Glass Schedule are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.

2.7 GLAZING SEALANTS

A. General: Provide products of type indicated, complying with the following requirements:

B. Gasket, Blocking, and Spacer Wet Glazing Materials: Silicone, compatible with and adherent to each material it will be in contact with, as recommended by the manufacturer to fulfill performance requirements.

C. Structural and Butt Glazing Sealants: Refer to Section 07 92 00 "Joint Sealants," Article "Elastomeric Joint Sealants," subparagraph "Structural Glazing."

2.8 GLAZING GASKETS

A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C 542, black.

B. Dense Compression Gaskets:

1. Silicone: Continuous extruded silicone with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 1115, Type C. Provide injection molded corners.

C. Soft Compression Gaskets: Continuous extruded expanded foam with, cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown all in compliance with the applicable provisions of ASTM C 509, Option II, Type II; provide the following:

1. Silicone.

D. Continuous Structural Gaskets/Spacers: Continuous extruded silicone or silicone compatible rubber, with cross sectional profile, physical properties, and tolerances as recommended by the window and curtain wall manufacturer, and as required, to comply with the performance requirements specified and shown. Gaskets/spacers shall be tested for compatibility with silicone sealants and shall be subject to the acceptance of the sealant manufacturer.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces, and wet glazing materials, contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Silicone complying with ASTM C 1115, blocks, 85 +/- 5 Shore A durometer hardness, 1/16 inch less than the channel width, and length based on the face area of the glass unit to be supported in accordance with GANA standards and glass manufacturer recommendations, but not less than 4 inches.

D. Edge Blocks: Silicone complying with ASTM C 1115, blocks, 65 +/- 5 Shore A durometer hardness, minimum 4 inches long and sized to allow 1/8 inch clearance between edge of glass and block.

E. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.10 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

1. Edge and Surface Conditions: Comply with the recommendations of AAMA "Structural Properties of Glass" for "clean-cut" edges, except comply with manufacturer's recommendations when they are at variance therewith.

2. Exposed Glass Edges and Surface Condition: All edges shall be flat with an arrissed edge profile (small bevel of uniform width not exceeding 1/16 inch at an angle of approximately 45 degrees to the surface of the glass) with a polished (surface is reflective in appearance similar to the major surface of the glass) surface.

B. Cutting: Do not nip glass edges. Edges may be wheel cut or sawed and seamed at manufacturer's option. For glass to be cut at site, provide glass 2 inches larger than required in both dimensions, so as to facilitate cutting of clean cut edges without the necessity of seaming or nipping. Do not cut, seam, nip or abrade heat-treated glass.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine glass framing, with glazier and glass framing erector present, for compliance with the following:

1. Compliance with the specified manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

A. Clean glazing stops, glazing channels, and rabbets which will be in contact with the glazing materials immediately before glazing. Loose particles present or resulting from fabrication and cleaning shall be removed by blowing out joints with oil-free compressed air, or by vacuuming joints. Remove protective coatings, oils from cutting and drilling operations, and residue on metallic surfaces with solvents that leave no residue. Do not allow solvent to air dry without wiping. Use only lint-free towels for wiping of surfaces. Wipe metal surfaces with IPA (isopropyl alcohol) unless otherwise required by compatibility and adhesion testing results.

1. Prime surfaces to receive glazing compounds. When priming, comply with wet glazing manufacturer's recommendations.

B. Inspect each glass unit immediately before installation. Do not install any units which are improperly sized or have damaged edges, scratches or abrasion or other evidence of damage. Remove labels from glass immediately after installation.

C. Seal vent (breather or capillary) tubes in insulating glass units in accordance with the insulating glass manufacturer's written recommendations.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

1. All glass units shall be installed in accordance with the glass manufacturer's recommendations.

a. Unitized Shop-Glazed Structural Silicone Window and Curtain Wall Systems: Comply with the recommendations of the structural silicone and curtain wall framing manufacturers; where conflicts arise, the most stringent shall apply.

1) Structurally seal glass unit to mullions with specified two-part structural silicone sealant. Place and tool structural silicone beads to remove air pockets and bubbles; remove excess structural silicone from glass and metal substrates. Insert and shape weatherseal joint backer rods, or gaskets, into void between glass units and between glass units and framing to the proper depth to receive silicone weatherseal sealant. Place silicone weatherseal sealant into void and tool flush with adjacent exterior glass lite faces; remove excess sealant from glass and metal substrates.

B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to surfaces indicated to receive glazing materials. Use primers as determined by preconstruction compatibility and adhesion testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless more stringent requirements are recommended by glass manufacturer. Place blocks to allow water passage to weep holes. Set blocks in thin course of silicone sealant.

1. For Glass Units Less Than 72 inches: Locate setting blocks at sill one-quarter of the width in from each end of the glass, unless otherwise recommended by the glass manufacturer.
2. For Glass Units 72 inches or Greater: Locate setting blocks at sill one-eighth of the width in from each end of the glass, but not less than 6 inches, unless otherwise recommended by the glass manufacturer.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.

2. Provide 1/8 inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking to prevent glass lites from moving sideways in glazing channel, sized and located to comply with the glass manufacturer's recommendations and the requirements in referenced glazing publications.

1. Edge blocking will not be required at structural glazed window and curtain walls unless specifically required by the glass manufacturer for the conditions shown.

I. Set glass lites with uniform pattern, draw, bow, and similar characteristics, producing the greatest possible degree of uniformity in appearance on the entire exterior wall elevation.

1. Set glass units with void between edge of units and glazing channel.
2. Orient and install insulating glass units made up with one lite of low emissivity coated glass with the uncoated glass lite on the inboard (building) side.
3. Orient and install insulating glass units made up with one lite of tinted glass with the untinted glass lite on the inboard (building) side.

3.4 PROTECTION AND CLEANING

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way and from any source, including natural causes, accidents, and vandalism.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

3.5 GLASS SCHEDULE

A. Low-E Insulating Glass: Where glass of this designation is indicated, provide low-emissivity insulating-glass units complying with the following:

1. Basis of Design Product: Vitro Solarban 70
2. Overall Unit Thickness and Thickness of Each Lite: 25 and 6 mm.
3. Interspace Content: Air.
4. Indoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.
    a. Kind HS (heat strengthened), unless Kind FT (fully tempered) is indicated on Drawings or required by code to meet safety glazing requirements.
5. Outdoor Lite: Type I (transparent glass, flat), Class 1 (clear) float glass.
    a. Kind HS (heat strengthened), unless Kind FT (fully tempered) is indicated on Drawings or required by code to meet safety glazing requirements
6. Low-Emissivity Coating: Sputtered on second surface.
7. Visible Light Transmittance: 64 percent.
8. Winter Nighttime U-Value: 0.28.
9. Solar Heat Gain Coefficient: 0.27.
10. Outdoor Visible Reflectance: 13 percent.

END OF SECTION 08 80 00

SECTION 08 83 00 - MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

1.2 Not all listed items may be part of this project nor are all items listed. Refer to drawings for complete scope. If MIRRORS are shown in drawings but not scheduled coordinate with Architect for desired product type prior to cost assumption.

A. Section includes wall mounted float glass mirrors.

1.3 ACTION SUBMITTALS

A. Product Data: Submit product data for each product indicated, including description of materials and process used to produce mirrored glass, source of glass, glass coating components, edge sealer, and quality control provisionsShop Drawings: Submit shop drawings showing plans, elevations, sections, details, and attachments to other Work.

B. Samples: Submit samples, 12 inches square in size, of each type of mirror glass specified including edge treatment on 2 adjoining edges of samples.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit product certificates signed by manufacturers of mirror glass certifying that their products and edge sealers comply with specified requirements.

B. Preconstruction Test Report: Submit mirror mastic glass coating compatibility test reports from organic protective coating manufacturer indicating that mirror mastic has been tested for compatibility and adhesion with organic protective coating. Include organic coating manufacturers' interpretation of test results relative to performance and recommendations for use of mastics with organic protective coating.

C. Warranty: Submit special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed work similar in material, design, and extent to that indicated; whose work has resulted in installations with a record of not less than 5 years of successful in-service performance.

B. Glazing Publications: Comply with the applicable recommendations of the following. Where recommendations conflict the more stringent shall apply:

1. Glass Association of North America (GANA): "Glazing Manual" and the Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
2. National Glass Association (NGA): "Custom Mirrors, Fabrication and Installation."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with mirrored glass manufacturer's written instructions for shipping, storing, and handling mirrored glass as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrored glass units that deteriorate f.o.b. the nearest shipping point to Project site, within five years from date of Substantial Completion.

1. Deterioration of Silvered Mirrored Glass: Defects developed from normal use not caused by maintaining and cleaning mirrored glass contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

PART 2 - PRODUCTS

2.1 SILVERED FLAT GLASS MIRROR MATERIALS

A. Clear Glass Mirrors: 6.0 mm thick and complying with ASTM C 1503, Mirror Select Quality for use in visually demanding applications requiring minimal distortions and blemishes. Provide two-layer silvering process.

2.2 FABRICATION

A. Cutouts: Fabricate cutouts for notches and holes in mirrored glass without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrored glass.

B. Mirror Edge Treatment:

1. Cutting and Polishing: Flat edges where the clean cut "square" edge of the glass is flat and surface edges are slightly arrissed. After grinding the arisses, edges shall be polished to a high gloss surface where the surface reflectivity is similar in appearance to the major surface of the glass.
2. Edge Sealing: Immediately after cutting to final sizes, and applying edge treatment, factory seal edges of mirrors with edge sealer to prevent chemical or atmospheric penetration of glass coating.

2.3 MISCELLANEOUS MATERIALS

A. Setting Blocks: Non-rubber or non neoprene based elastomeric material manufactured for setting silvered flat glass mirrors, compatible with adhesive used for placement, with a Type A Shore durometer hardness of 85, plus or minus 5. 1/8 inch wide by 1/4 inch high by 4 inches long.

B. Edge Sealer: Coating compatible with glass coating and approved by mirrored glass manufacturer for use in protecting against silver deterioration at mirrored glass edges.

1. Basis-of-Design: Royal Adhesives & Sealants, LLC; Premier Plus®.
2. Subject to compliance with requirements, provide the Basis-of-Design or a comparable product by one of the following:

    a. Franklin International.
    b. Laurence, C. R. Co., Inc.
    c. Liquid Nails Adhesive.
    d. Palmer Products Corporation.
    e. Royal Adhesives & Sealants, LLC.
    f. or approved equal

C. Barrier Coat: Provide mastic barrier coat if recommended for conditions of installation.

D. Film Backing for full length mirrors and Safety Mirrors, as required by IBC: Film backing and pressure sensitive adhesive; both compatible with mirror backing paint and certified by mirror manufacturer.

E. Glassless Mirrors: Alvas glassless studio mirrors.

F. Drywall and Plywood Paint: A high quality primer or sealer of type as recommended by the mirror mastic manufacturer.

G. Top and Bottom Aluminum J Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate 6 mm thick mirrors and heavy bodied mirror mastic specified and in lengths required to cover bottom and top edges of each mirror in a single piece. The ends of the back lips of all channels shall be factory snipped and filed so that they will not be seen after installation. The bottom channel shall be drilled with a minimum of 2 - 1/4 inch diameter weep holes located between the setting blocks.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 inch and 7/8 inch in height, respectively. CRL Polished Finish 1/4 inch Standard "J" Channel (Part Number D636P); C. R. Laurence Co., Inc.
2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 inch and 1-3/16 inch in height, respectively. CRL Polished Finish 1/4 inch Deep Nose "J" Channel (Part Number D645P); C. R. Laurence Co., Inc.

H. Fasteners:

1. Steel Stud Framing: For fastening J-channels to drywall stud and backer sheet framing provide #8 gage diameter, 1 inch long, Phillips type pan head drywall screws in quantity as required for support and fastening of continuous j-molds to drywall stud framing.
2. Plywood Fasteners: Provide #8 gage diameter, minimum 1 inch long, Phillips flat countersunk head, sharp pointed, coarse threaded, zinc coated, steel wood screw fasteners in quantity as required for support and fastening of continuous j-molds to plywood substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates.

1. Mirror, drywall and plywood substrates shall be free of dust, be clean, and dry prior to application of mirror mastic and drywall and plywood paint. If plywood or drywall surfaces have been painted prior to application of the specified drywall and plywood paint the existing paint shall be sanded through to the original surface and the substrate cleaned prior to the application of drywall and plywood paint.

3.2 GLAZING

A. General: Install mirrors with mirror glazing channels to comply with written instructions of mirror and mirror glazing channel manufacturers, with referenced GANA and NGA publications, and as specified. Mount mirrors plumb, in line, and in a manner that avoids distorting reflected images.

B. Comply with mastic manufacturer's printed directions for preparation and sealing of mounting surfaces by sealing drywall, and plywood, substrates with drywall and plywood paint. Allow paint to dry before applying mirror mastic.

C. Mirror Channel Installation:

1. To Plywood: Drill, do not dimple, back lip of channel to receive fasteners with holes properly sized and spaced to receive fasteners. Attach mirror channels by screw attaching mirror channel through the back lip of the channel to plywood substrate in accordance with the fastener manufacturer's written instructions. Install the web of the top channel 1/4 inch higher than the height of the mirror to allow the raising of the mirror into the top channel and its subsequent lowering onto the bottom channel. After installing fasteners place masking tape over the entire length of the back lip of the channel completely covering the fastener heads to protect the mirror from being chipped in setting. Adhere setting blocks at quarter points for bottom mirror channels using only 2 setting blocks per mirror panel.
2. To Drywall: Drill and countersink, do not dimple, back lip of channels to receive stud fasteners with holes properly sized and spaced to receive stud fasteners. Attach mirror channels by screw attaching mirror channel through the back lip of the channel through drywall, stud framing, and sheet metal backer plate substrates in accordance with the fastener manufacturer's written instructions.

    a. Install the web of the top channel 1/4 inch higher than the height of the mirror to allow the raising of the mirror into the top channel and its subsequent lowering onto the web of the bottom channel. After installing fasteners place masking tape over the entire length of the back lip of the channel completely covering the fastener heads to protect the mirror from being chipped in setting. Adhere setting blocks to the web of the bottom mirror channels, located at quarter points, using 2 setting blocks per mirror panel.

D. Mirror Installation: Apply mastic in vertical beads or mounds to the wall, not to the mirror back to avoid potential damage caused by mastic applicator tools, in compliance with mastic manufacturer's written instructions to allow air circulation between back of mirrors and face of mounting surface. Each vertical bead shall be approximately 1/2 inch in width with a minimum of one bead for every square foot of mirror. Each mound shall be approximately 1-1/2 inches in diameter with a minimum of one mound for every square foot of mirror. Do not apply mastic within 6 inches of the mirror edges to prevent squeeze out. Place beads or mounds so space will be left between them when the mirror is installed. After mastic is applied, align mirrors and press into place. Each vertical bead shall spread to approximately 2 inches in width and each mound shall spread to a pat approximately 3-1/2 inches in diameter after pressing mirror into place.

3.3 PROTECTION AND CLEANING

A. Protect mirrored glass from breakage and contaminating substances resulting from construction operations. Using clean warm water, clean mirrors by methods recommended in referenced glazing standards.

END OF SECTION 08 83 00

08814/11-99/ttt

SECTION 09 91 23 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and field application of paint systems on the following interior substrates:

1. Gypsum board.
2. Wood and hardboard.
3. Steel

1.2 DEFINITIONS

A. General: The following terms apply to this Section. Gloss level shall be determined according to ASTM D 523.

1. Gloss Level 1(Flat, or Matte): Not more than 5 units at 60 degrees and 10 units at 85 degrees.
2. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees.
3. Gloss Level 3 (Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees.
4. Gloss Level 4 (Satin or Low Luster): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees.
5. Gloss Level 5 (Semigloss): 35 to 70 units at 60 degrees.
6. Gloss Level 6 (Gloss): 70 to 85 units at 60-degrees.
7. Gloss Level 7 (High Gloss): More than 85 units at 60 degrees.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat, with texture to simulate actual conditions.

1. Provide stepped Samples, defining each separate coat, including primers. Use representative colors when preparing Samples for review. Resubmit until required gloss, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.

3. Submit paint samples on hardboard, 12 inches square, of each color and texture required.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 1 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Benjamin Moore Family of Products (Benjamin Moore, Coronado, Corotech, Insl-x, LenMar)
2. PPG Paints (PPG)
3. Sherwin-Williams Co. (SW)

B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers.

2.2 PAINT, GENERAL (PT##)

A. Material Compatibility: Provide materials for use within each paint system that are compatible with one another and with the substrates indicated, under conditions of service and application, as demonstrated by manufacturer based on testing and field experience. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: VOC content of not more than 50 g/LNonflat Paints and Coatings: VOC content of not more than 100 g/L.
2. Dry Fog Coatings: VOC content not more than 150 g/L.
3. Primers, Sealers, and Undercoaters: VOC content not more than 100 g/L.
4. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC content not more than 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: VOC content not more than 340 g/L.
6. Pre-Treatment Wash Primers: VOC content not more than 420 g/L. Floor Coatings: VOC content not more than 100 g/L.

7. Shellacs, Clear: VOC content not more than 730 g/L.
8. Shellacs, Pigmented: VOC content not more than 550 g/L.

C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.

E. Low-Emitting Materials: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

F. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

G. Colors and Gloss: As indicated in Finish Schedule on Drawings. Reference to a particular manufacturer's number or color name is used only as a convenience for the Architect in order to establish the Project color and gloss requirements. These references are not intended to describe the required generic paint systems. For generic paint system requirements, refer to the "Interior Paint Schedule" at the end of Part 3, as applicable to the respective conditions of use.

1. The selection of paint colors and gloss are indicated by manufacturer and color type; designated as "PT##."
2. Furnish the same lots, batches, etc. within the same contiguous areas of the building (i.e., corridors on the same floors, common rooms which adjoin each other, etc.).

2.3 PREPARATORY COATS

A. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

B. Primer Sealer, Latex, Interior:

1. Benjamin Moore; Ultra Spec 500 Interior Latex Primer (N534).
2. PPG; Speedhide Zero Interior Latex Sealer Quick-Drying (6-4900).
3. SW; ProMar 200 Zero VOC Interior Latex Primer (B28W02600).

C. Where manufacturer does not recommend a separate primer formulation on substrate indicated, use paint specified for finish coat.

2.4 WATER-BASED PAINTS

A. Latex, Interior, Gloss Level 1 (Flat):

1. Benjamin Moore; Ultra Spec 500 Interior Flat (N536).
2. PPG; SPEEDHIDE zero Interior Zero-VOC Latex Flat (6-4110XI).
3. SW; ProMar 200 Zero VOC Interior Latex Flat (B30-2600 Series).

B. Latex, Interior, Gloss Level 3 (Eggshell).

1. Benjamin Moore; Ultra Spec 500 Interior Eggshell (N538).
2. PPG; SPEEDHIDE zero Interior Zero-VOC Latex Eggshell (6-4310XI).
3. SW; ProMar 200 Zero Interior VOC Latex Eg-Shel (B20-2600 Series).

C. Latex, Interior, High Performance Architectural, Gloss Level 3 (Eggshell):

1. Benjamin Moore; Corotech PreCatalyzed Waterborne Epoxy Eggshell V342.
2. PPG; Pitt-Glaze WB1 Interior Eggshell Pre-Catalyzed Water-Borne Acrylic Epoxy (16-310).
3. SW; Pro Industrial Pre-Catalyzed Waterbased Epoxy Eg-Shel (K45W1150 Series).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with manufacturer's requirements for paint application. Comply with procedures specified in PDCA P4.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

3.2 PREPARATION

A. Remove hardware and hardware accessories, cover plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible, provide surface-applied protection before surface preparation and painting.

B. Before applying paint or other surface treatments, clean substrates of substances that could impair bond of paints. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified. Provide barrier coats over incompatible primers or remove and reprime.

1. Gypsum Wallboard: Repair all surfaces in gypsum wallboard with wallboard joint finishing compound or spackling compound, filled out flush and sanded smooth. Clean all surfaces and taped joints of dust, dirt and other contaminants and be sure they are thoroughly dry before applying paint.
2. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.
3. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
4. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

    a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
    b. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

D. Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tint each undercoat a lighter shade to facilitate identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the topcoat but provide sufficient difference in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in Finish Schedule on Drawings.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
4. Extend coatings in exposed surfaces, as required, to maintain system integrity and provide desired protection.

    a. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place.

5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

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

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.

a. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
b. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
c. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

2. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

1. .
2. .

3.4 CLEANING

A. At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

C. After completing painting operations in each space or area, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection, if any.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from paint application. Correct damage to work of other trades by cleaning, repairing, or replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 INTERIOR PAINTING SCHEDULE

A. Gypsum Board Substrates:

1. Latex System:

a. Primer: Sealer, latex, interior.
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior (gloss as indicated in Finish Schedule).

B. Steel Substrates:

1. High-Performance Architectural Latex System:

a. Primer: Acrylic.
b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

2. Semigloss Dry Fall Coating:

a. Primer: Interior semigloss dry fall coating.
b. Intermediate Coat: Interior semigloss dry fall coating.

c. Finish Coat: Interior semigloss dry fall coating.

C. Steel (Factory-Primed) Substrates:

1. High-Performance Architectural Latex System:

a. Primer: Acrylic (applied over factory primer).
b. Intermediate Coat: Latex, interior, high performance architectural; matching topcoat.
c. Topcoat: Latex, interior, high performance architectural (gloss as indicated in Finish Schedule).

END OF SECTION 09 91 23

SECTION 10 26 00 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall coverings.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for stainless-steel corner guards.
2. Section 08 71 00 "Door Hardware" for stainless-steel mop, kick, armor, and push plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: Include locations and extent of impact-resistant wall protection and details of installation.

C. Samples: For each unit and for each color and texture required.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full-size units of maximum length, including vinyl plastic cover and aluminum retainer, equal to [**2**] <**Insert number**> percent of each type, color, and texture of each type of unit installed, but no fewer than [**two**] <**Insert number**> units.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide components with flame-spread and smoke-developed indices of not more than 25 and 450, respectively, when tested per ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.2 IMPACT-RESISTANT WALL COVERINGS

A. Semirigid Sheet Wall Covering: Embossed, fiber-backed, impact-resistant plastic sheets, chemical and stain resistant.

1. Basis-of-Design Product: AS indicated on Interior Material Schedule.
2. Sheet Size: 48 by 96 inches .
3. Sheet Thickness: 0.040 inch .
4. Trim: Manufacturer's standard, matching moldings and trim as required for complete installation.

2.3 FINISHES

A. Plastic Color: As selected from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Preparation: Complete finishing operations, including painting, before installing impact-resistant wall protection system components. Before installation, clean substrate to remove dust, debris, and loose particles.

B. Install impact-resistant wall protection system components level, plumb, and true to line without distortions.

1. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

C. Where splices occur in horizontal runs of more than 20 feet , splice aluminum retainers and plastic covers at different locations along the run.

D. Immediately on completion of installation, clean plastic covers and accessories using standard ammonia-based household cleaning agent. Clean metal components according to manufacturer's written instructions.

1. Remove excess adhesive using methods and materials recommended by manufacturer.

END OF SECTION 10 26 00

SECTION 12 36 61 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops and backsplashes.

B. Related Requirements:

1. Section 12 36 40 "Stone Countertops."

1.2 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.
2. One full-size quartz agglomerate countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: Include recommended cleaning materials and procedures, and list of materials detrimental to surfaces.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of simulated stone countertops.

1.6 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace simulated stone countertops that fail in materials or workmanship within specified warranty period.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective simulated stone countertops.
2. Warranty Period: Lifetime, from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOPS (SC##)

A. Configuration: Provide countertops with the following front and backsplash style:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.

B. Countertops: 1.18-inch thick, quartz agglomerate with front edge built up with same material.

C. Backsplashes: 1.18-inch thick, quartz agglomerate.

D. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Backsplashes: Fabricate with loose backsplashes for field assembly.

E. Fabricate countertops in sections if one piece is not possible for joining in field, with joints at locations indicated and as follows:

1. Bonded Joints: 1/32 inch or less in width.

2.2 COUNTERTOP MATERIALS

A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

B. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.

1. Basis of Design: Subject to compliance with requirements, provide product as indicated in Finish Schedule on Drawings or comparable products by one of the following :

a. Caesarstone.
b. Cambria.
c. Cosentino USA.
d. E. I. du Pont de Nemours and Company.
e. LG Chemical, Ltd.
f. Samsung Chemical USA, Inc.
g. Technistone USA, Inc.
h. Transolid, Inc.

2. Colors and Patterns: As indicated by manufacturer's designations in Finish Schedule on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive countertops; remove loose and foreign matter that could interfere with adhesion.

3.2 INSTALLATION

A. Install countertops in accordance with manufacturer's written instructions and approved Shop Drawings.

B. Install countertops level to a tolerance of 1/8 inch in 8 feet , and with a maximum variation in plane between adjacent pieces at joint of plus or minus 1/16 inch.

C. For quartz agglomerate countertops, fasten by applying continuous bead of adhesive along all base cabinet surfaces, or if underlayment is used, apply continuous bead of adhesive along perimeter and around openings. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's recommended written instructions. Carefully dress joints smooth; remove excess adhesive and sealant, and clean entire surface.

1. Bond joints with stone adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

    a. Fill joints with stone adhesive level with quartz surfacing.
    b. Clamp or brace quartz-agglomerate surfacing in position until adhesive sets.

2. Install backsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

3.3 CLEANING

A. Clean countertops in accordance with manufacturer's instructions.

3.4 PROTECTION

A. Protect installed countertops with non-staining covering.

END OF SECTION 12 36 61

SECTION 21 13 00 - FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide a complete fire protection system as indicated on the Drawings and as specified herein consisting of the following but not limited thereto.

1. Wet standpipe system.
2. Wet, dry, deluge and pre-action fire sprinkler systems.
3. Exterior fire protection piping system.
4. Fire hydrants.
5. Fire extinguishers.
6. Fire pump, jockey pump and controllers.
7. Temporary standpipes for construction.

B. It is the intent of this Specification for the Contractor to provide complete hydraulically designed wet and dry pipe sprinkler systems for the areas indicated in these Specifications and shown on the Contract Drawings. This Contractor shall be the Engineer of record for the fire sprinkler system. Furnish all design, material, and labor to complete the contract within the intent of these Specifications and Contract Drawings even though each and every item necessary is not specifically mentioned or shown.

C. The Promenade and Plaza buildings shall be provided with a wet fire protection system.

D. The existing glycol-based Gondola Square fire protection system shall be extended to serve Gold Walk interior areas.

E. The existing glycol-based Gondola Square fire protection system shall be modified and extended to serve interior renovation projects in Building A, Building C, and Building F.

1.2 QUALITY ASSURANCE

A. Contractor Qualifications: Work shall be performed by a Contractor regularly engaged in the design and installation of fire protection systems in accordance with NFPA requirements and having at least three years continuous experience in this type of work. Experience shall include projects of similar type, size and complexity.

B. Design Criteria: Provide fire protection systems of types, pressure, flow and densities required by the prevailing edition of the NFPA 13 and regulatory agencies having jurisdiction.

1. Systems shall be calculated and of configuration acceptable to regulatory agencies.
2. Provide sprinkler head densities per NFPA 13 and as shown on documents.
3. Fire pump shown on the plans is of adequate size to serve the system. Notify engineer prior to bid if this does not appear to be the case. Pressure losses throughout the system shall be within the capacity of the scheduled pump. The contractor may propose, at his option, increased pressure loss due to reduced system pipe sizing resulting in a larger pump. It will be the contractor's responsibility to cover all costs (space requirements, electrical impact, etc.) associated with the increased pump size and horsepower.

C. Pipe sizes shown on drawings may be larger than minimum required. This is to accommodate additional partitioning. Do not reduce sizes.

D. Requirements of Regulatory Agencies: Total system shall be acceptable upon completion and testing in accordance with the requirements of the following:

1. Jurisdictional Code Enforcement Agencies
2. Jurisdictional Insurance Agency or Underwriter
3. Confirm requirements of the authority having jurisdiction and Owner's Insurance Underwriter prior to bid.

E. Certificate of Completion: Submit Certificate of Completion of fire protection work, stating that the work has been completed and tested in accordance with the specified standards, that there are no defects in the system and it is operational.

1.3 CODES AND STANDARDS

A. Comply with local fire department regulations and with the following:

1. Standpipe system

    a. UBC Standard 38-2

2. Local Water Department
3. Local Building Department
4. FM Global
5. Local Health Department
6. Local Public Works
7. Prevailing editions of NFPA 13, 14, 24
8. Local modifications to the Fire Codes
9. UL 218 Standard for Fire Pump Controllers
10. UL 1008 Automatic Transfer Switches
11. UL 508 Industrial Control Equipment

12. NFPA 20 Installation at Centrifugal Fire Pumps
13. NFPA 70 National Electrical Code

B. All materials and equipment used in the installation of the fire protection system shall be as listed in the Underwriters' Laboratories, Fire Protection Equipment Directory or approved in the Factory Mutual Approved Guide and shall be the most current product of the manufacturer, and shall bear their label.

1.4 SUBMITTALS

A. Submittal data shall be in accordance with Division 1 and the following shall be submitted for review to the Architect prior to the start of installation:

1. Material and equipment information shall include catalog cuts and technical data for each system component or device. This shall include, but not be limited to piping, fittings, globe and angle valves, O.S.&Y valves, butterfly valves, check valves, automatic sprinkler heads, escutcheons, hangers, flow switches, tamper switches, alarm valves, trim and required accessories, dry pipe valves, trim and required accessories and air compressor.

B. Prepare shop drawings showing layout of fire protection system. Use minimum scale of 1/8" = 1'-0" for floor plans. Drawings shall coordinate with all building structural features and components and show routing of piping to clear same. Drawings shall be accurately dimensioned to show proposed location of all fire protection system components. System design shall be completely coordinated with the architectural, structural, mechanical, and electrical features of the building. The drawings shall show all details required by NFPA 13 - Sprinkler System, Installation for "Working Drawings". In all areas with suspended ceilings, reflected ceiling plans shall be prepared showing the location of sprinklers, lights, diffusers, grilles, etc.

C. Submit a complete schedule of the material and equipment proposed for this installation to the Architect/Engineer for approval. Include catalog cuts, diagrams, drawings, and such other descriptive data as may be required to clearly show what, where, and how the component is intended to be installed. In the event any items of material or equipment contained in the schedule fail to comply with the specifications, such items may be rejected.

D. Submit plans and hydraulic calculations signed and sealed by the Professional Engineer supervising the design of the fire sprinkler system, and one (1) set of reproducible of the complete shop drawings of the sprinkler system to the regulatory agencies having jurisdiction. After approvals are obtained, submit the drawings and hydraulic calculations to the Architect for review. Written approval of the Architect must be obtained before purchasing or installing any equipment.

E. Approval of submittals will not relieve the Contractor of the responsibility for correcting any errors which may exist or for meeting requirements of the specifications. No partial submittals will be accepted.

F. A set of approved installation drawings shall be kept at the job site and marked to indicate all installation conditions which are different from the approved drawings.

1.5 DESIGN REQUIREMENTS

A. It shall be the Contractor's responsibility to size the sprinkler system pipes in accordance with the requirements of the prevailing edition of NFPA 13. Contractor shall submit all calculations to the Engineer for review at time of drawing submittal. Submittal of these calculations to the Engineer will in no way relieve the Contractor of his responsibilities for complete and proper design of the fire protection system.

B. It shall be the Contractor's responsibility to design the system so that no interferences exist between the fire protection system and work of other trades, equipment and systems designed and installed by others. The latest issues of all architectural, structural, mechanical and electrical drawings will be furnished for reference to assist the Contractor in preparing the design so as to avoid interference.

C. This Contractor shall provide all necessary control wiring and equipment necessary for an operational system. This includes, but not limited to, key switches, releasing panels, solenoid valves, etc.

1.6 WATER SUPPLY

A. The water supply as shown on the drawings will be installed by other divisions of the work, who will provide a flange connection inside the building for the fire protection system. The fire protection Contractor shall make the required connection at this point for the fire protection system. Coordinate with General Contractor prior to bid to show the complete scope of work between civil and the fire protection contractor.

1.7 WARRANTIES

A. The entire new system shall be warranted to be free from defects for a period of one (1) year from the date of Notice of Acceptance.

1.8 PROJECT RECORD DOCUMENTS

A. Upon completion of the work, the Contractor shall revise all fire protection drawings to agree with the construction as actually accomplished and stamp "As-Built". Those drawings where no

change is involved shall be likewise stamped. These “As-Built” drawings shall show the fire protection system as it existed at the completion of the contract work.

B. See Division 1 for additional requirements.

1.9 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the General Conditions of the Contract and Supplementary General Conditions and Division 1 - General Requirements, apply to work of this Section. This Contractor shall comply with all applicable sections of Division 21 through 23.

PART 2 - PRODUCTS

2.1 WET PIPE AND FITTINGS

A. Pipe joints above ground shall be screwed, flanged, welded, roll-grooved with mechanical couplings. Welded joints are not acceptable in pipe less than 2” in diameter. No welding permitted except with certified welders in shop.

B. Piping above ground shall be Schedule 40 black steel pipe. Thin wall schedule 10 pipe may be used when in conformance with NFPA 13 and when approved by the applicable Fire and Building departments.

C. Threaded fittings above ground shall be gray cast iron suitable for 175 psi cold water working pressure and so rated.

D. In lieu of weld, threaded, or flanged connections, mechanical type couplings and fittings as manufactured by Tyco Grinnell Grooved Piping Products and Victaulic or approved equal, may be used in piping above grade.

E. Provide escutcheons on penetrations of interior walls.

F. Below Grade:

1. Ductile iron pressure pipe, tar coated, cement lined:

    a. Pipe: ANSI A21.51, Class 50
    b. Fittings: ANSI 21.10
    c. Rubber gaskets: ANSI 21.11

G. Any piping used shall have a UL Corrosion Ratio (CRR) of 1.00 or greater.

2.2 DRY PIPE AND FITTINGS

A. Pipe joints above ground shall be screwed, flanged, welded, cut-grooved with mechanical couplings. Rolled grooved will not be allowed in dry pipe systems. Welded joints are not acceptable in pipe less than 2" in diameter. No welding permitted except with certified welders in shop.

B. Piping above ground shall be Schedule 40 black steel pipe.

C. All fittings on galvanized piping shall be galvanized in accordance with ASTM A153.

D. Fittings shall be suitable for 175 psi cold water working pressure and so rated.

E. In lieu of weld, threaded, or flanged connections, mechanical type couplings and fittings as manufactured by Tyco Grinnell Cut Grooved Piping Products and Victaulic or approved equal, may be used in piping above grade.

F. Provide escutcheons on penetrations of interior walls.

G. Any piping used shall have a UL Corrosion Ratio (CRR) of 1.00 or greater.

H. Nitrogen Generator with Integral Air Compressor:

1. Basis-of-Design – Subject to compliance with requirements, provide Engineered Corrosion Solutions Nitrogen Generator.
2. The nitrogen generator shall be wall mounted with integral air compressor sized to provide all dry and preaction fire sprinkler systems with supervisory nitrogen gas. Sizing shall be based on the total volume of all fire sprinkler systems being served by the nitrogen generator as determined by hydraulic calculations for each system. Documentation of the calculations and nitrogen generator sizing must be provided with the submittals. Where the quantity of systems, total cumulative volume of systems or physical location of system risers require, multiple nitrogen generators shall be supplied.
3. The nitrogen generator shall be electronically controlled with the capability to adjust system operating pressure settings without the requirement of any additional equipment.
4. The nitrogen generator shall include an integral air compressor sized per the manufacturer's requirements.
5. The integral air compressor shall be oil-less, be rated for continuous duty and have an output pressure rating of 100 psig.
6. The integral air compressor shall be capable of producing a continuous volume of compressed air that is sufficient to fill the largest FPS being supplied by the air compressor to operating pressure within thirty (30) minutes per NFPA 13 requirements and also meet the compressed air requirements of the nitrogen generator it is supplying.
7. The nitrogen generator shall not require a nitrogen storage tank or refrigerated dryer.
8. The nitrogen generator shall be designed to achieve a nitrogen concentration of 98% or greater within fourteen (14) days of start-up and maintain that concentration within all fire protection systems continuously.

9. The nitrogen generator shall have a connection to attach and sample the purity of nitrogen within the FPS. Purity sampling device can be portable or fixed.
10. The nitrogen generator shall be equipped with a filtration system to remove residual water and hydrocarbons (if needed) from the compressed air stream.
11. The nitrogen generator shall be powered by a 120VAC power supply. Coordinate power requirements and location with electrical contractor. The nitrogen generator power supply shall be per NFPA 70 and all local requirements.
12. The nitrogen generator shall be equipped with an internal bypass with bypass alarm to prevent long term oxygen exposure in fire sprinkler system.
13. Coordinate power requirements and location with electrical contractor. The nitrogen generator power supply shall be per NFPA 70 and all local requirements.

    a. Air Maintenance Device:

        1) The fire sprinkler contractor shall furnish and install an approved air maintenance device for each dry or preaction fire sprinkler system.
        2) The air maintenance device shall be equipped with a field adjustable pressure regulator for use in setting the maximum system pressure. Approved air maintenance devices are:

            a) Victaulic Series 757
            b) Tyco Model AMD-1
            c) Reliable Model A-2
            d) Or approved equal

        3) Air maintenance device shall be installed per the manufacturer's instructions.

    b. Integral Air Vent (electric):

        1) The fire sprinkler contractor shall furnish and install an electric integral air vent for each fire sprinkler system that will close automatically once the desired nitrogen concentration has been reached.
        2) The electric integral air vent shall be installed on the fire sprinkler riser at the locations shown on the drawings. Installation of the electric integral air vent outside of the fire sprinkler valve room is not permitted.
        3) The electric integral air vent shall be equipped with a solenoid valve and separate electric control box. The electric integral air vent shall be powered by a 120VAC power supply. Coordinate power requirements and location with electrical contractor.
        4) The electric control box shall be wall mounted and installed adjacent to the integral air vent on the fire sprinkler riser. Coordinate solenoid connection requirements and location with electrical contractor.
        5) The solenoid valve shall be wired to the electric control box per NFPA 70 and all local requirements.

6) The integral air vent shall have an adjustable pressure regulator to prevent accidental depressurization of the fire sprinkler system should a disruption occur to the air/nitrogen supply
7) The electric integral air vent shall have a connection to attach and sample the purity of nitrogen within the FPS. Purity sampling device can be portable or fixed.
8) The piping between FPS and electric integral air vent must not create a water trap; the connecting piping must drain when FPS is drained or the electric automatic air vent will not function properly.
9) A 1/2 in. outlet is required to attach the vent assembly to the FPS.
10) The isolation ball valve of the electric automatic air vent shall be closed during hydrostatic and/or air pressure testing of the FPS and then placed in the open position for the commissioning and operation of the nitrogen generator or cylinders.

2.3 BUTTERFLY VALVES

A. Butterfly valves shall be furnished with worm gear type indicating operator to assure slow closing. Valves shall have a completely sealed shaft, integral flange seals, and hex drive.

2.4 O.S.&Y. VALVES

A. Outside stem and yoke gate valves shall be of the wedge disc type, shall permit straight line flow and complete shut-off, and shall be so designed that the valves can be packed under pressure when wide open. Valve shall be iron body, bronze trim, flanged or screwed ends, with rising stem and rated minimum 175 psi non-shock cold water service.

2.5 CHECK VALVES

A. All swing check valves shall be 175 psi non-shock cold water service, iron body, bronzed trim, horizontal swing with renewable bronze seat and rings. All check valves two (2) inches and smaller shall be bronze, screwed, horizontal swing type. All check valves two and one half (2½) inches and larger shall be flanged or grooved type.

B. All wafer check valves shall be minimum 175 psi working pressure, iron body with spring actuated double bronze plate and rubber seat.

2.6 GLOBE AND ANGLE VALVES

A. Valves shall be furnished with renewable disc, non-shock, and shall back seat in the fully opened position to allow repacking under full pressure without removing the valve from the line. Valve shall be rated for minimum 175 psi working pressure.

2.7 VALVE SUPERVISORY SWITCHES

A. All valves two inches or larger which control water to automatic sprinkler heads shall be equipped with supervisory switches having one normally open contact and one normally closed contact.

2.8 FLOW SWITCHES

A. All flow switches shall be field adjustable vane type with pneumatic retard and 175 psi working pressure. Units shall be suitable for installation by drilling pipe and securing with U-bolt furnished with the switch. Units shall be single pole double throw, suitable for 24Volt D.C. service with one normally open contact and one normally closed contact. Waterflow switches shall be adjusted so that the device will transmit a waterflow alarm within 30 seconds of opening the inspector's test valve on the sprinkler system.

2.9 FIRE HOSE

A. Single jacket rubber lined, one and one half (1½) inch, 100 continuous feet, 100 percent synthetic jacket with dacron filler. Hose shall be totally immune to mildew and rot. NST thread.

2.10 FIRE HOSE NOZZLE

A. One and one half (1½) inch cast brass "ALL FOG" nozzle with rubber bumper for Class A, B, or C fires. No straight stream adjustment. NST thread.

2.11 TAMPER SWITCHES

A. Approved manufacturers are System Sensor, Potter Electric or equal.

B. Switch shall be listed for use on the type of valve to be monitored.

2.12 EXTERIOR ALARM

A. Approved manufacturers are Farr Alarm, Potter Electric, System Sensor.

B. Alarm shall have combination horn and light and be constructed for exterior use.

C. Furnish interior alarms where required by the authority having jurisdiction.

2.13 DRY PIPE VALVE

A. Approved manufacturers are Tyco, Viking, Victaulic and Reliable.

B. Dry pipe valve shall separate system water supply from the air-filled system piping. Valve shall have an external reset, flanged or grooved connections, gasketed hand hole cover, brass to neoprene air seat, brass-to-brass water seat, spring-loaded clapper with full open latch. Provide all accessories consisting of angle valves, globe valves, pipe nipples and fittings, water and air pressure gauges, mechanical or electrical accelerator when required and maintenance air compressor sized in conformance with NFPA 13.

2.14 AUTOMATIC FIRE SPRINKLER HEADS

A. Approved manufacturers are Tyco, Viking, Reliable, Victaulic.

B. Sprinkler heads shall have a temperature rating of 155°F except for heads in areas of high temperature and in close proximity to heat sources which shall be temperature rated in accordance with NFPA 13.

C. Sprinkler heads in ceilings to be concealed pendent.

D. Sprinkler heads in exposed areas shall be upright type, standard brass.

E. Sprinkler heads in dry-pipe systems shall be upright (where exposed) or dry-pendent type (in ceilings).

F. Sprinklers for installation in wall, ceilings, soffits or similar shall include integral escutcheon plates designed for friction or set screw fit. Escutcheon throat shall be minimum ¾" depth.

G. Coordinate exact location, type and color of all sprinkler heads, escutcheons and plates with the Architect.

H. Supply Owner an extra stock of six sprinklers minimum, three of each type, with applicable sprinkler wrenches. Sprinklers shall be packed in a suitable container for wall mounting. Provide additional heads that may be required by NFPA 13.

2.15 FIRE DEPARTMENT CONNECTION

A. Approved manufacturers are Potter-Roemer, or equal.

B. Fire department connection shall be 2-way projecting standpipe inlet with self-closing clapper valves and pin lug swivels and caps with chains equal to Potter-Roemer Series 5720 and Potter-Roemer escutcheon plate Series 5960 with appropriate lettering. Furnish with type of thread as directed by the local fire department and of size shown on the drawings.

2.16 FIRE HOSE VALVE

A. Approved manufacturers are Potter-Roemer, or equal.

B. 2½" Hose valve with 2½" x 1½" reducer with pin lug cap and chain, polished brass finish equal to Potter-Roemer 4065-B.

2.17 FIRE HOSE CABINET

A. Approved manufacturers are Potter-Roemer, or equal.

B. Fire hose cabinet shall be recessed 20-gauge, white, baked enamel steel box, 20-gauge tubular steel door with 18-gauge frame with a continuous steel hinge (brass pin), door and frame finished with a baked-on gray primer coat equal to Potter-Roemer 1500-A.

C. Cabinet shall contain (3½" hose valve with 2½" x 1½" reducer with pin lug cap and chain - Denver) 1½" hose rack assembly with lined hose and fog nozzle equal to Potter-Roemer; 2½" hose valve with pin lug cap and chain equal to Potter-Roemer 4065; 2½ gallon pressurized water portable fire extinguisher with stainless-steel shell equal to Potter-Roemer 3202.

2.18 ROOF MANIFOLD

A. Approved manufacturers are Potter-Roemer, or equal.

B. Cast brass 2-way outlet body equal to Potter-Roemer No. 5840 with No. 4200 gate valves with caps and chains.

C. Control valve shall be non-rising stem Kennedy No.4701 or equal with wall post indicator Kennedy No. 641-13 or floor stand Kennedy No.2945 as required.

2.19 ALARM CHECK VALVES

A. Approved manufacturers are Tyco, Viking, Reliable and Victaulic.

B. Alarm check valve shall provide for the proper functioning of a water motor alarm and/or electric alarm. Valve cover shall allow for replacement of all moving parts without removing the valve from an installed position. Valve shall have flanged or grooved connections. All moving parts shall be brass, bronze or stainless-steel with replaceable neoprene clapper and brass seat. Valve housing shall be tapped to allow installation of alarm accessories, two pressure gauges (one above, and one below the seat) and main drain. Provide all accessories consisting of angle valves, globe valves, orifice restriction, pipe nipples and fittings, retarding chamber, water pressure gauges and circuit closer with two sets of contacts for electric alarms. Valve shall be rated for 175 psi working pressure.

2.20 ALARM DEVICES

A. Equipment necessary to accomplish a transmitted waterflow signal and auxiliary contacts shall be provided. Main shut-off valves shall be electrically supervised. Any tamper-proof switches required for testing the sprinkler system shall be furnished. Alarm devices shall be as manufactured by Potter Electric Signal Company or approved equal.

1. Transmitted Alarm: A transmitted alarm shall be provided for the transmission of waterflow signals to the main fire alarm control panel. Wiring shall be provided in Division 26.

2.21 TEST AND STATUS CONNECTIONS

A. Furnish and install test connection for fire protection system and pipe to appropriate drains.

2.22 MISCELLANEOUS

A. Nameplate data information: The nameplates shall be installed on each main riser and shall include the following design data: building designation, location of remote area, design density, area of application, and system demand (GPM and PSIG at base of riser).

B. Control valve signs: The Contractor shall provide a description sign, minimum dimensions seven (7) inches by nine (9) inches, for every valve in the preaction system which controls water to sprinkler heads. Signs shall be single faced, white letters on a red background, with a space designating who to notify if valve needs to be closed. Signs shall be fastened to each valve with lightweight chain.

C. Miscellaneous signs: These signs for alarm test valves, main drains, auxiliary drains, etc. shall have minimum dimensions of two (2) inches by six (6) inches. Signs shall be single faced, white letters on a red background. Each sign shall be fastened to each valve with lightweight chain.

PART 3 - EXECUTION

3.1 PREPARATION

A. The Contractor shall investigate the conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. The Contractor shall field verify all dimensions and conditions governing his work at the building. Materials shall not be fabricated or delivered to the site before the approved submittals have been received by the Contractor.

3.2 GENERAL INSTALLATION

A. Investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, and accessories as may be required to meet such conditions. The Contractor shall field verify all dimensions and conditions governing his work at the building. Materials shall not be fabricated or delivered to the site before the approved shop drawings and equipment submittals have been received by the Contractor.

B. Entire installation shall be in accordance with approved shop drawings. When unforeseen job site conditions will not permit piping to be installed as shown on the drawings, necessary changes will be made to accomplish a coordinated system without additional cost to the Owner, even though pipe may have been delivered to the site cut to predetermined lengths.

C. Provide gate valves of size and at locations shown on the drawings and any additional valves required by local authorities. Locate all valves where readily accessible. Provide chain wheel operators or permanent ladders for all valves not accessible from the floor. All main line valves shall be electrically monitored or secured with a chain and padlock which will lock the valve in an open position.

D. Provide check valves of size and at location shown on the drawings and any additional check valves that might be required by local authorities.

E. Provide valved test drains as required by NFPA. Pipe test drains to spill on grade whenever possible or to nearest floor drain, or receptor.

F. Make provisions to drain all parts of the piping system.

G. All dry pipe/preaction system piping shall be back pitched (sloped) to drain points. ½" per 10' for branch piping and 1/8" per 10' for mains. Provide auxiliary drains at all low points.

H. The hydraulic calculations shall be performed in accordance with the requirements of NFPA 13 and 14. The Contractor shall calculate the demand point for the system so that it remains ten (10) percent below the final water supply curve at the connection to the public water system. The demand point for the systems shall include an allowance for the inside and outside hose demand. The basis for the hydraulic calculations shall be determined by a waterflow test performed by the Contractor and acceptable to the Authority Having Jurisdiction.

I. Be responsible for trenching, bedding material, removal of waste material, paving removal and replacement, barricades, and any materials necessary for vehicle and person access across work areas.

J. Bedding shall be well graded non-expansive, non-organic soil containing no rocks over one (1) inch in diameter. There shall be no refuse of corrosive materials in this soil.

K. All bedding and backfill shall be laid and compacted in accordance with Section 23 05 03 and Division 2.

L. Drain termination: all express drains.

3.3 PIPING INSTALLATION

A. Perform the work in a professional workmanlike manner, according to the best practices of the trade. All sprinkler piping must be substantially supported from the building structure and only approved type hangers shall be used. Sprinkler piping in all areas shall be concealed unless otherwise noted on the contract drawings. In those noted locations and in areas with no ceiling, piping shall be installed as high as possible using necessary fittings and auxiliary drains to maintain maximum height. Any deviations found necessary shall be immediately brought to the attention of the Architect. All piping discharging outside (main drains, inspectors test pipes) shall do so on paved surfaces or on splash blocks.

B. All inside piping shall be joined by means of threaded, flanged, flexible gasketed joints, or other approved method. Risers, feed mains, cross mains, and branch lines may be shop welded using approved welding fittings. Welding and brazing shall conform to the standards as set forth in NFPA #13. Welding and torch cutting shall not be permitted as a means of installing or repairing sprinkler system piping on-site.

C. Provide expansion compensation loops at all building expansion joints and other areas where thermal and structural movement may require.

D. Chrome-plated escutcheons shall be provided where exposed piping passes through finished floors, walls, partitions, and ceilings. Secure plates to pipe with set screws or spring clips.

E. Refer to section 23 05 53 for pipe labeling requirements. Piping identification will also be subject to the requirements of applicable codes.

3.4 AUTOMATIC FIRE SPRINKLER HEAD INSTALLATION

A. All sprinkler heads shall be in alignment, and parallel to ceiling features, walls, etc. The Contractor shall be responsible for the removal and replacement of ceilings, providing ceiling access panels, cutting, patching and restoration of finishes as necessary.

B. Conform to spacing and dimensional constraints indicated by the Architect on the reflected ceiling plans.

C. Sprinkler heads shall be centered within ceiling grid.

3.5 FIRE STOPS AND PENETRATION SEALS

A. All new piping penetrations through fire rated floors and walls shall be sealed with fire resistant sealant to prevent the spread of smoke, fire, toxic gas, and water through the penetration either before, during or after a fire. The fire rating of the penetration seal shall be at least that of the floor or wall into which it is installed.

B. See Section 23 05 03 for requirements.

3.6 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install check valve and ball drip valve where they will not be subjected to freezing temperatures. The discharge line from the ball drip valve shall be visible.

3.7 FIRE HOSE CABINET INSTALLATION

A. Branch piping to valves must have rigid bracing independent of fire hose cabinet.

3.8 PRESSURE GAUGE INSTALLATION

A. Install pressure gauges at the following locations: street side of check valve; at system side of all control valves. Each gauge connection shall not be less than ¼" and shall be equipped with a shut-off valve and with provision for draining.

B. The required pressure gauges shall be 3" diameter minimum and shall have a maximum limit not less than twice the normal working pressure at the point where installed. They shall be installed to permit removal, and shall be located where they will not be subject to freezing.

3.9 TAMPER SWITCH INSTALLATION

A. Install tamper switches on all control valves.

3.10 FIRE ALARM WIRING

A. All fire alarm and monitor wiring shall be done under the Electrical Division but the proper operation will be the fire protection Contractor's responsibility.

3.11 FLOOR CONTROL VALVE INSTALLATION

A. Floor control valve shall be a complete assembly consisting of an OS&Y valve, grooved butterfly, or pressure control valve, vane type flow switch with retard chamber, inspector's test

and main drain valves. Preassembled UL/FM floor control assemblies equal to Tyco Riser Manifolds are allowed.

B. Pipe discharge from inspector's test and main drain valves through sight glass and orifice to a drain riser.

C. This contractor shall install drain risers to serve floor control valves.

3.12 PIPE TESTING

A. The entire fire protection piping system shall be tested hydrostatically at not less than 200 psi pressure for two hours, or at 50 psi in excess of the maximum static pressure when the maximum static of NFPA pressure is in excess of 150lbs. The hydrostatic test pressure shall be measured at the low point of the individual system or zone being tested. Each complete system (all associated piping and alarms), shall be tested and accepted as a complete unit, with data recorded on an approved "Contractor's Material and Test Certificate". System pressure tests shall be against a blank test flange and not against a valve seat.

B. All tests shall be conducted in the presence of the Architect and Owner. Any system failing to meet the specified test requirements shall be retested at no additional cost, until the test requirements are met.

3.13 FIRE EXTINGUISHERS

A. Install where shown on plans in wall-mounting bracket in accordance with manufacturer's directions.

B. Comply with the requirements of NFPA 10.

3.14 MAINTENANCE AND OPERATIONAL INSTRUCTIONS

A. System description, system theory of operation, and system final inspection and acceptance documents of the completed system (as built) shall be submitted in a bound book as described in Division 1. The maintenance manuals and instructions shall include a brief description of the type of system installed, routine-type maintenance work defined by step-by-step instructions that should be performed to ensure long life and proper operation, and the recommended frequency of performance. The instructions shall also include possible trouble spots with diagnosis and correction of each. The theory of operation brochures shall describe the function of each component or subassembly in block-diagram type presentation to a degree that a craftsman will understand the system well enough to operate and maintain it.

3.15 PROTECTION

A. Protect all apparatus, fixtures, materials, equipment, and installations so as to prevent damage as a result of new work. The Contractor shall replace at his own expense any item, which is marred, defaced, broken, or damaged in any way, prior to the date of Notice of Acceptance.

END OF SECTION 21 13 00

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 05 01 – Mechanical and Electrical Coordination
Section 23 05 02 – Basic Mechanical Requirements
Section 23 05 03 – Basic Mechanical Material and Methods
Section 23 05 13 – Motors and Starters
Section 23 05 21 – Pipe and Pipe Fittings
Section 23 05 22 – Piping Accessories
Section 23 05 23 – Valves
Section 23 05 29 – Pipe Support and Anchors
Section 23 05 30 – Electronic Speed Controllers
Section 23 05 48 – Vibration Control
Section 23 05 53 – Mechanical Identification

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 22 05 00

SECTION 22 05 50 - PLUMBING SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 05 49 – Seismic Restraints

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 22 05 50

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 07 00 – Mechanical Insulation

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 22 07 00

SECTION 22 08 00 - COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 08 00 – Building Mechanical System Commissioning.
Section 23 08 01 – Commissioning Agent Requirements

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 22 08 00

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract and Division 1 Specification Sections (General Requirements), apply to this Section.

1.2 SUBMITTALS

A. Submit manufacturer's data on the following:

1. Pressure reducing valves.
2. Backflow preventers.
3. Water hammer arresters.
4. Piping products, fitting and connection methods.
5. Roof drains, floor drains, floor sinks, cleanouts and area drains.
6. Downspout nozzles.
7. Manhole frames and covers.
8. Backwater valves.
9. Catch-basins and covers.
10. Water meter and meter pit.
11. Trap primers
12. Trap guards
13. Thermostatic mixing valves

B. Submit complete drain down written procedure and drain-down diagrams with the Operation and Maintenance Manuals.

1. Diagrams shall indicate each valve, and its location, used for facility drain down. Diagram shall be based on installed condition.

1.3 STANDARDS

A. Materials shall comply with the following standards.

1. Cast iron pipe:

a. ASTM A-74
b. CISPI 301

c. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF® International.

2. Cast iron pipe fittings:

   a. ASTM A-888
   b. CISPI 301
   c. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute ® and listed by NSF® International.

3. Cast iron pipe joints

   a. Standard Duty Hubless Couplings shall conform to CISPI Standard 310 and be certified by NSF® International.
   b. Heavy Duty Hubless couplings shall conform to ASTM C 1540 and shall be used if indicated.
   c. Gaskets for Service Weight hub & spigot shall conform to ASTM C 564

4. Copper pipe:

   a. Type K, L, M: ASTM B88
   b. DWV: ASTM B306-88

5. Ductile iron pipe: ASTM A377-89
6. All components in contact with potable water shall be listed for compliance to NSF 61 Lead Free requirements.
7. PVC PIPE AND FITTINGS

   a. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
   b. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns

1.4 RELATED WORK

A. Section 23 05 29 Pipe Supports and Anchors.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING AND ACCESSORIES

A. Above Ground Inside Building, Size 4" and Under:

1. Pipe: Copper tube, hard temper, Type L.
2. Fittings: Wrought copper or cast bronze.
3. Solder: 95-5 tin antimony (no lead).
4. Refer to section 230521 for other acceptable joining methods for copper tube 4" and smaller.

B. Above Ground Inside Building, Size 4" and Larger:

1. Stainless-steel pipe, Schedule 40 with any of the following fittings: (Schedule 10 as approved by Owner.)

    a. 125 lb. Stainless flanged, threaded or welded.
    b. Stainless grooved pipe fittings, designed for rolled or cut grooved joint, 275 lb. working pressure.

        1) Manufacturers:

            a) Grinnell
            b) Gruvlok
            c) Victaulic

C. Above Ground Inside Building, (Option for up to 8")

1. Copper tube, hard temper, Type L, with grooved joints/pipe systems designed for potable water.

D. Below Ground Inside Building, Size 2" and Under:

1. Pipe: Copper tube, annealed, Type K.
2. Fittings: Wrought copper, brazed.

E. Below Ground Outside Building, 2 ½" and Over:

1. Ductile pressure pipe, tar coated, cement lined:

    a. Pipe: ANSI A21.51, Class 50.
    b. Fittings: ANSI 21.10.
    c. Rubber Gaskets: ANSI 21.11.

F. Use approved fittings for connections between dissimilar pipe systems.

2.2 DOMESTIC WATER PRESSURE REDUCING VALVE

A. Manufacturer:

1. Design Basis: Watts Model LF223S (1/2" through 2-1/2")
2. Other Acceptable Manufacturers:

    a. Beeco
    b. Febco
    c. Wilkins

3. Construction:

    a. Seal: Renewable, stainless steel.
    b. Strainer: Stainless steel.
    c. Diaphragm: High temperature resistant.
    d. Must comply with NSF 61 and NSF/ANSI 372

2.3 BACKFLOW PREVENTER, (REDUCED PRESSURE ZONE TYPE) (FOOD SERVICE OTHER THAN CARBONATORS AND COFFEE MAKERS)

A. Manufacturer:

1. Design Basis: Watts No.SS009QT Series
2. Construction: Stainless-steel trim and body, complete with test cocks, resilient seat, shut-off valves, and air gap fitting.
3. Other Acceptable Manufacturers:

    a. Beeco
    b. Febco
    c. Wilkins

4. Complies with ASSE STD 1013
5. Must comply with NSF 61 and NSF/ANSI 372.

2.4 BACKFLOW PREVENTER, (DUAL CHECK WITH ATMOSPHERIC PORT) (FOOD SERVICE CARBONATORS AND COFFEE MAKERS)

A. Manufacturer:

1. Design Basis: Watts No.SD-3
2. Construction: 316 Stainless-steel trim and body, NSF approved

3. Other Acceptable Manufacturers:

    a. Febco
    b. Wilkins

4. Extend vent to floor sink/drain
5. Complies with ASSE 1022
6. Must comply with NSF 61 and NSF/ANSI 372

2.5 BACKFLOW PREVENTER, (REDUCED PRESSURE ZONE TYPE) (DOMESTIC WATER SERVICE)

A. Manufacturer:

1. Design Basis: Watts No. LF909, (1/2" through 10")
2. Construction: Bronze body, stainless-steel trim, complete with test cocks, resilient seat, shut-off valves, and air gap fitting. Provide with strainer.
3. Other Acceptable Manufacturers:

    a. Febco
    b. Wilkins

4. Complies with ASSE STD 1013.
5. Must comply with NSF 61 and NSF/ANSI 372.

2.6 BACKFLOW PREVENTER (DOUBLE CHECK) (FIRE PROTECTION SERVICE)

A. Manufacturer:

1. Design Basis: Watts No. 709 (2-1/2" through 10")
2. Construction: Epoxy coated cast iron body, replaceable bronze seats.
3. Other Acceptable Manufacturers:

    a. Beeco
    b. Febco
    c. Wilkins

4. Complies with ASSE STD 1015.

2.7 BACKFLOW PREVENTER (ATMOSPHERIC VACUUM BREAKER)

A. Manufacturer:

1. Design Basis: Watts No. LF008 Series (3/8" through 1")
2. Construction: Bronze body, ball valve shut offs.
3. Other Acceptable Manufacturers:

    a. Febco
    b. Wilkins

4. Complies with ASSE STD 1020.
5. Must comply with NSF 61 and NSF/ANSI 372.

2.8 WATER HAMMER ARRESTER (SHOCK ABSORBERS)

A. Manufacturers:

1. Design Basis: Zurn Shoktrol Z-1700
2. Construction: Stainless Steel, Bellows
3. Other Acceptable Manufacturers:

    a. J.R. Smith
    b. Josam
    c. PPP, inc
    d. Sioux Chief

4. Standards: PDI WH201, ASSE STD 1010.
5. Must comply with NSF 61 and NSF/ANSI 372.

2.9 TRAP PRIMERS (TP)

A. Manufacturers:

1. Design basis: PPP as noted in Plumbing Fixture Schedule.
2. Construction: Corrosion resistant brass. "O" rings shall have a flexibility range of -40°F to 450°F.
3. Provide distribution units for connector points as shown on plans.
4. Complies with ASSE STD 1018.
5. Must comply with NSF 61 and NSF/ANSI 372.

2.10 TRAP GUARDS (TG)

A. Manufacturers:

1. Design basis: ProSet Trap Guard
2. Construction: A flexible tube made of elastomeric material that is treated to roll up when water is passing through drain.
3. Install in floor drains and floor sinks from 2” up to and including 4” as shown on plans indicated with a (TG) behind drain designation.
4. Larger sizes can be custom made by ProSet upon request.
5. Use of trap guards as approved by local authority.

2.11 WATER METER

A. Meter shall be located in pit exterior to building.

B. Meter and pit shall be furnished and installed under civil division. Piping shall be extended to within 5’0” of building by site utility contractor. Mechanical contractor shall verify and coordinate location and elevation of connection point.

2.12 SANITARY AND VENT PIPING (WITHIN BUILDING)

A. Above Ground:

1. Cast iron hub and spigot, neoprene gasket.
2. Cast iron no hub, neoprene gasket and stainless-steel sleeve joint.
3. DWV copper with DWV fittings, solder joint.
4. PVC schedule - 40 solid core (As approved by local building department and Owner).

    a. No PVC allowed in exposed areas due to acoustics.

B. Exposed in finished spaces:

1. DWV copper with DWV fittings.

C. Underground:

1. Cast iron hub and spigot, neoprene gasket.
2. PVC schedule 40 - solid core (approved by local building department and Owner).

2.13 HEAVY DUTY NO HUB COUPLINGS

A. Heavy Duty Couplings shall conform to ASTM C1540.

B. Use on the following:

1. Sanitary vent piping 4” and larger.
2. Sanitary piping 3” and larger.
3. All storm piping.

C. 1-1/2”, 2”, 3” and 4”: 3” wide 304 stainless-steel shield; (4) minimum stainless-steel clamps; fixed and “floating” eyelet.

D. 5” and over: 4” wide 304 stainless-steel shield, with six (6) stainless-steel clamps mounted in series.

E. Torque to minimum 80-inch pounds or per manufacturer’s recommendation.

F. Acceptable manufacturers: Husky Series 4000, Mission Heavy Weight and Charlotte Pipe.

2.14 STANDARD DUTY COUPLINGS

A. Standard duty couplings shall conform to CISPI 310-85: 0.008” thick corrugated stainless steel.

B. Use of the following:

1. Sanitary vent piping up to and including 3” piping.
2. Sanitary piping up to and including 2” piping.

C. Torque to inch pounds per manufacturer’s recommendation.

D. Acceptable manufacturers: Tyler, Mission, AB&I, Clamp All, Huskey and Charlotte Pipe.

2.15 PUMPED SANITARY PIPING (ABOVE AND BELOW GRADE)

A. DWV copper with DWV fittings, solder joint.

B. 125 lb. galvanized steel, threaded.

C. Galvanized malleable or ductile iron grooved pipe fittings, designed for cut grooved joint.

D. Hub and spigot or no hub couplings are not allowed.

2.16 SOIL AND VENT PIPING PRODUCTS

A. Use approved fittings for connections between dissimilar pipe systems.

1. For transitions above slab, couplings shall conform to ASTM C1460
2. For transitions below slab, couplings shall conform to ASTM C1173

B. Manufacturers:

1. Acceptable Manufacturers:

a. J.R. Smith
b. Jones Spec
c. Josam
d. Wade
e. Watts Ancon
f. Zurn

C. Cleanout Plugs:

1. Material: Cast bronze or brass.
2. Type: Countersunk.
3. Threads: ANSI B2.1.

D. Wall Cleanout Covers:

1. Type: Frameless, round, low profile plate.
2. Material: Stainless steel or chrome plated brass.
3. Attachment: Single exposed flush screw.
4. Finish:

a. Non-painted surfaces: Bright polished.
b. Surfaces to be painted: Prime coat.

E. Floor Cleanouts:

1. Body: Standard round Duco cast iron.
2. Attachment: Bronze screws.
3. Sleeve: Full thickness of floor slab.
4. Top:

a. Shape:

1) Where floor covering has rectangular pattern: Square.
2) Other areas: Round.

5. Cover:

    a. For Vinyl Tile and Similar Floor Coverings: Recessed to receive inset of floor material.
    b. For carpeted floor covering provide carpet cleanout marker.
    c. Other areas: Nickel bronze scoriated finish.

6. Provide heavy duty floor cleanouts for all areas accessible by vehicles or forklift traffic.

F. Exterior Cleanouts to Grade:

1. Material: Duco cast iron.
2. Ferrule: Caulk type.
3. Plug: Cast bronze countersunk type.

G. Vandal-Proof Caps

1. Material: Duco cast iron.
2. Attachment: Recessed Allen set screw.

H. Backwater Valve:

1. Material: Duco cast iron.
2. Valve: Bronze.
3. Provide cleanout cover.

    a. Locate in accessible manhole.

2.17 SANITARY SEWER PIPING (BELOW GRADE-EXTERIOR TO BUILDING)

A. Match material and methods specified in Division 2 for sitework sanitary sewer system or as listed below.

B. Use approved fittings for connections between dissimilar pipe systems.

C. Plastic Pipe:

1. Acceptable Manufacturers:

    a. Carlon
    b. Johns-Manville
    c. Robintech

2. Material: PVC ASTM D3034
3. Strength: SDR35

2.18 MAN-HOLES

A. Concrete Base:

1. Construction: Poured in place.
2. Material: 3000 lb. concrete.

B. Man-Holes

1. Construction: Pre-cast or poured in place.
2. Material: ASTM C478

C. Frames and Covers:

1. Material: Grey cast iron, ASTM A48 Class 30B
2. Meets or exceeds FS RR-F-621.
3. Legend: Cast in “Sanitary” or “Storm” as required.
4. Steps: Grey cast iron, ASTM A48 Class 30B.

D. Type:

1. Rated for H-20 (Heavy Truck) wheel loading.
2. Neenah R-6099 or equivalent.

    a. 48” clear opening or as required by application. Coordinate any alternate size with Architect/Engineer.

2.19 STORM WATER PIPING (INSIDE BUILDING)

A. Above Ground:

1. Cast iron, hub and spigot, neoprene gasket joints.
2. Cast iron no hub, neoprene gasket and stainless-steel clamps.
3. Schedule 40 galvanized steel with screwed or grooved mechanical fittings. (Optional: Welded joints)
4. Schedule 40 PVC – solid core (As approved by local building department and Owner).

    a. No PVC allowed in exposed areas due to acoustics.

B. Underground:

1. Cast iron hub and spigot, neoprene gasket.
2. PVC schedule 40 - solid core (approved by local building department and Owner).

2.20 STORM WATER PIPING (BELOW GROUND-EXTERIOR TO BUILDING)

A. Match material and methods specified in Division 2 for sitework storm sewer system or as listed below.

B. Match materials and methods specified for soil and vent piping above.

C. Use approved fittings for connections between dissimilar pipe systems.

2.21 STORM DRAINAGE PRODUCTS

A. Acceptable Manufacturers:

1. J.R. Smith
2. Jones Spec
3. Josam
4. Wade
5. Watts Ancon
6. Zurn

B. Roof Drain: (RD)

1. Material: Cast Iron
2. Dome: Cast Iron
3. Include:

    a. Combined flashing collar and gravel stop.
    b. Extension for insulation.
    c. Under-deck clamp.
    d. Sump receiver.
    e. Expansion joint.

C. Overflow Roof Drain: (OD)

1. Same as Roof Drain Type 1 except:

    a. Provide water dam. Top of water dam shall be 2” above low point of roof or per local code if different.

D. Downspout Nozzle: (DSN)

1. Material: Cast bronze body and flange.

2.22 SAND AND OIL INTERCEPTOR

A. Materials:

1. Pre-formed or cast concrete.

B. Capacity: See plans.

C. Design:

1. Comply with local authority having jurisdiction.
2. Two compartment.
3. Two access manholes with ladders and manhole covers. Covers to be cast with “Sewer”.
4. Design to be H20 loading in all traffic areas
5. See detail shown on plans for general requirements.

2.23 GREASE INTERCEPTOR

A. Materials:

1. Pre-formed or cast concrete.

B. Capacity: See plans.

C. Design:

1. Comply with local authority having jurisdiction.
2. Two compartment.
3. Two access manholes with ladders and manhole covers. Covers to be cast with “Sewer”.
4. Design to be H20 loading in all traffic areas
5. See detail shown on plans for general requirements.

2.24 GREASE AND OIL TRAPS (INDIVIDUAL FIXTURE) (MANUAL)

A. Acceptable manufacturers:

1. J.R. Smith
2. Josam
3. Wade
4. Zurn

B. Construction: Fabricated steel with acid resistant coating inside and outside.

C. Capacity as noted on drawings. Manual type.

D. Accessories: Flow control fitting, removable baffles, threaded inlet and buffet, extension collar as required, internal air relief, double wall trap without cleanout and gasketed scoriated cover.

E. Approval Standard: Plumbing and Drainage Institute (PDI) approval.

2.25 GREASE TRAPS (INDIVIDUAL FIXTURE) (AUTOMATIC)

A. Furnish and install Thermaco Big Dipper Model No. W-350-IS, bright finish type 304 stainless-steel exterior, rotationally molded polyethylene interior automatic self-cleaning grease and oil recovery separator(s) for floor-mounted or partially recessed installation, rated at 35 gallons per minute (2.21 l/s) peak flow, 70 pounds (31.8 Kg) of grease capacity and including as an integral part of the unit, 1 rotating gear hydrophobic wheel assembly for automatic grease/oil removal, an integral flow control device, self-regulating enclosed electric immersion heater, a vessel vent, an integral gas trap, a digital control for programmable operation, a field reversible motor location, a field reversible grease/oil sump outlet, quick release stainless-steel lid clamps, a gasketed and fully removable 304 stainless-steel lid, a lift-out strainer basket access, an internal stainless-steel strainer basket for collection of course solids, and a separate grease and oils collection container. Electric assembly shall be tested to comply with pertinent sections of the Standards for Safety ANSI/UL 73 and/or ANSI/UL 1004. Electric motor equipped with overload protection. Two (2) no-hub connectors for plumbing connection provided.

2.26 SEDIMENT INTERCEPTORS

A. Acceptable Manufacturers

1. Park Environmental “Trash Trooper”

2.27 THERMOSTATIC MIXING VALVES

A. Master Type - ASSE 1017 Devices

B. Individual or Group - ASSE 1070 Devices

PART 3 - EXECUTION

3.1 GENERAL

A. Testing: Test in accordance with the applicable Plumbing Code.

B. Connections to Equipment Furnished Under Other Sections:

1. Make final connections to all equipment shown on drawings as connected to supply and/or drain piping.
2. Furnish all devices necessary for final connection, including:

    a. Tail pieces
    b. Stops
    c. Supplies

C. Corrosion Protection:

1. Provide isolation between concrete or mortar and any copper pipe.
2. All below grade piping shall be adequately protected from corrosion.

D. Comply with Section 23 05 29 Pipe Supports and Anchors for pipe support requirements.

3.2 INSTALLATION OF DOMESTIC WATER PIPING AND PRODUCTS

A. Install all horizontal water piping level and parallel to building construction (except piping noted to be drained down slope toward drain at 1/8” /ft. min.). Make any changes in direction with fittings, don’t kink or bend. All vertical piping to be plumb. Provide dielectric isolation between uninsulated pipe and hangers. Provide plastic grommets when going through metal studs. Tape is not acceptable for dielectric isolation.

B. Backflow Preventer:

1. Provide backflow preventer requirements as follows:

    a. Reduced pressure at make-up for hydronic systems.
    b. Vacuum breaker at all hose bibbs.
    c. Reduced pressure on water entry.
    d. Reduced pressure on irrigation systems.
    e. Stainless steel reduced pressure on water lines to carbonated beverage dispensers and ice makers.

C. Water Hammer Arrestors:

1. Provide water hammer arrestors in the piping systems and adjacent to all pieces of equipment wherein quick-closing vales are installed.
2. Water hammer arrestors shall be properly sized and selected per PDI Standard WH 201 and having sufficient displacement volume to dissipate the calculated kinetic energy generated by the piping system. Install all units in a vertical position.
3. Provide access panels.
4. Install water hammer arrestors as close as possible to inlet side of quick closure valves and devices.
5. Install water hammer arrestors in upright position on inlet side of solenoid valve.
6. Do not install water hammer arrestors at greater than 90-degree angle from vertical position.
7. Water hammer arrestors extended to above ceiling are not acceptable.

D. Disinfection:

1. After installation of all fixtures served, fill all domestic water lines with a chlorine-water solution of 50 parts per million minimum.
2. Hold solution in pipe for at least 24 hours.
3. Open and close all valves 3 times during chlorination.
4. Waste chlorine solution from each outlet.
5. Measure solution at end. If not 10 ppm, repeat.

E. Meters:

1. Install water meter in accordance with Water Supplier’s standard.

F. Pressure Reducing Valves: Install pressure gauges upstream and downstream of all pressure reducing valves.

3.3 INSTALLATION OF SANITARY AND VENT PIPING

A. Couplings: See Part 2 for use of standard and heavy-duty couplings.

B. Gaskets: Install gaskets in accordance with manufacturer’s recommendations for the use of lubricants, cements, and other special installation requirements.

1. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.
2. All no-hub couplings and fittings to be restrained from movement in accordance with CISPI Standard 310.
3. Make all cast iron joints as detailed in the Cast Iron Soil Pipe Institute’s Handbook

C. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings as detailed in Part 2.14.A.

D. All buried thermoplastic piping shall be installed in strict conformance of ASTM D2321.

E. Do NOT use compressed air or gases to test Drain, Waste, and Vent Systems or Storm Systems

F. Cleaning Piping:

1. Clear the interior of pipe of dirt and other superfluous material as the work progresses.
2. Place plugs in the end of uncompleted pipe at the end of the day or whenever work stops.

G. Test Plugs:

1. Provide test plugs in floor drains and roof drains at the time of installation.
2. Leave test plugs in place for the duration of construction until sewer or drainage system is complete.

H. Vent Flashing:

1. Provide 4 lb. sheet lead (24" x 24" minimum).
2. Extend lead 5" above the vent and turned down into vent pipe.
3. Refer to Section 7600 for single ply roof system components.

I. Vent Location: Do not install vents within 2 ft. of roof edge, parapet, wall line, or an "on-the-roof structure" and within 10 ft. of any air intake.

J. Cleanouts:

1. Provide cleanouts as required by code.
2. Provide cleanouts for end runs of all water closet, urinal and lavatory batteries.
3. Final locations of cleanouts to be approved by the Architect for all finish spaces.

K. Grease, and Sand/Oil Interceptors and Traps:

1. Provide solid unexcavated earth or concrete support under interceptors.
2. Do not support interior traps from floor extension.
3. Vents from these interceptors shall extend separately to the outdoors.

3.4 INSTALLATION OF STORM DRAINAGE PIPING (ABOVE GROUND WITHIN BUILDING)

A. Couplings:

1. Utilize heavy duty, 8 psi, no-hub couplings for cast iron. No-hub may only be used on piping within 20' below the roof. This limitation is to prevent a failure of the no-hub

couplings in the event of a downstream system blockage. In lieu of this restriction adequate relief or coupling restraints per 3.4.A.3, must be provided and approved by the engineer.
2. Threaded or mechanical couplings with galvanized piping are acceptable for all locations.
3. All no-hub couplings and fittings to be restrained from movement in accordance with CISPI Standard 310.

B. Gaskets: Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special installation requirements.

C. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.

D. Cleaning Piping:

1. Clear the interior of pipe of dirt and other superfluous material as the work progresses.
2. Place plugs in the end of uncompleted pipe at the end of uncompleted pipe at the end of the day or whenever work stops.

E. Test Plugs:

1. Provide test plugs in floor drains and roof drains at the time of installation.
2. Leave test plugs in place for the duration of construction.

F. Roof Drains:

1. Install drains on the center line of sheet lead pan.
2. Clamp flashing into drain flashing collar.
3. Install domes immediately after completion of roof installation.

G. Expansion:

1. Provide a vertical expansion joint at each connection to roof drain unless an offset is provided.
2. Where piping crosses building expansion joints, provide swing or expansion joints to allow for building movement.

H. Downspout Nozzles: Install with flange secured to wall at base of concealed storm leaders that discharge through the building wall above grade.

I. Provide sway bracing and anchorage of piping as required by local code. At a minimum provide sway bracing at changes of direction greater than 45 degrees for pipes 4" or larger.

3.5 INSTALLATION OF SANITARY SEWER AND STORM WATER PIPING (EXTERIOR TO BUILDING)

A. Couplings: See Part 2 for use of couplings.

B. Lay piping true to the grades and alignment indicated with unbroken continuity of invert.

C. Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements and other special installation requirements.

D. Install plastic pipe in accordance with pipe manufacturer's written instructions.

E. Install cast iron hub and spigot pipe under roads and paved areas.

F. Clear the interior of piping of dirt and other superfluous material as the work progresses. Maintain a swab or drag in the line and pull past each joint as it is completed.

G. Place plugs in the end of uncompleted conduit at the end of the day or whenever work stops.

H. Flush lines if required to remove collected debris.

I. Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.

J. Grout joints between cast iron pipe and concrete pipes thoroughly with cement mortar to make watertight joint.

K. Inspect conduit to determine whether line displacement or other damage has occurred.

1. Make inspection after lines between manholes, or manhole locations, have been installed and approximately 2 ft. of backfill is in place and at completion of the project.

L. If the inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, take whatever steps are necessary to correct such defects to the satisfaction of the Architect/Engineer.

M. Set grade cleanouts located in unpaved and asphalt paved areas in 12" x 12" x 4" concrete pad.

1. Provide concrete pad.

3.6 MANHOLES

A. Precast Concrete Manholes:

1. Place precast concrete sections as shown on the drawings.
2. Where manholes occur in pavements, set tops of frames and covers flush with finish surface.
3. Elsewhere, set tops 3” above finish surface unless otherwise indicated.

B. Provide rubber joint gasket complying with ASTM C443.

C. Apply bituminous mastic coating at joints of sections.

3.7 TRAP PRIMERS

A. Install all trap primers and required distribution units as shown on plans and as required by manufacturers recommendations.

3.8 TRAP GUARDS

A. Install elastomeric trap guards in specified floor and sink drains as indicated on plans.

END OF SECTION 22 10 00

SECTION 22 21 23 - NATURAL GAS SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and Install:

1. Natural gas piping.
2. Valves and specialties.

B. Gas Meter: The gas meter and piping upstream of meter will be provided by the Gas Utility Company and paid for by this Contractor.

1.2 SUBMITTALS

A. Manufacturer's Product Data: Submit for:

1. Gas cocks.
2. Gas meter.
3. Emergency shut-off valves and relays.
4. Pressure reducing valves.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING

A. Above Ground:

1. Two Inch and Smaller:

   a. Pipe: Schedule 40 black steel.
   b. Fittings: 150 lb. malleable iron, threaded.

2. Over Two Inch:

   a. Pipe: Schedule 40 black steel, plain end.
   b. Fittings: Standard weight, butt weld.

3. All piping within return air plenums or concealed (inaccessible) in building construction shall be as called for piping over 2".

B. Underground:

1. Pipe: Schedule 40 black steel, ASTM A53, Grade B, seamless, plain end.
2. Fittings: Standard weight, steel.

    a. Two Inches and Smaller: Socket weld.
    b. Over Two Inch: Butt weld.

3. Coating:

    a. Pipe: AAPCA TGF-3.
    b. Fittings: Protecto Wrap No. 200.

        1) Primer: No. 1170

2.2 GAS COCKS

A. Description: Corrosion-resistant plug, permanently lubricated, corrosion-resistant bearings, suitable seals for intended service, lever operator.

2.3 PRESSURE REGULATING VALVES

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 (DN 50) and smaller; flanged for regulators NPS 2-1/2 (DN 65) and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Actaris.
    b. American Meter Company.
    c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    d. Invensys.
    e. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 100 psig (690 kPa).

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Actaris.
    b. American Meter Company.
    c. Eclipse Combustion, Inc.
    d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
    e. Invensys.
    f. Maxitrol Company.
    g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 2 psig (13.8 kPa).

2.4 EMERGENCY GAS VALVES AND CONTROL STATIONS

A. Control Station: ASCO No. 108D906, key operated to open switch, pushbutton to close with pilot light.

1. Stainless-steel face plate for flush mounting.
2. "GAS VALVE CONTROL" to be inscribed on the plate.
3. Key switch labeled "ON".
4. Pushbutton labeled "OFF".

B. Valve: ASCO No. 8215, 2-way solenoid, 110-Volt, 60 Hz, AC.

1. Normally closed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Remove cutting and threading burrs before assembling piping.

B. Do not install defective piping or fittings.

C. Do not use pipe with threads which are chipped, stripped or damaged.

D. Use Teflon tape on male pipe threads.

E. Plug each gas outlet, including valves with a threaded plug or cap, immediately after installation, and retain until continuing piping or equipment connection is completed.

F. Do not install any valves or unions inside concealed areas or above ceiling in building.

G. Vent gas PRVs outside the building in accordance with local code.

H. Paint all exposed gas pipe with a minimum of 2 coats on rust resistant pipe.

3.2 BURIED PIPE

A. Coated Pipe: Follow IAPMO Standard IS 13-84.

B. Buried piping shall be buried 24" minimum.

1. All buried joints shall be welded and left exposed until testing has been completed.

3.3 EMERGENCY SHUT-OFFS

A. Install emergency shut-off valves where shown.

B. Deliver switches and relays to Installer of electrical work.

3.4 TEST

A. Prior to initial operation, test and purge fuel gas piping in accordance with local code requirements or the National Fuel Gas Code.

1. Test at 65 psig minimum.
2. Repair or replace piping as required to eliminate leaks, and re-test.

END OF SECTION 22 21 23

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data for the following:

1. Domestic water heaters.
2. Domestic hot water storage tanks.
3. Pumps.
4. Sump Basins.
5. Startup report for gas fired heaters.
6. Warranty and service policies.

1.2 WARRANTY

A. Water Heater and Storage Tank:

1. Furnish a certificate of warranty outlining all specifics of heater manufacturer's warranty.
2. The warranty shall be a minimum of 5 years for all water heater products.
3. The heater shall have a first year service policy including labor, troubleshooting, and parts, all to be serviced by the manufacturer's representative.
4. Initiation and/or continuation of warranty coverage shall not be dependent upon annual inspections, regular replacement of anode rods, water chemistry, or rust.
5. Complete copies of all warranties and service policies, including all exclusions and conditions, shall be presented to the owner as part of the submittal package.

B. Burner and Heat Exchanger: The burner and all heater parts will have a one-year warranty. Heat exchanger and combustion chamber will have a 15-year warranty covering manufacturing or material defects, leaks, and/or the production of rusty water.

C. Storage Tanks:

1. Storage tanks shall have a 25-year warranty covering manufacturing or material defects, leaks, and/or the production of rusty water.

1.3 QUALITY ASSURANCE

A. The water heater will operate at a minimum thermal efficiency as scheduled when tested by an independent laboratory to ANSI Z21.10.3 (DOW 10 CFR 431). The water heater will comply with the current ASHRAE 90.1 requirements.

B. The water heater will be constructed and stamped in accordance with Section IV, Part HLW of the ASME code and be National Board listed.

C. All water heaters used in food service applications shall be NSF approved.

D. Gas water heaters shall be compliant with ANSI Z.21.10.3 or UL 795.

E. Water heaters shall be U.L, ETL or CSA certified as a complete unit.

F. All components in contact with potable water shall comply with NSF standards.

PART 2 - PRODUCTS

2.1 GAS FIRED WITH INTEGRAL STORAGE TANK

A. Manufacturers:

1. Acceptable Manufacturers:

    a. A.O. Smith
    b. Bradford White
    c. Hubbell
    d. PVI Industries, LLC
    e. Ruud-Rheem
    f. State

B. Construction:

1. Water heaters will be of the BTU input(s) and storage capacity indicated on the equipment schedule.
2. The water heater will be a vertical fire tube, design that is constructed and stamped in accordance with Section IV, Part HLW of the ASME code. Water heater will be National Board Registered for a working pressure of 150 psi and will be pressure tested at 1-1/2 times working pressure.
3. Water heater will be a down-fired, fire tube design contained within an integral storage tank.
4. Tank, combustion chamber and fire tubes will be unlined. Lined or plated water heaters will NOT be acceptable.
5. Tank, combustion chamber and fire tubes will be constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923Methods A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected shall be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2 and ASTM G123 - 00(2005) “Standard

Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution."

6. Tank will be welded utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.
7. All internal and external tank surfaces shall undergo full immersion passivation and pickling processing to meet critical temperature, duration and chemical concentration controls required to complete corrosion resistance restoration of pressure vessel surfaces. Other passivation and pickling methods are not accepted. Immersion passivation and pickling certification documents are required and shall be provided with each product.
8. Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials shall contain more than 80% post-consumer recycled materials and be 100% recyclable.
9. All water contacting tank surfaces will be non-porous and exhibit 0% water absorption.
10. All tank connections/fittings will be non-ferrous or stainless steel.
11. To preserve thermal efficiency, the water heater will not use or require a circulator piped from the hot water outlet to the cold-water inlet of the heater for the purpose of temperature control during normal operation. Connection for a building return circulation line will be made to a dedicated hot return fitting at the center of the storage vessel and not the cold inlet piping. Connection to a sidearm tank, if used, will be made to a dedicated hot return fitting at the center of the storage vessel and not the cold inlet piping.
12. Finished vessel will NOT require sacrificial or impressed current anodes and none will be used. Water heaters or sidearm storage tanks that employ anode rods of any type will NOT be acceptable.
13. Combustion will be provided by a premix, fan-assisted surface burner with a gas train meeting UL, ANSI and FM standards for the input specified.
14. Burner will be stainless steel.
15. Gas train components will be capable of self-proportionating gas and air to maintain optimum combustion in response to varying vent pressures.
16. At 199,000 to 399,000 BTU input, the burner will be fixed input.
17. At 500,000 BTU input and higher, the burner will employ non-linkage modulation utilizing only a VFD drive to vary gas and air.
18. Burner NOx emissions will be less than 20 ppm when corrected to 3% oxygen.
19. Water heater will be a category IV, condensing appliance and vent through PVC or Polypropylene. Water heater will satisfy requirements for sealed combustion. Vents for inlet air and exhaust can terminate in different pressure zones.

2.2 PERFORMANCE

A. Water heater will meet the thermal efficiency and standby heat loss requirements of the latest version of the ASHRAE 90.1 standard.

B. Water heater will be certified by the DOE/EPA Energy Star program for commercial water heaters, whereby standby loss and thermal efficiency are independently tested and certified.

C. Water heater will be third party tested and certified to NSF 5.

D. Water heaters will be third party tested and certified to NSF/ANSI 372 standard for lead content.

2.3 WATER HEATER TRIM

A. As a minimum, the heater will be equipped with the following:

1. electronic flame monitoring
2. electronic low water cutoff
3. an immersion operating control
4. an immersion UL listed temperature limiting device
5. an ASME- rated temperature and pressure relief valve

B. Operating and safety controls shall meet the requirements of UL 795 and FM

C. The water heater shall employ an electronic operating control with digital temperature readout. Operator shall be capable of connecting to a building automation system through serial connection using Modbus RTU protocol.

2.4 ELECTRIC WATER HEATER (LIGHT DUTY)

A. Manufacturers:

1. Acceptable manufacturers:

a. A.O. Smith
b. Bradford White
c. Rheem
d. Rudd
e. State

B. General:

1. Water heater to be light commercial grade complying with standby loss requirements of the U.S. Department of Energy and current edition of ASHRAE/IESNA 90.1.Heaters to comply with NSF/ANSI 61 and NSF 372 for lead free requirements.
2. Water Heater volume, input capacity, recovery and voltage to be as scheduled on the Drawings.

C. Construction:

1. The storage tank shall be glass lined insulated with baked enamel finish. Tank to be capable of an operating pressure of 150 Psig.
2. Tank shall be equipped with a ball-type drain valve.
3. Elements to be medium watt density with zinc plated copper sheaths.
4. Tank to be provided with an ASME rated Temperature and Pressure Relief Valve.
5. Tank to have anode rod corrosion protection.

D. Warranty:

1. The water heater components to carry a minimum three-year warranty from defects.

2.5 GAS FIRED WATER HEATER (LIGHT DUTY, STORAGE TYPE, CONDENSING)

A. Manufacturers:

1. Acceptable Manufacturers:

a. A.O. Smith
b. Bradford White
c. Rheem
d. Rudd
e. State Industries

B. General:

1. Water heater to be light commercial condensing gas type with sealed combustion chamber complying with standby loss requirements of the U.S. Department of Energy and current edition of ASHRAE/IESNA 90.1.Heaters to comply with NSF/ANSI 61 and NSF 37 for lead free requirements. Heater to be certified to ANSI Z21.10.3-CSA-4.3 standard.
2. Water Heater volume, input capacity, recovery, thermal efficiency and voltage to be as scheduled on the Drawings.

C. Construction:

1. The storage tank shall be glass lined insulated with baked enamel finish. Tank to be capable of an operating pressure of 150 Psig.
2. Tank shall be equipped with a ball-type drain valve.
3. Modular blower to include a built-in safety device to prevent main burner operation if blower is not operating. Blower to have 120V/1 PH control connection. A hot surface ignitor to initiate operation without a standing pilot.
4. Heater to be capable of direct venting utilizing PVC, CPVC or stainless-steel material for both exhaust and combustion air.

5. Tank to be provided with an ASME rated Temperature and Pressure Relief Valve.
6. Tank to have anode rod corrosion protection.

D. Warranty:

1. The water heater tank to carry a minimum three-year warranty and components with a one-year warranty from defects.

2.6 PUMPS

A. General:

1. Statically and dynamically balance rotating parts.
2. Construction shall permit complete servicing without breaking piping or motor connection.
3. Pumps operate at 1750 rpm unless scheduled otherwise.
4. Pump connections shall be flanged.
5. For duplex sump pumps/sewage ejectors provide a remote-mounted alternating panel.

B. In-Line Circulating Pumps:

1. Manufacturers:

a. Design Basis: Bell & Gossett.
b. Other Acceptable Manufacturers:

1) Armstrong
2) Taco

2. Description:

a. Type: In-line circulating pumps.
b. Casing: Bronze for 125 psi working pressure.
c. Impeller: Bronze.
d. Shaft: Steel with copper sleeve or stainless steel.
e. Bearings: Oil lubricated, bronze, sleeve.
f. Seal: Carbon rotating against a stationary ceramic seat, rated for 225ºF.

3. Pump components in contact with domestic water system shall meet the requirements of NSF/ANSI Standard 61.

C. Sump Pumps - Submersible Type:

1. Manufacturers:

   a. Design Basis: Weil.
   b. Other Acceptable Manufacturers:

      1) Aurora
      2) Hydromatic
      3) Pacific
      4) Swaby

2. Pump: Submersible Type, designed for use in submerged applications

a.	Motor Type:	NEMA 6, Air Filled, Class F Insulation, Oil filled not accepted
b.	Temp Limiter:	Motor shall include a Temperature Limiter
c.	Motor Shell:	Cast iron, finned on 5 hp and larger, with lifting handle
d.	Shaft:	Solid 316 Stainless steel, Shaft Sleeves are not acceptable
e.	Power Cable:	Neoprene jacket, 20’ minimum in length
f.	Motor Cover:	Includes cable sealing system to prevent water entry
g.	Bearings:	Double-sealed and permanently lubricated ball bearings
h.	Seal:	Mechanical up to 3 hp, Tandem Mechanical required for 5hp plus
i.	Sensor:	Moisture Sensor and Temp Limiter required on 5 hp and above
j.	Operation:	Up to 150° F intermittent duty and 120° F for continuous duty
k.	Thermal:	Motors shall include built-in thermal overload protectors
l.	Impeller:	Heavy Duty ASTM A48-83 Cast iron
m.	Hardware:	All external hardware shall be 304 stainless steel

3. Removal System

a.	Removal:	Removal and reinstallation without disturbing discharge piping
b.	Connection:	Metal to metal connection on pump to floor elbow
c.	Construction:	Base Elbow and Sliding Bracket to be ASTM A48-83 Cast Iron

4. Control: Control Panel with Tethered Float Switches

   a. Control Panel

      1) UL Listed Label
      2) NEMA 4 Enclosure
      3) TEST-OFF-AUTO switch for each pump
      4) Automatic Alternation after each cycle
      5) Through-the-door disconnect
      6) High Water Alarm (HWA) with 95dB horn and silence button
      7) Indicator Lights For: Control Power, Pump Run, High Water, Overload

8) Fused Control Transformer
9) Overload Protection
10) Moisture Sensor and Temp Limiter Circuits on 5 HP and greater
11) One set each of dry contacts for monitoring: HWA & Pump Run
12) Hour Meter for each pump
13) Configure for Off/Stop, Lead/Start, Lag/Standby and High Water Alarm

b. Tethered Floats

1) Provide mercury tethered float switches

D. Sump Pumps - Vertical Pedestal Type:

1. Manufacturers:

a. Design Basis: Weil.
b. Other Acceptable Manufacturers:

1) Aurora
2) Hydromatic
3) Pacific
4) Swaby

2. Motor: Totally Enclosed Fan-Cooled (TEFC), Flexible Coupling
3. Shaft: 416 Stainless steel
4. Bearings:

a. Thrust: Sealed Ball Bearing
b. Upper: Bronze Sleeve Bearing
c. Intermediate: Cast Iron Housing with Grease lubricated bronze sleeve bearing
d. Lower: Grease lubricated bronze sleeve bearing

5. Casing: Cast Iron
6. Impeller: Heavy Duty ASTM A48-83 Cast iron
7. Pump Legs: Galvanized
8. Control: Control Panel with Mechanical Lever

a. Control Panel

1) UL Listed Label
2) NEMA 4 Rated Enclosure or
3) TEST-OFF-AUTO switch for each pump
4) Automatic Alternation after each cycle
5) Through-the-door disconnect
6) High Water Alarm (HWA) with 95dB horn and silence button
7) Indicator Lights For: Control Power, Pump Run, High Water, Overload

8) Fused Control Transformer
9) Overload Protection
10) One set each of dry contacts for monitoring: HWA & Pump Run
11) Hour Meter for each pump
12) Configure for Off/Stop, Lead/Start, Lag/Standby and High Water Alarm

b. Mechanical Lever

1) Provide Mechanical Lever Float Switch

a) Stainless-Steel Float Rod and Float Ball
b) Adjustable stops

9. Cover:

a. Material: Steel with openings and studs for mounting floor plates of pumps
b. Sump Diameter: See Schedule

E. Sewage Ejectors - Submersible Type:

1. Manufacturers:

a. Design Basis: Weil
b. Other Acceptable Manufacturers:

1) Aurora
2) Hydromatic
3) Pacific
4) Swaby

2. Pump: Submersible Type, designed for use in submerged applications

a.	Motor Type:	NEMA 6, Air Filled, Class F Insulation, Oil filled not accepted
b.	Temp Limiter:	Motor shall include a Temperature Limiter
c.	Motor Shell:	Cast iron, finned on 5 hp and larger, with lifting handle
d.	Shaft:	Solid 316 Stainless steel, Shaft Sleeves are not acceptable
e.	Power Cable:	Neoprene jacket, 20’ minimum in length. Coordinate with panel location.
f.	Motor Cover:	Includes cable sealing system to prevent water entry
g.	Bearings:	Double-sealed and permanently lubricated ball bearings
h.	Seal:	Mechanical up to 3 hp, Tandem Mechanical required for 5hp plus
i.	Sensor:	Moisture Sensor and Temp Limiter required on 5 hp and above
j.	Operation:	Up to 150° F intermittent duty and 120° F for continuous duty
k.	Thermal:	Motors shall include built-in thermal overload protectors

l. Impeller: Heavy Duty ASTM A48-83 Cast iron, 2" Solids Handling
m. Hardware: All external hardware shall be 304 stainless steel

3. Removal System

a. Removal: Removal and reinstallation without disturbing discharge piping
b. Connection: Metal to metal connection on pump to floor elbow
c. Construction: Base Elbow and Sliding Bracket to be ASTM A48-83 Cast Iron

4. Control: Control Panel with Tethered Float Switches

a. Control Panel

1) UL Listed Label
2) NEMA 4 Enclosure
3) TEST-OFF-AUTO switch for each pump
4) Automatic Alternation after each cycle
5) Through-the-door disconnect
6) High Water Alarm (HWA) with 95dB horn and silence button
7) Indicator Lights For: Control Power, Pump Run, High Water, Overload
8) Fused Control Transformer
9) Overload Protection
10) Moisture Sensor & Temp Limiter Circuits on 5 HP and greater
11) One set each of dry contacts for monitoring: HWA & Pump Run
12) Hour Meter for each pump
13) Configure for Off/Stop, Lead/Start, Lag/Standby and High Water Alarm.

b. Tethered Floats

1) Provide mercury tethered float switches

F. Oil-Minder Sump Pumps (Elevator Pits):

1. Manufacturers:

a. Design Basis: Stancor
b. Other acceptable manufacturers:

1) Weil

2. Provide pump and control systems capable of pumping water while containing oil. The system shall function automatically and shall provide for an alarm and separate LED lights in the event of:

    a. The presence of oil in the sump
    b. High liquid in the sump, or
    c. High amps or a locked rotor condition.

3. LED lights shall be provided for:

    a. Power
    b. Pump run function.

4. Pump:

    a. The pump shall be a submersible type, capable of pumping up to 37’ TDH and 74 GPM.
    b. The pump shall be approved to UL 778 standards and shall include thermal and overload protection.
    c. The motor shall be rated ½ H.P., 1 phase, 115V and capable of operating continuously or intermittently.
    d. The motor housing shall be constructed of #304 stainless steel and mechanical seats shall be housed in a separate oil-filled compartment.

5. Control:

    a. The main control shall be approved to UL 508 standards and housed in a gasketed NEMA 4X enclosure with a see-through window for observation of operating functions.
    b. The control shall be equipped with an 8-pin twist lock receptacle, dual solid-state Oil-Minder relays with variable sensitivity settings, an over current relay, self-cleaning stainless-steel sensor probe, high decibel warning horn with alarm silencing switch, dual floats, clearly marked terminal board and remote monitoring contact.
    c. A NEMA 4X junction box with 8-pin twist-lock electrical receptacle and 25’ (additional lengths available in 25’ increments) of mating 8 conductor cable shall be provided.
    d. All cables between the pump and junction box shall be 16’ long and the cable and plug from the control unit shall be 8’ long.
    e. The control unit, junction box, pump, floats and sensor shall be factory assembled as a complete, ready-to-use system and shall be tested and approved as a complete system by a nationally recognized testing laboratory.
    f. The system shall allow for the main control to be located outside of the elevator hoistway to be monitored for all functions without having to enter the elevator shaft.

G. Sump Basins:

1. Precast concrete (refer to detail).
2. Fiberglass reinforced polyester

a. Acceptable Manufacturers:

1) AK Industries.
2) Fiberbasin Incorporated.
3) Topp Industries.

b. Minimum Wall Thickness:

1) At Flange: ½"
2) At Hubs: 3/8"
3) Other Areas: 3/16"
4) Top flange to be extended for support to suspend unit from structural slab.

c. Connections: To accommodate piping shown on drawings.
d. Cover Attachment: Tapped bronze inserts in flange for bolt down cover.
e. Size: As shown on drawings, or, if not shown, of size determined by pump manufacturer.
f. Basin Cover:

1) Material: Steel or Aluminum
2) Provision for Lifting: Ring or handle.
3) Cut-Outs: For removal of cover without disturbing piping or wiring.
4) H20 loading for traffic areas.

2.7 INSTANTANEOUS POINT-OF-USE ELECTRIC WATER HEATER

A. Acceptable Manufacturers:

1. Chronomite
2. Eemax
3. Hubbell
4. PVI

B. Construction and Accessories:

1. Stainless-steel heating elements.
2. Built-in temperature shutoff at 190 degrees.
3. 0.5 GPM inline flow control fitting.
4. Flow switch activated at 0.4 GPM and shutoff at 0.3 GPM

PART 3 - EXECUTION

3.1 DOMESTIC HOT WATER HEATER

A. Installation:

1. Make connections between water heaters and domestic water piping system with dielectric unions.
2. Install isolation valves at both cold water and hot water connections to water heater.
3. Furnish and install copper drain piping from temperature and pressure relief valve for water heater.

    a. Furnish drain full size of relief valve opening and extend as indicated.

4. Install condensate neutralizer on all condensing water heaters. Route discharge from condensate neutralizer to approved receptor.
5. Water heaters installed in office tenant spaces and residential units to have galvanized drip pans with drains installed beneath the tanks.

B. Adjusting:

1. Provide start-up and adjustment by factory authorized personnel. A copy of the start up report will be provided to the owner.
2. Provide equipment video on manufacturer's website which covers, startup, equipment controls, and operation, for later use by the owner.
3. Upon completion of water heater installation, verify satisfactory control operation under maximum demand conditions as recommended by manufacturer.
4. Adjust discharge water temperature as required. Make control adjustments required.

3.2 IN LINE CIRCULATING PUMPS

A. Install pumps to allow complete removal without dismantling connecting piping. Provide air cock and drain connection on horizontal pump casings.

B. Provide line sized gate valve and strainer on suction and line sized soft seated check valve and globe valve or plug valve on discharge.

C. Support pump and piping so that weight of pipe is not carried on pump casing. Additionally, support such that neither pump nor piping is supported by associated equipment.

D. Provide manual switch and aquastat where required.

E. Verify motor position is in accordance with manufacturer's installation instructions.

3.3 HEAT TRACE

A. Install self-regulated heater and components on domestic hot water supply piping mains and risers as indicated in the plans and specifications after the piping has been pressure tested, but before the thermal insulation is applied. Secure the heater to piping with Raychem GT-66 fiberglass tape.

B. Apply “electric traced” signs to the outside of the thermal insulation.

C. After installation and before and after installing the thermal insulation, test heater using a 1000 VDC megger. Minimum insulation resistance should be between 20 and 1000 megohms regardless of length.

3.4 SUMP PUMPS

A. Provide union in discharge piping above floor.

B. Provide gate valve above floor.

C. Provide lift check valve close to pump discharge.

D. Install and adjust float control.

E. Manufacturer’s Representative to be present for Start-Up and provide test report. Test pump staging and float operation by flooding pit to simulate operation. Test shall be observed by Engineer or Owner Representative.

F. Elevator Sump Pump Control Panels – Panels will be located out from high end spaces. Coordinate location and provide additional controls and power cables as required.

END OF SECTION 22 30 00

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data for plumbing fixtures and accessories, in accordance with Division 1.

B. LEED Submittals: Credit WE 3.1 and 3.2: Product Data for plumbing fixtures indicating water consumption.

PART 2 - PRODUCTS

2.1 GENERAL

A. All manufacturers are listed in alphabetical order and not by preference.

B. Provide factory fabricated fixtures.

C. Provide trim, carriers, valves and accessories as required for complete installation.

D. All carriers are floor mounted unless otherwise noted. All carriers shall be bolted down to floor structure.

E. Refer to Drawings for "Plumbing Fixture Schedule".

F. Comply with Local, State and Governing ordinances concerning maximum water requirements of plumbing fixtures: Tank type W.C. and flush valve type W.C. = 1.28 gal./flush; lavs = .5 GPM; urinals = 1.0 (.5 or .125) gal./flush and showers = 1.5 gal. maximum.

G. All valves, fixtures and accessories in contact with domestic water shall meet the requirements of NSF/ANSI Standard 61. Exception includes toilets, bidets, etc.

2.2 PLUMBING FIXTURES

A. Acceptable Manufacturers:

1. Water Closets, Urinals, Lavatories:

   a. American Standard
   b. Kohler
   c. Sloan
   d. Toto
   e. Zurn

2. Faucets:

   a. American Standard
   b. Cambridge Brass
   c. Chicago
   d. Delta
   e. Kohler
   f. Moen
   g. Sloan
   h. Symmons
   i. Toto
   j. Zurn

3. Flush Valves

   Diaphragm Type

   a. Sloan
   b. Zurn

   Piston Type Flush Valves

   c. Kohler
   d. Sloan
   e. Toto
   f. Zurn

B. Water Closets:

1. Unless otherwise specified, all water closets are vitreous china water saver type, white.
2. All flush valves, stops and supplies are to be chrome plated brass. Flush valves to be non hold open type. See section 2.3.

C. Urinals:

1. Unless otherwise specified, all urinals are vitreous china water saver type, white.
2. All flush valves are to be chrome plated brass, non hold open. See section 2.3.

D. Lavatories:

1. Unless otherwise specified, all lavatories are white.
2. Provide chrome plated brass angle stops, supplies, tail piece, P trap and grid strainer for all lavatories.
3. Provide offset P traps on all ADA lavatory installations.

2.3 FLUSH VALVES

A. Exposed diaphragm type, chrome plated flush valve. Valves will have paraflow diaphragm kit for flush discharge adjustment. Valve will be a non-hold open, and have no external volume adjustment. Valve will have ADA compliant handle, back check control stop will have a sweat solder adapter kit with cast set screw with flange. Valve body, cover, tailpiece and control stop will be in conformance with ASTM alloy classification. Valve will be in compliance with applicable sections of ASSE 1037 and ANSI A117.1 requirement for people with disabilities.

2.4 WATER CLOSET SEATS

A. Acceptable Manufacturers:

1. Beneke
2. Centoco
3. Church

B. Construction: Unless otherwise specified seats shall be heavy duty solid plastic, white with open front, concealed self-sustaining check hinge less cover. Seat shall have an antimicrobial compound as an integral part of the plastic and shall match shape of bowl (elongated or regular).

2.5 MOP SINK BASIN

A. Manufacturers:

1. Design Basis: See “Plumbing Fixture Schedule” on drawings.
2. Other Acceptable Manufacturers:

    a. Fiat Products
    b. Mustee
    c. Stern Williams

B. Material: Terrazzo or Molded Stone

C. Mount: Floor

D. Faucet: Chrome plated with vacuum breaker, integral check valves, pail hook and wall brace.

E. Drain: Stainless steel, flat strainer, 3" IPS.

2.6 SHOWER VALVES

A. Acceptable Manufacturers:

1. American Standard
2. Bradley
3. Cambridge Brass
4. Chicago
5. Delta
6. Kohler
7. Leonard
8. Speakman
9. Symmons

B. Features: Single handle, automatic pressure and temperature balancing, and volume control, forged brass body with ceramic valving, adjustable temperature stop and polished chrome handle.

C. Handheld shower to be non-positive control to comply with ADA and shall be equipped with either an integral check valve or a vacuum breaker.

D. Heads and Arm: Polished chrome plated brass.

E. Shower valves shall turn off from hot to cold.

2.7 STAINLESS-STEEL SINKS

A. Acceptable Manufacturers:

1. Elkay
2. Kohler
3. Just

B. Material: 18-gauge, type 304, stainless steel.

C. Mounting: Countertop, self-rimming.

D. Trap: 1½" adjustable, cast brass.

E. Stops: Loose key, ½" FPT, flexible supply, flange.

F. Provide chrome plated brass tailpiece and grid strainer.

G. ADA accessible sinks shall not exceed 6 ½" in depth.

2.8 GARBAGE DISPOSER

A. Acceptable Manufacturers:

1. In-Sink-Erator
2. Kitchenaid
3. Maytag
4. Waste King

B. Features:

1. Continuous feed.
2. Stainless sink flange.

2.9 FLOOR SINK

A. Acceptable Manufacturers:

1. Josam
2. JR Smith
3. Wade
4. Watts Ancon
5. Zurn

B. Body: Cast iron with acid-resisting porcelain enameled interior.

C. Rim and Grate: Nickel bronze

D. Provide with clamping collars with waterproof membrane clamps

2.10 FLOOR DRAINS

A. Acceptable Manufacturers:

1. Josam
2. JR Smith

3. Wade
4. Watts Ancon
5. Zurn

B. Body: Duco cast iron, with flashing collar.

C. Grates and sediment strainers as specified in schedule.

D. Provide primer taps as specified in schedule.

E. Provide with clamping collars with waterproof membrane clamps.

2.11 ELECTRIC WATER COOLERS

A. Acceptable Manufacturers:

1. Cordley
2. Elkay
3. Halsey Taylor
4. Haws
5. Oasis
6. Sunroc

B. Industry Standards: Provide water coolers with UL and ARI labels, and which meet or exceed standards of the Safe Drinking Water Act and Lead Contamination Control Act, NSF Standard 61, Section 9. (Proposition 65 in California.) All components in the waterway to be lead free.

C. Evaporator and Chiller: All copper construction.

D. Accessories:

1. Automatic pressure regulator.
2. Stop and supply.
3. Cast brass P-trap.
4. Provide bottle filler when indicated.
5. Front push button activation.
6. Removable grid strainer.
7. Required mounting frame.
8. Bottle filler.

E. Finish: Heavy gauge stainless steel with No. 4 satin finish.

F. Units to meet all NSF and ADA standards.

2.12 DRINKING FOUNTAINS

A. Acceptable Manufacturers:

1. Cordley
2. Elkay
3. Halsey Taylor
4. Haws
5. Oasis
6. Sunroc

B. Industry Standards: Provide drinking fountains and/or cuspidor which meet or exceed standards of the Safe Drinking Water Act and Lead Contamination Control Act, NSF Standard 61, Section 9. (Proposition 65 in California.) All components in the waterway to be lead free.

C. Accessories:

1. Automatic pressure regulator.
2. Stop and supply.
3. Cast brass P-trap.
4. Provide bottle filler when indicated.
5. Front push button activation.
6. Removable grid strainer.
7. Required mounting frame.
8. Bottle filler.

D. Finish: Heavy gauge stainless steel with No. 4 satin finish.

E. Units shall meet all NSF and ADA standards.

2.13 WASHING MACHINE WALL BOX

A. Acceptable Manufacturers:

1. Guy Gray
2. IPS
3. Symmons

B. Material: Brass.

C. Connections:

1. ½” CW and HW with shock arrestors. (Supplies from top or bottom as indicated.)
2. 2” drain.

2.14 WASH FOUNTAINS

A. Acceptable Manufacturers:

1. Acorn
2. Bradley

B. Accessories:

1. Precast terrazzo bowl.
2. Supplies as noted on drawings.
3. Centrally rising vent.
4. P trap.
5. Foot control – sectional.
6. Liquid soap dispenser.
7. Color, Granite (to be verified by Architect).
8. Thermostatic mixing valve.
9. Standard vinyl clad straight pedestal panels.

2.15 EQUIPMENT FURNISHED UNDER OTHER SECTIONS

A. Provide all materials necessary to make final connections to owner equipment furnished under other Sections of these Specifications including:

1. Tail pieces
2. Stops
3. Supplies
4. P traps, standard and/or offset
5. Escutcheons

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install each fixture with P trap with cleanout plug, easily removable for servicing and cleaning.

B. Provide chrome plated, rigid or flexible supplies to fixtures with stops, reducers and escutcheons.

C. Finish wall and floor penetrations when exposed to view in finished areas with set screw type, chrome plated brass escutcheons.

D. Set plumbing fixtures level and plumb, spaced in accordance with architectural dimensioned drawings, and securely install to be rigid.

E. Install wall-mounted lavatories, urinals and water closets with wall carriers mounted to the floor.

F. Solidly attach floor-mounted carriers for all fixtures to floor using proper fasteners based on floor construction.

G. Cover fixture bolts with china bolt caps of the same color where required.

H. All wall-mounted fixtures to be caulked between fixture and wall.

I. Securely anchor flush valves behind or within walls to be rigid and not subject to movement due to push or pull action on the valve.

J. Fixture Mounting Heights:

1. Refer to Architectural drawings and ADA standards.

K. Floor Drains:

1. Refer to Architectural drawings for exact locations and additional installation requirements.
2. Install floor drains with P-traps and vent as required.
3. Install drains on the center line of sheet lead pan and/or membrane in waterproofed areas and in floors above lowest floor.
4. Clamp pan and/or membrane into drain flashing collar.
5. Install strainers immediately after completion of finish floor installation.
6. Coordinate locations with mechanical equipment.
7. Install trap primers as indicated.

L. All exposed piping serving plumbing fixtures that may be used for ADA purposes shall have traps and supplies insulated per ADA requirements.

M. Install flushing mechanism for both ADA accessible flush valves and flush tanks to the side of water closet that has the most floor space per ADA requirements. Provide for ADA prescribed clearances between the top of the flush valve and grab bars.

N. Provide a tempering valve that conforms to ASSE 1070 for all lavatories and sinks used as a public hand wash facility.

3.2 ADJUSTING AND CLEANING

A. Cleaning:

1. Clean strainers, traps, aerators, and valves of debris, sand and dirt.
2. At completion, thoroughly clean plumbing fixtures and equipment.

B. Adjusting: After cleaning and flushing operations are accomplished, adjust flush valves, faucets, showers, bubblers for proper flow.

3.3 PROTECTION

A. Protect fixtures and related components from damage before, during, and after installation to date of Final Acceptance or Owner move-in. Provide protective coverings or other protection as required.

B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit.

C. Feasibility and match to be judged by Architect or Engineer.

D. Remove cracked or dented units and replace with new units.

E. Contractor shall be responsible for replacing damaged fixtures or components.

END OF SECTION 22 40 00

SECTION 22 90 00 - PLUMBING PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 90 00 – Project Closeout

PART 2 - NOT USED

PART 3 - NOT USED

END OF SECTION 22 90 00

SECTION 23 05 01/26 05 01 - MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. The Divisions 21 through and 26 through 28 contractor(s) shall comply with the provisions of this section. The Divisions 21 through 23 contractor(s) shall verify electrical service provided by the electrical contractor before ordering any mechanical equipment requiring electrical connections. Provide submittals of all mechanical equipment to Division 26 through 28 contractor(s).

B. The final responsibility for properly coordinating the electrical work of this section shall belong to the Divisions 21 through 23 system contractor performing the work, which requires the electrical power.

1. Each Divisions 21 through 23 contractor shall be responsible for providing power wiring for certain devices as described in the specifications and on the drawings. This work shall be provided by a licensed electrician in accordance with all of the applicable provisions of the Division 26 through 28 specifications, NEC and local codes.

1.2 WORK INCLUDED

A. Carefully coordinate the interface between Divisions 21 through 23 (Mechanical) and Divisions 26 through 28 (Electrical), and Division 23 09 00 (Building Management and Automatic Temperature Control Systems) before submitting any equipment for review or commencing installation

1.3 DEFINITIONS

A. Automatic: Pertaining to a function, operation, process or device that, under specified conditions, functions without intervention by human operator.

B. Disconnect Switch: A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a power source.

C. Motor Control Center: A floor-mounted assembly of one or more enclosed vertical sections having a common horizontal power bus and primarily containing motor starting units.

D. Control Circuit/Power: The circuit which carries the electrical signals of a control apparatus or system directing the performance of the controller but does not carry the main power circuit.

E. Manual Operation: Operation by hand without the use of any other power.

F. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who furnishes motor.

G. TC: Temperature Controls = Division 23 09 00 Contractor who furnishes control.

H. EC: Electrical Contractor = Divisions 26 through 28 Contractor.

I. FA: Fire Alarm Contractor = Division 28 Contractor who furnishes Fire Alarm System.

J. IPC: Ice Plant Contractor = Contractor who furnishes the Ice Plant System.

K. EP: Electric to Pneumatic Converter.

L. PE: Pneumatic to Electric Converter.

1.4 RESPONSIBILITY SCHEDULE

A. Responsibility: Unless otherwise indicated, all motors and controls for Divisions 21 through 23 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	**Furnished Under**	**Set In Place Under**	**Power Wiring Under**	**Control Wiring Under**
MC: Mechanical Contractor TC: Temperature Contractor EC: Electrical Contractor FA: Fire Alarm Contractor				
AHU Interior Marine Lights	MC	MC	EC	MC
Equipment Motors	MC	MC	EC	--
Automatically or Manually Controlled Starters/Contactors: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
In Motor Control Centers (Note 4)	EC	EC	EC	TC
Motor Speed Controllers: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
Disconnect Switches (Note 1)	EC	EC	EC	--
Thermal Overload Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC or TC	MC or TC	--	TC
Control Transformers	MC or TC	MC or TC	EC or TC	TC
Push Button Stations, Pilot Lights	MC	EC	EC	EC

ITEM -	**Furnished Under**	**Set In Place Under**	**Power Wiring Under**	**Control Wiring Under**
MC: Mechanical Contractor TC: Temperature Contractor EC: Electrical Contractor FA: Fire Alarm Contractor				
Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)	MC or TC	EC or TC	EC or TC	TC
Equipment in Temperature Control Panels	TC	TC	TC	TC
Standalone Control Panels (BAS) (Note 6)	TC	TC	TC	TC
Valve Motors, Damper Motors, Solenoid Valves, etc.	TC	TC	TC	TC
EP Valves or Switches, P.E. Switches, etc.	TC	TC	--	TC
Fire Alarm System (Note 3)	FA	FA	EC	FA
Fire Sprinkler Alarm (Note 3)	MC	MC	EC	FA
Duct System Smoke Detectors (Note 5)	FA	MC	--	TC/FA
Relays for Fan Control via duct detectors (Note 5)	MC	MC	EC	TC
Room Smoke Detectors Including Relays for Fan Control (Note 3)	FA	FA	--	FA
Smoke Management Controls (Note 6)	FA	FA	EC	FA
CO Sensors	TC	TC	TC	TC
Control Air Compressor	TC	TC	TC	TC
Refrigerated Air Dryer	TC	TC	TC	TC
Equipment Interlocks	TC	TC	--	TC
Fire/Smoke and Smoke Dampers (Note 6)	MC	MC	EC	FA
Smoke Control Dampers (for smoke management system)	MC	MC	EC	FA/TC
Positive Indication Devices (i.e., current sensors, end switches, airflow sensors)	TC	TC	--	FA/TC
Heat Trace Systems (Note 7)	MC	MC	MC	MC

Notes:

1. If furnished as part of factory wired equipment furnished and set-in place by MC, wiring and connections by EC.
2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set-in place by MC and connected by EC. If they

do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor.

3. Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28.
4. Electrical contractor is responsible for wiring from starter to motor, unless factory wired.
5. Temperature control contractor shall provide conduit and wire from auxiliary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from detector to fire alarm panel.
6. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.

    a. Division 26 shall provide all power and control wiring to fire/smoke or smoke dampers. Division 23 and 26/28 shall provide parallel control wiring (with 28 fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes. Refer to Smoke Control and Fire Alarm Drawings and the Fire Alarm Matrix.
    b. Fire alarm system shall override automated building control system during smoke exhaust mode.
    c. TC wiring to fire/smoke or smoke dampers required only when damper also serves HVAC system.

7. Mechanical contractor shall be responsible for fully functional heat trace system. Mechanical contractor shall engage licensed electrician to install heat trace system. Where applicable, mechanical contractor shall engage temperature controls contractor to install control wiring to Division 23 09 00 system.

B. Power Wiring by Divisions 21 through 23: The electrical power for certain equipment provided under Divisions 21 through 23 has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21 through 23 trade requiring such power.

Sufficient power for this purpose shall be furnished as “spare” dedicated circuit capacity in Division 26’s panelboards. All wiring, conduit and electrical devices downstream of the panelboards are the responsibility of the Divisions 21 through 23 trade requiring the power.

1. Such equipment is hereby defined as:

    a. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing and mechanical drawings (Division 22 and 23 work).
    b. Fire protection air compressors, dry-pipe control panels and valves. Required connections are included in the Division 21 work and will be shown by that contractor’s engineered system design drawings.

        1) Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28 fire alarm work.

2) Division 21 shall provide pre-action control panel and interconnection between nearest suitable fire alarm panel and location of pre-action valve(s).
3) Division 28 shall provide interconnection between fire command center alarm panel (provided under Division 28) and remote communication fire alarm panel (provided under Division 28).

c. Infrared plumbing fixtures. Fixtures requiring power are shown on the plumbing drawings and schedules. Provide junction box and or receptacle as required by manufacturer.
d. Temperature control panels, control air compressors and line voltage power for 24v control transformers. Required connections are included in Division 23 09 00 and will be shown by that contractor's control submittal drawings.
e. Condensate pumps. Provide power from associated unit or from nearby panelboard.

1.5 GENERAL REQUIREMENTS

A. Connections:

1. Connections to all controls directly attached to ducts, piping and mechanical equipment shall be made with flexible connections.

B. Starters:

1. Provide magnetic starters for all three phase motors and equipment complete with:

a. Control transformers.
b. 120V holding coils.
c. Integral hand-off-auto switch.
d. Auxiliary contacts required for system operation plus one (1) spare.
e. Refer to Section 23 05 13 Motors, Starters and Drives.

C. Remote Switches and Pushbutton Stations:

1. Provide remote switches and/or pushbutton stations required for manually operated equipment (if no automatic controls have been provided) complete with pilot lights of an approved type lighted by current from load side of starter.

D. Special Requirements:

1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

E. Identification:

1. Provide identification of purpose for each switch and/or pushbutton station furnished. Identification may be either engraved plastic sign permanently mounted to wall below switch or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

F. Control Voltage:

1. Maximum allowable control voltage 120V. Fully protect control circuit conductors in accordance with National Electrical Code.

G. DDC Control Interface:

1. Fully coordinate the requirements of each division with regard to supplying a complete DDC Control System prior to submitting bid.
2. All control power shall be furnished via dedicated line voltage circuits.
3. Dedicated control circuits from electrical panelboards to DDC control panels and from electrical panelboards to dedicated DDC J-boxes (for distributed control components such as VAV boxes), and control transformer line voltage connections shall be provided under Division 23 09 00 where required and as shown on the drawings.

    a. Exceptions: The following Divisions 21 through 23 equipment has been provided with electrical power feeders downstream of the panelboards by Division 26:

        1) Division 28, Fire Alarm System Panels.
        2) Division 23 09 00 Building Automation System (BAS):

            a) Each air handling unit (AHU) has been provided with a dedicated combination control and unit lighting circuit(s) to its air handling room.
            b) Certain BAS panels requiring emergency power.

        3) See the drawings for additional exceptions.

4. Low-voltage wiring from J-boxes to distributed control components, all low-voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23 09 00.
5. Any additional power requirements shall be the responsibility of the Division 23 09 00 Contractor requiring same and provided at no additional cost to the owner.

1.6 CEILING AND CHASE CAVITY PRECEDENCE

A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of

precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.

1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.
2. Hydronic main piping (12" and larger).
3. Plumbing vent piping.
4. Supply, return and exhaust ductwork.
5. Electrical conduit greater than 4" diameter.
6. Hydronic branch and mains (greater than 2", but less than 12").
7. Domestic water piping.
8. Fire sprinkler mains and leaders.
9. Hydronic branch piping (2" and less).
10. Domestic hot and cold-water branches.
11. Electrical conduit branch feeders.
12. Fire sprinkler branch piping and sprinkler runouts.

B. Light fixtures have precedence in a zone, which is the same height above the ceiling as the depth of the fixture (plus 2").

C. Examine the contract documents of all trades (e.g., all Divisions 21 through 23 and 26 through 28 drawings, the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).

D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.

E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.

F. Provide access doors for all equipment, valves, clean-outs, actuators and controls which require access for adjustment or servicing and which are located in otherwise inaccessible locations.

1. For equipment located in "accessible locations" such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. "Normal maintenance" includes, but is not limited to: filter changing; greasing of bearings; using p/t ports for pressure or temperature measurements; and replacement of ballasts, fuses, etc.

PART 2 - PRODUCTS

2.1 MOTOR HORSEPOWER

A. In general, all motors ¾ HP and above shall be three phase, all motors ½ HP or less shall be single phase.

B. Voltage and phase of motors as scheduled on the electrical drawings shall take precedence in the case of a conflict between the mechanical and electrical drawings or general condition 2.1. A., above.

C. Work under Divisions 21 through 23 includes coordinating the electrical requirements of all mechanical equipment with the requirements of the work under Divisions 26 through 28, before ordering the equipment.

1. If motor horsepowers are changed under the work of Divisions 21 through 23 without a change in duty of the motor's driven device, coordination of additional electrical work (if any) and additional payment for that work (if any) shall be provided under the section of Divisions 21 through 23 initiating the change. Increases or decreases in motor horsepower from that specified shall not be made without written approval from the Architect/Engineer.

PART 3 - EXECUTION - (NOT USED)

END OF SECTION 23 05 01/26 05 01

SECTION 23 05 02 - BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1 - General Requirements.

B. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. Architect/Engineer shall decide which is more stringent.

C. Provisions of this section shall also apply to all sections of Divisions 21 through 23.

1.2 DEFINITIONS

A. The definitions of Division 1 and the General Conditions of this specification also apply to Divisions 21 through 23 contract.

B. “Contract Documents” constitute the drawings, specifications, general conditions, project manuals, etc., prepared by Engineer (or other design professional in association with Engineer) for contractor’s bid or contractor’s negotiations with the Owner. Divisions 21 through 23 drawings and specifications prepared by the Engineer are not construction documents.

C. “Construction Documents”, “construction drawings”, and similar terms for Divisions 21 through 23 work refer to installation diagrams, shop drawings and coordination drawings prepared by the contractor using the design intent indicated on the Engineer’s contract documents. These specifications detail the contractor’s responsibility for “Engineering by Contractor” and for preparation of construction documents.

D. “(N)” indicates "new" equipment to be provided under this contract.

E. “(E)” indicates "existing" equipment on site which may or may not need to be relocated as a part of this work.

F. “(R)” indicates existing equipment to be relocated as part of this work.

G. "Furnish" means to "supply" and usually refers to an item of equipment.

H. "Install" means to "set in place, connect and place in full operational order".

I. "Provide" means to "furnish and install".

J. “Equal” or "Equivalent" means "meets the specifications of the reference product or item in all significant aspects." Significant aspects shall be as determined by the Architect/Engineer.

K. "Work by other(s) divisions"; "re: _____ Division", and similar expressions means work to be performed under the contract documents, but not necessarily under the division or section of the work on which the note appears. It is the contractor’s sole responsibility to coordinate the work of the contract between his/her suppliers, subcontractors and employees. If clarification is required, consult Architect/Engineer before submitting bid. By inference, any reference to a “contractor” or “sub-contractor” means the entity, which has contracted with the Owner for the work of the Contract Documents.

L. By inference, any reference to a “contractor” or “sub-contractor” means the entity, which has contracted with the owner for the work of the Contract Documents.

M. "Engineer" means the design professional firm, which has prepared these contract documents. All questions, submittals, etc. of this division shall be routed to the Engineer (through proper contractual channels).

1.3 COORDINATION WITHIN DIVISIONS 21 THROUGH 23

A. Contract Documents:

1. General: The Contract Documents are diagrammatic showing certain physical relationships, which must be established within the Divisions 21 through 23 work and its interface with other work. Such establishment is the exclusive responsibility of the Contractor. Drawings shall not be scaled for the purpose of establishing material quantities.
2. Supplemental Instructions: The exact location for some items in this Specification may not be shown on the Drawings. The location of such items may be established by the Architect/Engineer during the progress of the work.
3. Discrepancies:

    a. Examine Drawings and Specifications of all Divisions of the work.
    b. Report any discrepancies to the Architect/Engineer and obtain written instructions before proceeding.
    c. Should there be a conflict within or between the Specifications or Drawings, the more stringent or higher quality requirements shall apply.
    d. Items called for in either specifications or drawings shall be required as if called for in both.

4. Constructability:

    a. Examine Drawings and Specifications of all Divisions of the work.
    b. Report any issues to the Architect/Engineer which may prevent installation of Divisions 21 through 23 work in accordance with the Contract Documents and the original construction contract.
    c. Report all issues within ***30 days*** after contract.

B. Be responsible for providing proper documentation of equipment product data and shop drawings to all entities providing service. This coordination shall include, but not be limited to the following:

    1. Division 21 - Series contractor (Fire Protection Contractor) shall provide shop drawings to all other Division 21 through 23 contractors.
    2. Division 23 09 00 and 23 05 93 - Contractors (Automatic Temperature Controls, Building Management and Test-Adjust-Balance Contractors) shall be provided with equipment product data and shop drawings as appropriate from other Division 21 through 23 and Divisions 26 through 28 contractors, and shall furnish the same information about control devices (such as valves, test wells, etc.) to the appropriate Divisions 21 through 23 Contractor.

C. Coordination Drawings:

    1. Submit coordination drawings for all Divisions 21 through 23 work. The drawings shall be fully coordinated and signed off by all affected trades prior to submission. The coordination drawings shall include the following at a minimum.

        a. All major ductwork, piping, conduit and equipment.
        b. Reflected ceiling plans with light fixtures.
        c. Current architectural floor plans.
        d. Major structural elements.
        e. Elevations of piping ductwork or equipment.
        f. Sections through critical spaces.

    2. The drawings shall be at a suitable scale (1/8”=1’-0” minimum) to clearly show information.
    3. Any work installed without approved coordination drawings is done at the Contractor’s risk.

D. Electronic Drawings:

    1. Electronic drawings are available from ME Engineers. One complete set of electronic drawings in Revit or CAD format to be provided to GC for distribution. Electronic drawings are for reference only and available only upon receipt of electronic document disclaimer.

E. Existing Conditions:

1. Inspect existing conditions prior to bidding.
2. Provide proper coordination of mechanical work with existing conditions.

F. Utility Connections:

1. Coordinate the connection of mechanical system with the Civil drawings and utility companies.
2. Comply with regulations of utility suppliers.
3. The Contract Documents indicate the available information on existing utilities and services, and on new services (if any) to be provided to the project by utility companies and agencies.

    a. Notify Architect/Engineer immediately if discrepancies are found.

4. Coordinate mechanical utility interruptions one week in advance with the Owner and the Utility Company.

    a. Plan work so that duration of the interruption is kept to a minimum.

1.4 COORDINATION WITH OTHER DIVISIONS

A. General:

1. Coordinate Divisions 21 through 23 work to the progress of the work of other trades.
2. Complete the entire installation as soon as the condition of the building will permit.
3. The project will be constructed under multiple bid packages. Coordinate this Division's work with the progress of the other bid package's work.

B. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order:

1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.
2. Hydronic main piping (12" and larger).
3. Plumbing vent piping.
4. Supply, return and exhaust ductwork.
5. Electrical conduit greater than 4" diameter.
6. Hydronic branch and mains (greater than 2", but less than 12").
7. Domestic water piping.
8. Fire sprinkler mains and leaders.
9. Hydronic branch piping (2" and less).
10. Domestic hot and cold-water branches.
11. Electrical conduit branch feeders.
12. Fire sprinkler branch piping and sprinkler runouts.

C. Coordination with Electrical Work. Refer to Section 23 05 01.

D. Cutting and Patching: Refer to Division 1 and Section 23 05 03.

E. Chases, Inserts and Openings:

1. Provide measurements, drawings, and layouts so that openings, inserts and chases in new construction can be built in as construction progresses.
2. Check sizes and locations of openings provided.

    a. Any cutting and patching made necessary by failure to provide measurements, drawings, and layouts at the proper time shall be done at no additional cost to the Owner.
    b. Coordinate roof openings for all roof-mounted equipment. Openings on documents are diagrammatic and do not represent manufacturer specific requirements. Actual opening size, orientation and location, as well as structural coordination, is the responsibility of the mechanical contractor.
    c. Provide transitions on ductwork to accommodate actual roof openings.

F. Support Dimensions: Provide dimensions and drawings so that concrete bases and other equipment supports to be provided under other Sections of the Specifications can be built at the proper time.

1.5 COORDINATION WITH EXISTING OCCUPIED AREAS

A. Minimize disruptions to operation of mechanical systems in occupied areas.

B. Coordinate any required disruptions with the Owner, one week in advance.

C. Provide temporary connections to prevent long disruptions.

1.6 ENGINEERING BY CONTRACTOR

A. The construction of this building requires the contractor to design several systems or subsystems. All such designs shall be the complete responsibility of the contractor.

B. Systems or subsystems which require engineering responsibility by the contractor include, but are not limited to:

1. Any system not fully detailed on the drawings.
2. Fire sprinkler.
3. Equipment supports, and hangers not fully detailed in the drawings.
4. Pipe hangers, sleeves and anchors not specified in these documents, or cataloged by the manufacturer.
5. Fire stopping

6. Duct supports, hangers and miscellaneous steel as required.
7. Temperature controls.
8. Refrigeration systems.
9. Piping expansion and contraction provisions.
10. Equipment supports, hangers.
11. Sizing and routing of condensate piping.

1.7 REGULATORY REQUIREMENTS

A. Codes: Comply with the following:

1. International Building Code 2018
2. International Mechanical Code 2018
3. International Plumbing Code 2018
4. National Electric Code (NEC) Latest Edition
5. International Fire Code 2018
6. ASME Boiler and Pressure Vessel Code.
7. Local Modifications to above Codes.

B. Applicable pamphlets of NFPA.

C. Requirements of Local Utility Companies:

1. Comply with rules and regulations of local utility companies. Include in bid the cost of all valves, valve boxes, meter boxes, meters and such accessory equipment which will be required for the project.

D. Other Regulations: Comply with the latest editions of the following:

1. U.S. and State Department of Labor Safety Regulations pertaining to the completed project.
2. Requirements of Fire Departments serving the project.
3. Regulations of the Health Department having jurisdiction.
4. Regulations of the Office of State Fire Marshal.
5. ASHRAE Energy Conservation Standard 90.1.
6. ASHRAE Ventilation Standard 62.
7. Requirements of the State Oil Inspector.
8. Americans with Disabilities Act (ADA).
9. Clean Air Act.
10. Colorado Air Quality Control Commission Regulation #15.
11. Clean Water Act.
12. USGBC LEED-NC v4.0.

    a. In particular, all sealants and adhesives shall be low VOC type as defined by USGBC LEED-NC v4.0.

E. Additional Regulations: Follow additional regulations, which appear in individual Sections of these Specifications.

F. Contradictions: Where codes are contradictory, follow the most stringent, unless otherwise indicated in Plans or Specifications. Architect/Engineer shall determine which is most stringent.

G. Contract Documents Not in Compliance:

1. Where the Drawings and Specifications do not comply with the minimum requirements of the Codes, either notify the Architect/Engineer, in writing during the Bidding Period, of the revisions required to meet Code requirements, or provide an installation which complies with the Code requirements. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.
2. Follow Drawings and Specifications where they are superior to Code requirements.

H. Permits:

1. Obtain all permits required by authorities and agencies having jurisdiction for the work of this Division.
2. Post permits as required.

I. Tap and Connection Fees:

1. Pay fees charged by Utilities for making connections, bringing service to property line, or to meter and similar services.
2. Investment fees or plant development fees, which are charges levied by Utilities to cover the cost of the utility system to be borne by this project, are not part of the work of this Division.

J. Inspections and Tests:

1. Arrange for all required inspections and tests.
2. Pay all charges.
3. Notify Architect/Engineer 48 hours before tests.
4. Submit one copy for Owners records of permits, licenses, inspection reports and test reports.

K. LEED

1. This project will follow the guidelines and requirements of Leadership in Energy and Environmental Design (LEED). Provide all services and documentation required in this effort.
2. Commissioning: The project will have selected building systems commissioned as specified in Section 01810 – Commissioning. Coordinate pre-functional tests and start-up testing with commissioning.

1.8 RECORD DRAWINGS

A. General Recording Procedure:

1. Maintain a blue-line set of Divisions 21 through 23 Contract Drawings in clean, undamaged condition, for mark-up of installations, which vary, substantially from the Contract Drawings.
2. Record changes drawn to scale and fully dimensioned, as specified in Division 1.

    a. Work concealed behind or within other work, in an inaccessible arrangement.
    b. Mains and branches of piping systems:

        1) with valves and control devices located and numbered.
        2) with concealed unions located.
        3) with items requiring maintenance located (traps, strainers, expansion compensators, tanks, etc.).

    c. Underground piping and ducts, both exterior and interior.
    d. Ductwork layouts, including locations of coils, dampers, filters, boxes and similar units.
    e. Concealed control system devices and sensors.

B. Corrected Drawings:

1. Obtain a set of contract drawings on CAD.
2. Update the CAD files to reflect as-built conditions.
3. Transmit corrected CAD files and plots as a submittal to the Architect/Engineer for Owner's use and record.

C. Temperature Control Drawings:

1. Indicate as-built conditions of work under this contract including:

    a. Ladder wiring diagram.
    b. Pneumatic schematic diagrams.
    c. One line system diagram.
    d. Control schematic of equipment with control devices located and identified.
    e. Wiring or tubing termination diagrams.
    f. List of materials.
    g. Floor plan indicating all device locations.
    h. Control sequences.
    i. Indicate electrical power source for each point of connection to the electrical system.

2. Reproducible temperature control drawings shall be delivered to the Architect/Engineer prior to Owner's acceptance of project.

1.9 OPERATING AND MAINTENANCE DATA

A. Refer to Division 1 for additional requirements.

B. Submission:

1. Submit typed and bound copies of Operating and Maintenance Manuals prior to scheduling systems demonstration for the Owner, as specified in Division 1.
2. Bind each Maintenance Manual in one or more vinyl covered, 3-ring binders, with pockets for folded drawings.

    a. Mark the back spine of each binder with system identification and volume number.

C. Required Contents:

1. Manuals shall have index with tab dividers for each major equipment section to facilitate locating information on specific piece of equipment.
2. Identify data within each section with drawing code numbers as they appear on Drawings and Specifications. Include as a minimum the following data:

    a. Alphabetical list of system components, with the name, address and 24 hour telephone number of the company responsible for servicing each item during the first year of operation. Include point of contact for company.
    b. Operating instructions for complete system including:

        1) Emergency procedures for fire and failure of major equipment.
        2) Major start, operation and shut-down procedures.

    c. Maintenance Instructions for each piece of equipment including:

        1) Equipment lists.
        2) Proper lubricants and lubricating instructions for each piece of equipment.
        3) Necessary cleaning, replacement and/or adjustment schedule.
        4) Product Data.
        5) Installation instructions.
        6) Parts lists.
        7) Complete wiring diagrams.

    d. Temperature control diagrams and O&M information as specified above (as-built).
    e. Marked or changed prints locating concealed parts and variations from the original system design (as-built drawings).
    f. Balancing Report.
    g. Valve schedule and associated piping schematics. See Division 23 05 53, Mechanical Identification.
    h. Copies of any extended equipment warranties, which are greater than one year.

1.10 WARRANTIES

A. The warranty period is one year after Date of Acceptance.

1. During this period, provide labor and materials as required to repair or replace defects in the mechanical system at no additional cost to the Owner. Provide certificate with O&M manual submittal which guarantees same-day service response to Owners call for all such warranty service.
2. Provide certificates for such items of equipment which have warranties in excess of one year. Insert copies in O&M manuals. Such equipment shall include:

    a. Temperature Control Valves five (5) years.
    b. Chiller compressors five (5) years.

3. Provide extended manufacturers warranties to cover one full year from date of acceptance if standard warranty starts any time prior to that date.
4. Provide factory trained service personnel for all warranty work on the DDC Control System and the following equipment:

    a. Air cooled chiller.
    b. Boilers.

B. Refer to Division 1 for additional requirements.

1.11 SCOPE

A. The Contractor shall:

1. Supply all labor, transportation, materials, apparatus, light, and tools necessary for the completion of the mechanical work.
2. Install, maintain, and remove all construction equipment.
3. Be responsible for safe, lawful, and proper construction maintenance.
4. Construct, in the best and most workmanlike manner, a complete project and everything properly incidental thereto, as shown on the Drawings, as stated in the Specifications, or reasonably implied therefrom, all in accordance with the Contract documents.

1.12 MANDATORY GOVERNING PROVISION

A. Omissions of words or phrases, such as “the Contractor shall,” “in conformity with,” “shall be,” “as noted on the Drawings,” “according to the Drawings,” “an,” “the,” and “all,” are intentional.

B. Omitted words or phrases shall be supplied by inference.

1.13 PROTECTION OF PROPERTY AND MATERIALS

A. Provide protection against dust migration, rain, wind, storms, frost, or heat, so as to maintain all work, materials, apparatus, and fixtures free from injury or damage.

B. At end of each day's work, cover all new work likely to be damaged.

C. Do not interrupt the integrity of the building security overnight.

D. Refer to Division 1 for additional requirements.

1.14 OWNER FURNISHED EQUIPMENT

A. All equipment called out in the Specifications or shown on the Drawings as "Owner-Furnished Equipment" shall be installed and connected under this Contract. Provide rough-ins for all future connections indicated.

1.15 TEMPORARY FACILITIES

A. Light, Heat, Power, etc.

1. Responsibility for providing temporary electricity, heat and other facilities shall be as specified in Division 1.
2. Contractor shall be responsible for maintaining the equipment in an as-new condition. Equipment will not be turned over to the Owner until it is brought up to as-new condition.
3. The contractor shall be responsible for maintaining acceptable indoor air quality in adjacent occupied spaces.

B. Use of Permanent Building Equipment for Temporary Heating or Cooling.

1. Permanent building equipment shall not be used without written permission from the Owner. If this equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, etc. The contractor shall protect all equipment and systems as directed by the engineer. The warranty period shall not start until the equipment is turned over to the Owner for his use. The contractor shall provide extended warranties for parts and labor for all such equipment. Equipment shall not be turned over to the Owner until the temperature controls have been tested and accepted by the Owner and Engineer.

1.16 ROUGH-IN FOR FUTURE CONNECTION

A. Provide rough-in services for all systems which shall extend to future equipment or spaces as shown on the drawings.

1. Provide sufficiently sized branch plumbing lines with isolation valves to serve Building B and Plaza F&B Building with heating hot water and chilled water.
2. BAS/ATC Controls:

    a. Provide sufficiently sized master control panel(s) to accommodate a 10% increase in the number of equipment unit controllers in the Promenade building area plus any future equipment unit controllers in the Plaza Building and Building B.
    b. Provide sufficient electrical conduits (and J-boxes) from the master control panel(s) to a future point of connection with Building B and Plaza F&B buildings. The conduits shall be sized to accommodate the same number of wire and cables to each future Building B and Plaza F&B area as is necessary to accommodate similar areas.

1.17 INSTALLATION GENERAL REQUIREMENTS

A. Furnish, apply, install, connect, erect, clean, and condition manufactured materials and equipment as recommended in manufacturer’s printed directions (maintained on job site during installation).

B. Provide all attachment devices and materials necessary to secure materials together or to other materials.

C. Make allowance for ample and normal expansion and contraction for all building components and piping systems that are subject to such.

D. Install materials only when conditions of temperature, moisture, humidity, and conditions of adjacent building components are conducive to achieving the best installation results.

E. Erect, install, and secure components in a structurally sound and appropriate manner.

F. Where necessary, temporarily brace, shore, or otherwise support members until final connections are installed.

G. Leave all temporary bracing, shoring, or other structural supports in place as long as practical for safety and to maintain proper alignment.

H. Handle materials in a manner to prevent scratching, abrading, distortion, chipping, breaking, or other disfigurement.

I. Conduct work in a manner to avoid injury or damage to previously placed work.

J. Any work so impaired or damaged shall be replaced at no expense to Owner.

K. Fabricate and install materials true to line, plumb, and level.

L. Leave finished surfaces smooth and flat, free from wrinkles, warps, scratches, dents, and other imperfections.

M. Furnish materials in longest practical lengths and largest practical sizes to avoid all unnecessary jointing.

N. Make all joints secure, tightly fitted, and as inconspicuous as possible by the best accepted practice in joinery and fabrication.

O. Consult Engineer for mounting height or position of any unit not specifically indicated or located on Drawings or specified in Specifications.

P. Job mixed multi-component materials used in the work shall be mixed in such regulated and properly sized batches that material can be used before it begins to “set”.

Q. Mixing of a partially “set” batch with another batch of fresh materials will not be accepted and entire batch shall be discarded and removed from site.

R. Clean all mixing tools and appliances that can be contaminated prior to mixing of fresh materials.

S. In addition to the above refer to each Section of the Specifications for additional installation requirements for the proper completion of all work.

PART 2 - PRODUCTS

2.1 QUALITY CONTROL

A. Refer to Division 1 of the Specifications.

B. The manufacturer of equipment or materials listed on the drawings or specifically indicated in the specification is the basis of design. If the drawings and specifications are in conflict, the drawings shall take precedence. Other manufacturers listed are considered general equivalents only. See below for coordination of substitutions.

C. Products by manufacturers not listed in this Specification may be submitted to the Engineer only during normal submittal procedure, and only as “substitutions”. All bids must use basis of design or listed general equivalents.

D. Items submitted as a substitution to the basis of design or listed general equivalents shall be identified as such and shall include a written request for substitution indicating the following:

1. Contract price adjustment.
2. Contract time adjustment.
3. Item by item breakdown of differences between basis of design and substituted item.
4. Operation, maintenance, and energy cost difference.

E. Coordination of general equivalents and substitutions: Where Contract Documents permit selection from several general equivalents, or where substitutions are authorized, coordinate clearance and other interface requirements with mechanical and other work.

1. Provide necessary additional items so that selected or substituted item operates equivalent to the basis of design and properly fits in the available space allocated for the basis of design.
2. Provide all features which are standard on the basis of design.
3. Contractor is responsible for assuring that piping, conduit, duct, flue, and other service locations for general equivalents or substitutions do not cause access, service, or operational difficulties any greater than would be encountered with the basis of design.

2.2 GENERAL SUBMITTAL REQUIREMENTS

A. Refer to Division 1.

B. Coordination and Sequencing:

1. Coordinate submittals 2 weeks (min.) prior to expected order date so that work will not be delayed by submittals.
2. No extension of time will be allowed because of failure to properly coordinate and sequence submittals.
3. Do not submit product data, or allow its use on the project until compliance with requirement of Contract Documents has been confirmed by Contractor.
4. Submittal is for information and record, unless otherwise indicated, and is not a change order request.
5. Submitting contractor is responsible for routing reviewed submittals to all parties affected including but not limited to electrical, temperature control, and test and balance subcontractors.

C. Preparation of Submittals:

1. Refer to Division 1 requirements.
2. Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, Supplier, submittal name and similar information to distinguish it from other submittals.

3. Indicate any portions of work which deviate from the Contract Documents.

    a. Explain the reasons for the deviations.
    b. Show how such deviations coordinate with interfacing portions of other work.

4. Show Contractor's executed review and approval marking.
5. Provide space for Architect's/Engineer's "Action" marking.
6. Submittals which are received from sources other than through Contractor's office will be returned "Without Action".
7. Submittals shall be presented in a neat and legible fashion and shall be returned "Without Action" if presented in any other fashion.
8. Submittals shall have index with tab dividers for each component to facilitate locating information on specific pieces of equipment and products.

D. Quantities: Unless otherwise indicated in Division 1, submit six copies.

1. Refer to Division 1 requirements.
2. Multiple System Items: Where a required submittal relates to an operation or item of equipment used in more than one system, increase the number of final copies as necessary to complete the Maintenance Manuals for each system.
3. Preliminary Submittal: Provide a preliminary, two-copy submittal for automatic temperature controls and when product data is required (or desired by Contractor) for selection of options by Architect/Engineer.
4. General Distribution:

    a. Provide additional distribution of submittals (not included in foregoing copy submittal requirements) to Subcontractors, Suppliers, Fabricators, Installers, Governing Authorities and others as necessary for proper performance of the work.
    b. Include such additional copies in transmittal to Architect/Engineer where required to receive "Action" marking before final distribution.

        1) Show such distributions on transmittal forms.

E. LEED Submittals:

1. Credit WE 3.1 and 3.2: Product Data for plumbing fixtures indicating water consumption. Prerequisite EA 3.0: Product Data for new HVAC equipment indicating absence of CFC refrigerants.
2. Credit EA 4.0: Product Data for new HVAC equipment indicating absence of HCFC refrigerants.
3. Credit EA 5.0: Product Data and wiring diagrams for sensors and data collection system used to provide continuous metering of building energy and water consumption performance over time.
4. Credit EQ 1.0: Product Data and Shop Drawings for carbon dioxide monitoring system and/or outdoor air monitoring station.

5. Credit EQ 3.1:

    a. Construction Indoor Air Quality (IAQ) management plan.
    b. Product Data for temporary MERV 8 filtration media.
    c. Construction Documentation: Six photographs at three different occasions during construction of the different SMACNA requirements along with a brief description of the SMACNA approach employed, documenting implementation of the IAQ management measures, such as protection of ducts, cleaning of air handling units, installation of filters, and on-site stored or installed absorptive materials.

6. Credit EQ 3.2:

    a. Signed statement describing the building air flush-out procedures including the dates when flush-out was begun and completed and statement that filtration media was replaced after flush-out.
    b. Product Data for MERV 8 filtration media used during flush-out.
    c. Report from testing and inspecting agency indicating results of IAQ testing and documentation showing conformance with IAQ testing procedures and requirements.

7. Credit EQ 4.1: Product Data for adhesives and sealants used on the interior of the building indicating VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24).
8. Credit EQ 4.2: Product Data for paints and coatings used on the interior of the building indicating chemical composition and VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24).
9. Credit EQ 5: Product Data for MERV 13 filtration media used during occupancy.
10. Credit EQ 7.1: Product Data and Shop Drawings for sensors and control system used to monitor and control room temperature.

F. Response to Submittals: Where standard product data have been submitted, it is recognized:

1. That the Submitter has determined that the products fulfill the specified requirements.
2. That the submittal is for the Architect's or Engineer's information only, but will be returned with appropriate action where observed to be not in compliance with the requirements.

G. If more than two submissions (either for shop drawings, as-built drawings, or test and balance reports) are made by the contractor, the Owner reserves the right to charge the contractor for subsequent reviews by their consultants. Such extra fees shall be deducted from payments by the Owner to the contractor.

2.3 SPECIFIC CATEGORY SUBMITTAL REQUIREMENTS

A. Manufacturer's Data:

1. Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which of the variations is to be provided.
2. Delete or mark-out significant portions of pre-printed data which are not applicable.
3. Where operating ranges are shown, mark data to show portion of range required for project application.
4. For each product, include the following:

    a. Sizes
    b. Weights
    c. Speeds
    d. Capacities
    e. Piping and electrical connection sizes and locations.
    f. Statements of compliance with the required standards and regulations.
    g. Performance data.
    h. Manufacturer's specifications and installation instructions.

B. Shop Drawings:

1. Prepare Mechanical Shop Drawings, except diagrams, to accurate scale.

    a. Show clearance dimensions at critical locations.
    b. Show dimensions of spaces required for operation and maintenance.
    c. Show interfaces with other work, including structural support.

C. Test Reports:

1. Submit test reports which have been signed and dated by the firm performing the test.
2. Prepare test reports in the manner specified in the standard or regulation governing the test procedure (if any) as indicated.

D. Required equipment and shop drawing submittals:

1. Provide a submittal schedule with bid.
2. Provide equipment submittals for each item of equipment specified or scheduled in the contract documents.
3. Submittal Schedule shall show each item of equipment, applicable Section of the specifications where it is described, applicable Drawing number and schedule name where it is scheduled, date of Contractor's proposed submittal to Architect, required date to receive submittal from Architect and schedule order date.

4. Provide a Mechanical Shop Drawing Schedule for submission to the Architect with the Submittal Schedule. Refer to paragraph 1.3 -Coordination Within Divisions 21 through 23 above.
5. Review of shop drawings and product data by the Architect/Engineer, including any review annotations or stamp notations, does not relieve the contractor from the required compliance with the contract documents.
6. The shop drawing and product data review stamp notation requirements are defined as follows:

    a. "NO EXCEPTION TAKEN:" The reviewer did not observe any items which were not in compliance with the contract documents. All dimensions, details, and coordination with other trades are the responsibility of the contractor.
    b. "MAKE CORRECTIONS NOTED:" The reviewer indicated items observed that were not in compliance with the contract documents. The contractor shall not resubmit, but shall make corrections and provide corrected documents with the "Record Drawings."
    c. "REJECTED, REVISE AND RESUBMIT:" The reviewer indicated items observed which were not in compliance with the contract documents. The contractor shall resubmit showing corrections of all noted items. Delays for resubmittal do not relieve the contractor from meeting project schedules.
    d. "REJECTED:" The submission does not comply with the contract requirements. The entire submittal must be corrected and submitted for review. Delays for resubmittal do not relieve the contractor from meeting project schedules.

7. If shop drawings are submitted and returned as "NO EXCEPTION TAKEN" or "MAKE CORRECTIONS NOTED" and meet contract requirements, the contractor shall not resubmit any other shop drawings for these items.
8. If resubmittals are necessary, they shall be made as specified above for submittals. Resubmittals shall highlight all revisions made and cover shall include the phrase "RESUBMITTAL NO. _____."
   Resubmittal requirements do not entitle the Contractor to additional time and are not a cause for delay of the project.

2.4 COMPATIBILITY

A. General: Provide products which are compatible with other products of the mechanical work and with other work requiring interface with the mechanical work.

B. Altitude Ratings: Except where noted otherwise, all ratings and capacities stated in the Contract Documents are at the altitude of the project, not sea level. Project Altitude shall be considered to be 6,700 feet.

C. Fuel Characteristics:

1. Review fuel characteristics with the Fuel Supplier designated by the Owner.
2. Determine burner or combustion equipment provisions needed for optimum performance. Provide equipment accordingly.

D. Power Characteristics:

1. For power characteristics of equipment supplied under Division 21 through 23 Sections, refer to the Sections of Divisions 26 through 28 and the Electrical Drawings for the power characteristics of each power-driven item of mechanical equipment.
2. Coordinate available power with Electrical Contractor before ordering equipment. Mechanical Contractor shall be responsible for ordering equipment to meet the available power characteristics.
3. See also Division 23 05 01 of these specifications.
4. If there is a conflict between Divisions 21 through 23 documents and Divisions 26 through 28 documents, alert the engineer. Do not order equipment prior to determining the proper electrical service. No contract cost adjustment will be allowed for equipment ordered in conflict with the available power characteristics.

2.5 SAFETY PROVISIONS

A. Equipment Nameplates: Provide power-operated mechanical equipment with a permanent nameplate attached by the manufacturer, indicating:

1. The manufacturer
2. Product name
3. Model number
4. Serial number
5. Speed
6. Capacity
7. Power characteristics
8. Labels of testing, listing, or inspecting agencies
9. Other similar data

B. Where manufacturer affixed nameplate is not available, Mechanical Contractor shall fabricate and attach nameplate.

C. Guards:

1. Unless equivalent guards are provided integral with the equipment, enclose each belt drive (including sheaves) on both side in a galvanized, one-inch, mesh screen of No. 18-gauge steel wire or expanded metal, fastened to an approved, structural steel frame, securely fastened to the equipment or floor.

2. Provide tachometer holes at shaft centers. Unless equivalent guards are provided integral with the equipment, install a solid guard of No. 20-gauge galvanized steel over the coupling of each item of direct-driven equipment.
3. Sides are not required on these guards except to ensure rigidity.

2.6 SAFETY PROVISIONS

A. Any refrigeration system containing CFC-11, CFC-12, HCFC-123, HCFC-22, or any of the other refrigerants listed in the Clean Air Act as a Class I or Class II Ozone Depleting Compound shall comply with the Clean Air Act and the Colorado Air Quality Control Commission Regulation #15.

B. As a minimum all systems shall be equipped with refrigerant recovery service valves, relief valves capable of resetting after activation, and for system with more than 50 pounds of charge, and isolateable receiver and/or condenser capable of holding the complete charge.

PART 3 - EXECUTION

3.1 COORDINATION OF MECHANICAL INSTALLATION

A. Inspection and Preparation:

1. Examine the work interfacing with mechanical work, and the conditions under which the work will be performed, and notify the Architect/Engineer of conditions detrimental to the proper completion of the work at original contract price.
2. Do not proceed with the work until unsatisfactory conditions have been corrected.

B. Layout:

1. Layout the mechanical work in conformity with the Contract Drawings, Coordination Drawings and other Shop Drawings, product data and similar requirements so that the entire mechanical plant will perform as an integrated system, properly interfaced with other work, recognizing that portions of the work are shown only in diagrammatic form.
2. Where coordination requirements conflict with individual system requirements, comply with the Architect's or Engineer's decision on resolution of the conflict.
3. Take necessary field measurements to determine space and connection requirements.
4. Provide sizes and shapes of equipment so the final installation conforms to the intent of the Contract Documents.

C. Integrate mechanical work in ceiling spaces with suspension system, light fixtures and other work so that required performances of each will be achieved.

3.2 PRODUCT INSTALLATION

A. Manufacturer's Instructions:

1. Except where more stringent requirements are indicated, comply with the product manufacturer's instructions and recommendations.
2. Consult with manufacturer's technical representatives, who are recognized as technical experts, for specific instructions on special project conditions.
3. If a conflict exists, notify the Architect/Engineer in writing and obtain his instruction before proceeding with the work in question.

B. Movement of Equipment:

1. Wherever possible, arrange for the movement and positioning of equipment so that enclosing partitions, walls and roofs will not be delayed or need to be removed.
2. Otherwise, advise Contractor of opening requirements to be maintained for the subsequent entry of equipment.

C. Heavy Equipment:

1. Coordinate the movement of heavy items with shoring and bracing so that the building structure will not be overloaded during the movement and installation.
2. Where mechanical products to be installed on the existing roof are too heavy to be hand-carried, do not transport across the existing roof deck; position by crane or other device so as to avoid overloading the roof deck.

D. Return Air Path: Coordinate mechanical work in return air plenum to avoid obstructing return air path.

1. Do not make changes in layout which will reduce return air path cross-sectional areas. Minimum cross-sectional area will provide an average of 500 fpm and a maximum of 750 fpm velocity through return air plenum at specified supply air quantity unless otherwise noted.
2. Provide openings in any full height walls to allow for free movement of return air. Openings are to be sized for 500-750 fpm velocity. Notify the Architect/Engineer for any openings required in fire rated walls that are not shown on the contract drawings.
3. Report any obstructions by work of other Divisions to Architect/Engineer.

E. Clearances:

1. Install piping and ductwork:

    a. Straight and true.
    b. Aligned with other work.
    c. Close to walls and overhead structure (allowing for insulation).
    d. Concealed, where possible, in occupied spaces.

e. Out-of-the-way with maximum passageway and headroom remaining in each space. In spaces without ceilings, mechanical systems are to be installed tight to the underside of structure. Sloping pipe runs must originate tight to structure to allow for maximum installed height throughout.

2. Except as otherwise indicated, arrange mechanical services and overhead equipment with a minimum of:

   a. 7’0” headroom in storage spaces.
   b. 8’6” headroom in other spaces; where approved by Architect.

3. Do not obstruct windows, doors or other openings.
4. Give the right-of-way to piping systems required to slope for drainage (over other service lines and ductwork).

F. Access:

1. Provide for removal, without damage to other parts, of:

   a. Coils
   b. Humidifier manifolds
   c. Tubes
   d. Shafts
   e. Fan wheels
   f. Drives
   g. Filters
   h. Strainers
   i. Bearings
   j. Control components
   k. Other parts requiring periodic replacement or maintenance

2. Connect equipment for ease of disconnecting with minimum of interference with other work.
3. Provide unions where required.
4. Locate operating and control equipment and devices for each access.
5. Provide access panels where units are concealed by non-accessible finishes and similar work. See Section 23 05 03.
6. Extend all grease fittings to an accessible location.

3.3 PROTECTION OF WORK

A. All pipe ends, valves, ducts, and equipment left unconnected shall be capped, plugged or otherwise properly protected to prevent damage or the intrusion of foreign matter.

B. Do not allow any fans in the HVAC system to operate before the area served by the fan has been cleaned and vacuumed of all debris and dust which might enter the system.

C. Any equipment, duct or piping systems found to have been damaged or contaminated above "MILL" or "SHOP" conditions shall be replaced or cleaned to the Engineer's satisfaction.

D. Initial fill of traps:

1. Provide initial water seal fill for all waste P-traps, condensate traps, or similar traps.

3.4 PROTECTION OF POTABLE WATER SYSTEMS

A. All temporary water connections shall be made with an approved back flow preventer.

B. All hose bibs shall have as a minimum, a vacuum breaker, to prevent back flow.

C. Direct connections to hydronic systems shall only be made through a reduced pressure back flow preventer.

3.5 PROTECTION OF SYSTEMS SERVING OCCUPIED SPACES

A. Where work is being performed in occupied spaces, or occupancy is to be phased in with ongoing construction, contractor shall prevent contamination of all systems serving the occupants including but not limited to:

1. Supply or Return Air

a. Systems shall be capped or provided with adequate particulate and gas phase filtration to prevent dust, chemical, or biological contamination. Particulate filters shall be as a minimum equivalent to those specified for the completed system.

2. Domestic Water

a. Isolate sterilized portions from non-sterilized portions.

3.6 REFRIGERATION SYSTEMS

A. All techniques involved in the installation of refrigeration systems shall be certified and trained in accordance with the International Mechanical Code and applicable State Codes, and the applicable sections of the Clean Air Act.

B. No refrigerant shall be intentionally vented to the atmosphere. All refrigerant shall be recovered before opening a closed system for charging, evacuation, service or installation.

C. Refrigerants shall meet project LEED requirements.

3.7 ASBESTOS

A. The identification and/or abatement of asbestos hazards is not part of this contract.

1. If asbestos is encountered, contact Owner for instructions.

3.8 START-UP

A. Assign a full time Divisions 21 through 23 Start-Up Coordinator to this project.

B. The Start-Up Coordinator shall develop detailed start-up procedures, equipment checkout procedures and data forms for recording compliance with contract document performance criteria, and will assist in developing schedules for checkout and Owner acceptance.

C. The Divisions 21 through 23 Contractor shall include as part of the work of this contract, manpower, equipment, tools, ladders, instruments, etc. necessary to confirm start-up of Divisions 21 through 23 systems.

D. The Division 23 05 93, Test, Adjust and Balancing Contractor shall include as part of the work of his/her contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to assist the Start-Up Coordinator in accomplishing his/her work.

E. The Start-Up Coordinator shall be responsible for maintaining documentation of Start-Up activities until final acceptance of the project.

F. The documentation shall be kept current by the Start-Up Coordinator and shall be available for inspection at all times. At the time of acceptance of the project, the Start-Up Coordinator shall surrender 3 completed copies of the documentation to the Owner's representative.

G. Before Testing, Adjusting, Calibration and Balancing (Division 23 05 93), the Start-Up Coordinator shall confirm, in writing to the Owner, the following:

1. All equipment, components, and systems have been set, started-up, and adjusted.
2. Systems have been established at the appropriate temperatures and pressures for proper operation and performance.
3. All electric power connections, disconnects, fuses, circuit breakers, etc. are properly sized and installed.
4. The operation of all valves, dampers and sensors is positive (per the control sequences) and demonstrated.

H. Provide dated matrices for each item of equipment showing the date each of the start-up activities was witnessed or performed by the Start-Up Coordinator.

1. Start-up and operating performance test documentation shall include all Division 21 through 23 equipment with scheduled capacities and all Division 23 09 00 equipment.

I. At the completion of the start-up; and test and balance, Divisions 21 through 23 shall conduct a 72 hour dynamic mode demonstration of the systems in the presence of the Owner and Architect/Engineer.

3.9 DEMONSTRATION

A. Refer to Division 1 sections of the specifications regarding requirements of Record Drawings and Operation and Maintenance Manual submittal and systems demonstration.

1. Demonstrate to the Architect/Engineer that each system operates in accordance with the contract documents.
2. Explain the operation of each system to the Owner's Representative. Explain use of O&M manual in operating and maintaining systems.

B. Date and time of demonstration will be determined by Owner.

3.10 PROJECT CLOSEOUT

A. Refer to the individual sections of the specifications for individual closeout requirements.

B. Provide all documentation required for LEED certification.

C. Provide a written schedule of when systems are to be started up, tested and demonstrated along with dates for completion of the temperature controls and balancing. This schedule shall be submitted no later than 30 days prior to starting up and testing equipment.

D. The contractor shall notify the Architect/Engineer no later than 2 weeks in advance of system testing or demonstration.

3.11 LEED

A. During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3, as summarized below:

1. HVAC Protection – Use temporary heaters whenever feasible. Seal all duct and equipment openings with plastic. If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8,

as determined by ASHRAE 52.2-1999, shall be used over each return air grille. Replace all filtration media immediately prior to occupancy. All leaks in ducts and air handlers should be repaired promptly.

2. Source Control – For Contractor information, all paints, carpet, caulks, adhesives, sealants are specified as low-VOC and non-toxic. Recover, isolate and ventilate containers housing toxic materials. Avoid exhaust fumes from idling vehicles and gasoline fueled tools.
3. Pathway Interruption – During construction, isolate areas of work to prevent contamination of clean or spaces. Ventilate using 100% outside air to exhaust contaminated air directly to the outside during installation of VOC emitting materials. Use pressure differentials or barriers between work and clean areas to prevent contaminated air from entering clean areas.
4. Housekeeping – Protect building materials from weather and store in a clean area prior to unpacking for installation. Clean all coils, air filters, and fans before performing testing and balancing procedures. Institute cleaning activities designed to control contaminants in building spaces.
5. Scheduling – Complete applications of wet and odorous materials such as VOCs in paints, sealants, and coatings before installing absorbing materials such as ceiling tiles, carpets, insulation, gypsum products, and fabric-covered furnishings. Avoid exposure of all interior materials to moisture.
6. Protect stored on-site or installed absorptive materials from moisture damage.

B. After construction ends, prior to occupancy and with all interior finishes installed, perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60%.

1. Contractors option: Either full continuous flush-out or air contaminant testing is required, not both,
2. For building flushout, perform building flush-out before occupancy and after construction is compete, HVAC systems have been tested, adjusted, and balanced, and new filtration media has been installed. Perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60%. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25% of the total air volume prior to occupancy and provide minimum outside air volumes of 0.30 cfm per square foot or design minimum outside air rate, whichever is greater. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing. OR
3. For Air Contaminant testing, perform air contaminant testing prior to occupancy, after interior finishes are installed, HVAC system has been tested, adjusted, and balanced, and new HVAC filtration media has been installed. Collect indoor air samples representative of occupied areas. Collect samples at outside air intake of each air handler at the same time as indoor samples are taken. Analyze air samples and submit report. If air samples show concentrations higher than those specified, ventilate with 100% outside air and retest, or conduct full building flushout as specified above.

4. Air Contaminant Concentration Determination and Limits:

    a. Carbon monoxide: not more than 9 ppm and not more than 2 ppm higher than outdoor air.
    b. Formaldehyde: Not more than 50 ppb and not more than 20 micrograms per cubic meter higher than outside air.
    c. Total Volatile Organic Compounds: Not more than 500 micrograms per cubic meter and not more than 200 micrograms per cubic meter higher than outside air.
    d. 4-Phenylcyclohexene: Not more than 6.5 micrograms per cubic meter.
    e. Particulates: Not more than 50 micrograms per cubic meter.
    f. Total Particulates: Not more than 20 micrograms per cubic meter higher than outside air.

C. Construction waste management: Manage construction waste in accordance with provisions of Division 1. Submit documentation to satisfy the requirements of that section.

END OF SECTION 23 05 02

SECTION 23 05 03 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements.

B. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. The design team shall decide which is more stringent.

C. Provisions of this Section shall also apply to all Sections of Divisions 21 through 23.

1.2 SUMMARY

A. Furnish and install complete electric heat tracing systems as specified herein and as indicated on the mechanical and plumbing drawings. Heat Trace systems shall be installed to maintain the product UL listing with strict conformance to manufacturer's installation requirements.

B. The Division 23 contractor shall be responsible for fully functional and complete heat trace systems. Refer to specification section 23 05 01 Mechanical and Electrical Coordination for heat trace system scope responsibility.

1.3 SUBMITTALS

A. Manufacturer's Data - Submit manufacturer's data for:

1. Access panels.
2. Fire stopping materials.

    a. Application Data - Submit application data for firestopping materials showing UL required installation details for every combination of pipe material, penetrated structure, opening size and required fire rating within the scope of this project. Application data drawings shall include UL system number.

3. Heat Trace.

    a. Submit shop drawings for review prior to installation. Shop drawings shall show the overall system, component product data, each control location, cable lengths, electrical connection requirements, and electrical feed points. Provide a summary sheet of the entire system with capacity data for each cable length.

B. LEED:

1. Adhesives and Sealants:

a. Submit product data or other published information verifying the VOC (Volatile Organic Compound) content is less than or equal to the allowable VOC content established by the governing standard: South Coast Air Quality Management District (SCAQMD) Rule #1168, July 1, 2005 and Green Seal Standard for Commercial Adhesives GS-36, October 19, 2000.

2. Low-Emitting Paints and Coatings:

a. Submit product data or other published information verifying the VOC (Volatile Organic Compound) content is less than or equal to the allowable VOC content established by the governing standards: Green Seal Standard GS-11, Paints, First Edition, May 20, 1993; Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997; South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, January 1, 2004.

PART 2 - PRODUCTS

2.1 ACCESS PANELS

A. See Division 8 for access panel types and finishes.

1. If panels are not specified in Division 8, comply with the following:

a. Manufacturers:

1) Acudor
2) Karp Associates, Inc.
3) Milcor
4) Zurn.

B. Construction:

1. Doors: 14-gauge steel.
2. Frames: 16-gauge steel.
3. Fire Rating: Equivalent to construction in which installed.
4. Latches: Flush or concealed, ¼ turn.
5. Finish: Compatible with finish of construction in which installed.

2.2 FIRE STOPPING MATERIAL

A. Manufacturers:

1. Design Basis: 3M.
2. Other acceptable manufacturers:

    a. GE
    b. Metalines
    c. Hilti

B. General Requirements:

1. Products to be used shall have been tested in accordance with ASTM E 814-88, and be listed in the UL Fire Resistance Directory.

C. Bare Piping:

1. Model: FD 150, or CP-25.

D. Insulated Piping:

1. Model: CP-25 or FS-195, Intumescent.
2. “No-sag” or “self-leveling” as required.

E. Plastic Piping:

1. Model: CP-25 or FS-195, Intumescent.
2. “No sag” or “self-leveling” as required.

F. Accessories:

1. Provide fasteners, restricting collars, backing materials, and protective coatings as required to comply with the UL system listing.

2.3 ACOUSTICAL/PRESSURE SEALING MATERIAL

A. Manufacturers:

1. Manufacturers:

    a. D.A.P. Mono Acoustical Sealant
    b. GE
    c. Metacaulk
    d. Hilti
    e. Pecora

f. Tremco
g. U.S.G.

B. General Requirements:

1. Non-skinning, non-hardening synthetic butyl rubber.
2. Effective adhesive seal for air and vapor barrier.
3. Acceptable for use in air plenums.

C. Accessories:

1. Provide fasteners and backing rods as recommended by manufacturer.

2.4 HEAT TRACE FOR PIPING FREEZE PROTECTION IN WATER PIPING AND FIRE PROTECTION SYSTEMS

A. Manufacturers:

1. Design Basis: Raychem/Pentair.

   a. Model: XL-Trace

2. Other acceptable manufacturers:

   a. Chromalox
   b. Thermon
   c. Emerson/Nelson

B. General Requirements:

1. Intent of heat trace system is to prevent freezing of fluid inside piping.
2. For fire protection systems, this specification is applicable to fire protection supply lines and standpipes only.
3. Heat tracing system shall be designed to maintain the water temperature within the piping of at least 40ºF with an ambient temperature of -20ºF (60 ºF ΔT)**.** The piping shall be insulated as specified in section 23 07 00 Mechanical Insulation.
4. Heat trace circuits shall be limited to a single piped utility only. Where multiple piped utilities in the same location are required to be heat traced, provide separately controlled circuits for each piped utility (i.e. domestic cold water, domestic hot water/recirculation, chilled water, etc. are each on separately controlled heat trace circuits). Domestic hot water and domestic hot water recirculation are allowed to be on the same heat trace circuit. Fire Sprinkler piping heat trace systems shall be dedicated to fire sprinkler piping only.

C. Heat Trace System Requirements:

1. Heating cables shall be UL listed and FM approved electrical heating strips. The electric heat tracing shall be a self-regulating type of parallel circuit construction consisting of a continuous inner core of self-regulating conductive material between two parallel copper bus wires suitable for operation on 277-Volt, 60 hertz, single phase power. Heat trace to be self-regulating at all points of connection and shall be capable of being overlapped or installed on plastic piping without overheating. The heat tracing strips shall be capable of being cut to the desired length in the field. Operating energy shall be conserved by the self-regulating feature of the heater materials, which automatically controls heat output in proportion to the heat requirement. Maximum operating temperature and exposure temperature shall be 150°F. Minimum installation temperature shall be 0°F.
2. The heat trace system shall include all required components for a fully functional system including heating cable, power connection, splice connections, tee connections, end seals, controls, contactors, power distribution panels, glass cloth adhesive tape, aluminum tape, accessories, and tools required for installation. Components shall be specific to the application (i.e. above ground or below ground), pipe material, and insulation type. Heat traced piping shall be labeled “Electric Traced” with permanent labeling. Provide one label per 10 feet of pipe.
3. Above ground piping:

    a. Provide polyolefin jacket on heat trace cables.
    b. Non-fire protection systems: Heat Trace system shall be UL listed and FM approved for above ground general water piping freeze protection applications. Provide all components, connections, and accessories to maintain UL listing.
    c. Fire protection supply lines: Heat Trace system shall be UL listed for above ground fire protection supply line freeze protection applications. Provide all components, connections, and accessories to maintain UL listing. Comply fully with NFPA 13.
    d. Fire protection standpipes: Heat Trace system shall be UL listed for above ground fire protection standpipe freeze protection applications. Provide all components, connections, and accessories to maintain UL listing. Comply fully with NFPA 13.

4. Below ground piping:

    a. Provide fluoropolymer jacket on heat trace cables.
    b. Non-fire protection systems: Heat Trace system shall be UL listed and FM approved for below ground general water piping freeze protection applications. Provide all components, connections, and accessories to maintain UL listing.
    c. Fire protection supply lines: Heat Trace system shall be UL listed and FM approved for below ground fire protection supply line freeze protection applications. Provide all components, connections, and accessories to maintain UL listing. Comply fully with NFPA 13.
    d. Heating cables shall be protected from the pipe to the power connection box in UL listed water-sealed conduit, minimum ¾” diameter, suitable for location where installed.

e. Power connections and end seals shall be made above ground within UL listed junction boxes or manufacturer's connection kits.
f. Closed cell, waterproof thermal insulation with fire-retardant, waterproof covering approved for direct burial is required. Refer to Section 23 07 00 Mechanical Insulation for additional requirements.

D. Heat Trace Circuits:

1. Heat trace circuit quantity for 277V/1PH systems shall be based on maximum cable lengths below. All heat trace cabling shall be served by 20A GFEP circuit breakers. Where multiple cables are required, all cables may be on the same circuit as long as maximum total cable length is not exceeded. Tables below are based on the basis of design heat trace product installed on metallic or plastic piping with insulation as specified. For fluids over 200°F, provide insulation thickness per section 230700 Mechanical Insulation and select cabling as recommended by heat trace system manufacturer.

Heat Trace Circuits for Metallic Piping Systems with Fluids 200°F and less – 277V/1PH				
Pipe Size (Metallic Pipe)	**Insulation Thickness**	**Design Heat Loss in Watts per linear foot**	**Cable Quantity and Power Output at 40°F Maintain Temperature and 60°F ΔT (Watts per linear foot)**	**Maximum Total Cable Length per circuit at -20°F startup temperature, 277V/1PH, 20A GFEP Circuit Breaker**
½" and ¾"	1-1/2"	1.82 W/lf	(1) cable at 7.2 W/lf	245 ft.
1"	1-1/2"	2.06 W/lf	(1) cable at 7.2 W/lf	245 ft.
1-1/4"	2"	1.96 W/lf	(1) cable at 7.2 W/lf	245 ft.
1-1/2"	2"	2.18 W/lf	(1) cable at 7.2 W/lf	245 ft.
2"	2"	2.44 W/lf	(1) cable at 7.2 W/lf	245 ft.
2-1/2"	2"	2.8 W/lf	(1) cable at 7.2 W/lf	245 ft.
3"	2"	3.18 W/lf	(1) cable at 7.2 W/lf	245 ft.
4"	2"	3.8 W/lf	(1) cable at 7.2 W/lf	245 ft.
6"	2"	5.12 W/lf	(1) cable at 7.2 W/lf	245 ft.
8"	2"	6.34 W/lf	(1) cable at 7.2 W/lf	245 ft.
10"	2"	7.66 W/lf	(2) cables at 7.2 W/lf each	245 ft.
12"	2"	8.88 W/lf	(2) cables at 7.2 W/lf each	245 ft.
14"	2"	9.62 W/lf	(2) cables at 7.2 W/lf each	245 ft.
16"	2"	10.84 W/lf	(2) cables at 7.2 W/lf each	245 ft.
18"	2"	12.06 W/lf	(2) cables at 7.2 W/lf each	245 ft.
20"	2"	13.28 W/lf	(2) cables at 7.2 W/lf each	245 ft.

Heat Trace Circuits for Plastic Piping Systems with Fluids 200°F and less – 277V/1PH				
Pipe Size (Plastic Pipe)	**Insulation Thickness**	**Design Heat Loss in Watts per linear foot**	**Cable Quantity and Power Output at 40°F Maintain Temperature and 60°F ΔT (Watts per linear foot)**	**Maximum Total Cable Length per circuit at -20°F startup temperature, 277V/1PH, 20A GFEP Circuit Breaker**
½" and ¾"	1-1/2"	1.82 W/lf	(1) cable at 5.4 W/lf	245 ft.
1"	1-1/2"	2.06 W/lf	(1) cable at 5.4 W/lf	245 ft.
1-1/4"	2"	1.96 W/lf	(1) cable at 5.4 W/lf	245 ft.
1-1/2"	2"	2.18 W/lf	(1) cable at 5.4 W/lf	245 ft.
2"	2"	2.44 W/lf	(1) cable at 5.4 W/lf	245 ft.
2-1/2"	2"	2.8 W/lf	(1) cable at 5.4 W/lf	245 ft.
3"	2"	3.18 W/lf	(1) cable at 5.4 W/lf	245 ft.
4"	2"	3.8 W/lf	(1) cable at 5.4 W/lf	245 ft.
6"	2"	5.12 W/lf	(1) cable at 5.4 W/lf	245 ft.
8"	2"	6.34 W/lf	(2) cables at 5.4 W/lf each	245 ft.
10"	2"	7.66 W/lf	(2) cables at 5.4 W/lf each	245 ft.

Heat Trace Circuits for Plastic Piping Systems with Fluids 200°F and less – 277V/1PH				
Pipe Size (Plastic Pipe)	**Insulation Thickness**	**Design Heat Loss in Watts per linear foot**	**Cable Quantity and Power Output at 40°F Maintain Temperature and 60°F ΔT (Watts per linear foot)**	**Maximum Total Cable Length per circuit at -20°F startup temperature, 277V/1PH, 20A GFEP Circuit Breaker**
12”	2”	8.88 W/lf	(2) cables at 5.4 W/lf each	245 ft.
14”	2”	9.62 W/lf	(2) cables at 5.4 W/lf each	245 ft.
16”	2”	10.84 W/lf	(2) cables at 8.1 W/lf each	194 ft.
18”	2”	12.06 W/lf	(2) cables at 8.1 W/lf each	194 ft.
20”	2-1/2”	10.94 W/lf	(2) cables at 8.1 W/lf each	194 ft.

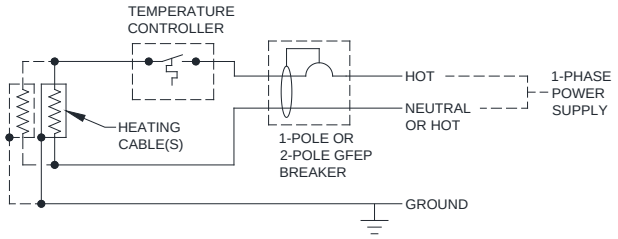
Adjust heat trace cabling power output and circuit quantity as required for design voltage, piping material, insulation type, insulation thickness, and selected manufacturer’s maximum cable lengths.

E. Controls and Power Distribution:

1. Each heat trace circuit shall be served by a dedicated heat trace controller:

    a. Provide microprocessor-based single-point heat trace electronic controller with programmable keypad and integral ground-fault protection. Basis of design: Raychem C910-485.
    b. Controller shall include internal trip functionality and shall comply fully with the NEC.
    c. Controller shall be NEMA 4X rated with ambient operating temperature range of -40°F to 140°F and relative humidity range of 0% to 90% non-condensing.
    d. Controller shall include local LED indicator lights to indicate when heater is on and when an alarm condition exists.
    e. Controller shall include an isolated solid-state triac relay and a dry contact relay for alarm annunciation.
    f. Controller shall be capable of detecting and reporting a ground fault, ambient temperature or piping temperature, and system current. Controller shall automatically conduct periodic testing of system for faults and shall alert the BMS when a fault is detected.
    g. Controller shall be wired in a single circuit control configuration with the controller mounted in series with the heating cable. Wiring shall be per manufacturer’s recommendations.
    h. Total heat trace circuit capacity may not exceed the current rating of the heat trace controller.

i. Power Wiring Diagram:



2. Control Methodology:

a. Provide 3-wire 100-ohm platinum resistance temperature detector (RTD) for ambient-sensing control of heat trace system.
b. RTD to be installed in same space as heat traced piping and wired to heat trace controller per manufacturer's recommendations. RTD shall measure ambient air temperature near heat traced piping system. Where system is larger than 75 linear feet, provide two RTDs wired to heat trace controller and mounted at the 1/3 and 2/3 distances of the heat traced piping run.
c. For heat trace installed on fire protection piping systems: Provide wired connection from heat trace controller to fire alarm control panel for alarm indication to fire alarm system. Comply fully with NFPA 13.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Quality Coordination: Where excavation and backfill for mechanical work passes through or occurs in the same area as work specified in Division 2, comply with both the requirements of Division 2 and the requirements of this Section, or whichever is the more stringent (as determined by the Architect/Engineer in cases of conflicting requirements).

B. Inspection:

1. Examine the areas to be excavated, and the conditions under which the work is to be performed.
2. Notify the Architect/Engineer in writing of conditions detrimental to the proper completion of the work.
3. Do not proceed with excavating until unsatisfactory conditions have been corrected.

C. General:

1. Do not excavate for mechanical work until the work is ready to proceed without delay, so that the total time lapse from excavation to completion of backfilling will be minimum.
2. Remove all rock and boulders from excavation before installing mechanical work.
3. Slope sides of excavations as required for stability, or provide necessary shoring.
4. Remove shoring during backfilling.
5. Excavate near large trees (within the drip line) by hand.

    a. Protect the root system from damage or drying to the greatest extent possible.
    b. Maintain moist condition for root system and cover exposed roots with burlap.
    c. Paint root cuts of 1” diameter and larger with asphaltic tree paint.

6. Saw-cut asphalt and concrete surfaces.

D. Existing Utilities: Locate and protect existing utilities and other underground work in a manner which will ensure that no damage or service interruption will result from excavating and backfilling.

E. Depth of Excavation:

1. Depth for Exterior Piping: Except as otherwise indicated, excavate for exterior piping so that the vertical distance between top of piping and finished grade will not be less than that prescribed by code.
2. Excavate for exterior water-bearing piping (water, steam condensate, drainage) so that the vertical distance between top of piping and finished grade will not be less than 5’0” vertical distance below finished grade.
3. Depth for Unsatisfactory Soil Conditions:

    a. Where directed, because of unsatisfactory soil condition at bottom of excavation, excavate additional depth as directed to reach satisfactory soil-bearing condition. Backfill with “squeegee” washed rock, or other approved sub-base material, compacted as directed, to indicated excavation depth.
    b. Where piping crosses over an area more than 5’0” wide, which has been previously excavated to a greater depth than required for the piping installation:

        1) Excavate to undisturbed soil in a width equal to the pipe diameter plus 2’0”.
        2) Install “squeege” washed rock, or 8” courses of approved subbase material; each course compacted to 95% of maximum density, as required to fill excavation and support piping.

    c. Refer to Change Order procedure elsewhere in Contract Documents.

F. Protection:

1. Provide temporary covering or enclosure and temporary heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install mechanical work on frozen excavation bases or subbases.
2. Coordinate excavations with weather conditions, to minimize the possibility of washouts, settlements and other damages and hazards.
3. Allow no more than 100 feet between pipe laying and point of complete backfilling.
4. Maintain dry excavations for mechanical work by removing water.

    a. Protect excavations from inflow of surface water.
    b. Pump minor inflow of ground water from excavations.
    c. Protect excavations from major inflow of ground water by installing temporary sheeting and waterproofing.
    d. Provide adequate barriers which will protect other excavations and below-grade property from being damaged by water, sediment or erosion from or through mechanical work excavations.

5. Provide signs, illumination and barricades as necessary to prevent accidents at excavations.
6. Install and operate a well-point dewatering system to maintain ground water at a level approximately 2’0” below mechanical work excavations, until backfilling is completed.

G. Excavated Material:

1. Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work. Do not store under trees (within the drip line).
2. Retain excavated material which complies with the requirements for backfill material.
3. Remove excavated material which is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material from project site, and dispose of in a lawful manner.
4. Coordinate acceptable stockpiling areas with Owner in advance of excavation.

H. Bedding:

1. Where indicated below, install as bedding material graded sand with 100% passing through a 3/8” sieve, and 0% passing through No. 100 sieve.

    a. Compact by tamping to form a firm base for the work.
    b. Install bedding from six inches below bottom of pipe to six inches above top of pipe.

c. Provide bedding for:

1) Wrapped, coated or plastic pipe and tanks.
2) Piping over six inches, horizontal cylindrical tanks, and similar work.

a) Shape the subbase to fit the shape of the bottom 90º of the cylinder, for uniform continuous support.

3) All water and sewer pipe.

2. Where rock is used as sub-base, place 8-mil polyethylene between rock and bedding.
3. Shape sub-bases and bottoms of excavations with recesses to receive pipe bells, flange connection, valves and similar enlargements in the piping systems.

I. Concrete Encasement: Where piping under roadways is less than 2'6" below surface of roadway, or where ductwork is buried below grade:

1. Provide 4" base slab of concrete to support piping and ductwork.
2. After piping or ductwork is installed and tested, provide 4" thick encasement (sides and top) of concrete before backfilling.

a. Provide external structural reinforcing of all rectilinear cross section ductwork or any ductwork which is less than 18 ga sheet metal (or equivalent) to prevent collapse of ductwork encasement.

3. Provide minimum 2500 psi concrete for encasement and slab.

J. Backfilling:

1. Do not backfill until installed mechanical work has been tested and accepted, wherever testing is indicated.
2. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities.
3. Do not backfill with frozen soil materials.
4. Backfill simultaneously on opposite sides of mechanical work, and compact simultaneously.
5. Do not dislocate the work from installed positions.
6. Backfill to elevations matching adjacent grades, at the time of backfilling excavations for mechanical work.
7. Backfill with finely graded sub-base material to 6" above wrapped, coated, and plastic piping and tanks, and to centerline of other tanks.
8. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the densities indicated in Division 2 using power-driven, hand-operated compaction equipment.

9. If densities are not indicated in Division 2, compact to the following percent of maximum per ASTM D1557:

    a. Lawn/Landscaped Areas: 85%.
    b. Paved Areas, Other than Roadways: 90%.
    c. Roadways: 95%.
    d. Floors: 95%.

10. Where compaction tests indicate lower densities of backfill than specified, continue compaction (and re-excavation and backfilling where necessary).

    a. Provide additional testing as directed by the Architect/Engineer.
    b. The allowable density tolerance is not more than one-test-out-of-five failing more than two percentage points below the specified density.
    c. Initial testing is not work of this Section.

11. Where subsidence is measurable or observable at mechanical work excavations during the guarantee period:

    a. Remove the surface (pavement, lawn or other finish).
    b. Add backfill material, compact, and replace the surface treatment.
    c. Restore the appearance, quality and condition of the surface or finish to match adjacent work.
    d. Eliminate evidence of the restoration to the greatest extent possible.

K. Landscape Restoration:

1. Where excavation and backfill for mechanical work passes through or occurs in a landscaped area, repair or replace the landscape work to match the original condition and quality of the work.
2. Comply with the requirements of Division 2 for repair or replacement of work, and for follow-up maintenance on lawns and planting to ensure satisfactory recovery.

L. Pavement Restoration:

1. Where excavation and backfill for mechanical work passes through or occurs in an area of paving or flooring, replace and restore the construction and finish of the paving or flooring to match the original condition and quality of the work.

M. Surface Repairs:

1. The repairing and replacing of previously installed landscape development work, paving, floor slabs and similar finishes occurring in excavated areas shall be provided, but is not included in work of Divisions 21 through 23.

3.2 CUTTING AND PATCHING

A. Refer to Division 1 of the Specifications.

B. General: Provide measurements, drawings and layouts to installers of other work so that required openings may be provided as construction progresses. Any cutting and patching made necessary by failure to provide this information shall be done at no increase in the contract amount.

C. General: All cutting and patching of existing work required for work of Divisions 21 through 23 is included in Divisions 21 through 23.

D. Where possible, mark openings to be cut on existing construction. Otherwise, provide measurements, drawings and layouts to the trade doing the cutting so that openings may be provided as construction progresses.

E. Cutting Concrete:

1. Where authorized, cut openings through concrete for pipe penetration and similar services by core drilling or sawing.
2. Do not cut by hammer-driven chisel or drill.

F. Cutting:

1. Cut openings in accordance with layouts, measurements or drawings of the Installer of work requiring openings. Cut openings in concrete by core drilling or sawing; not by hammer-driven chisel or drill.
2. Coordinate the location of all openings with structural drawings. Report any discrepancies to Architect. Do not proceed with work until discrepancies have been resolved.
3. Do not endanger or damage other work through the procedures and processes of cutting to accommodate mechanical work.
4. Review the proposed cutting with the Installer of the work to be cut, and comply with his recommendations to minimize damage.
5. Where necessary, engage the original Installer or other specialists to execute the cutting in the recommended manner.

G. Patching:

1. Where patching is required to restore other work because of either cutting or other damage inflicted during the installation of mechanical work, engage experienced craftsmen to complete the patching of the other work.
2. Restore the other work in every respect, including the elimination of visual defects in exposed finishes.
3. All openings in fire rated construction shall be patched and sealed with U.L. approved sealant to maintain the fire integrity of the structure.

H. Perform cutting, and patching required to:

1. Uncover work to provide 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/Engineer, uncover and restore work to provide for Architect/Engineers observation of concealed work.

I. Painting: Paint all surfaces marred by cutting and/or patching to match existing.

1. Engage experienced painters.
2. Comply with requirements of Painting Sections of this Specification.

J. Structural Limitations:

1. Do not cut or drill into structural framing, walls, floors, decks, and other members intended to withstand stress, except with Engineer's written authorization.

    a. Provide lintels, columns, braces and other temporary and permanent supports made by cutting.
    b. Submit shop drawings of permanent supports.
    c. Do not penetrate legs of structural "T's" or any other location where pre-stressed structural chords are likely to be encountered when cutting or drilling.

3.3 ACCESS PANELS

A. Furnish access panels where indicated and at locations where required for access to:

1. Concealed valves
2. Dampers
3. Control devices
4. Equipment servicing
5. Shock arresters
6. Air vents
7. Flow measuring and balancing stations
8. Any other device or item equipment requiring maintenance, adjustment or service.

B. Deliver access panels for installation by the trade responsible for surface in which installed.

1. Provide instructions for location.
2. Access doors shall be sized as required to allow equipment removal, with a minimum size of 12"x12".

3.4 SLEEVES

A. Provide sleeves for piping passing through walls, floors and roofs.

B. Set pipe sleeves and inserts in place before concrete is poured. Coordinate the placing of these items to avoid delaying concrete placing operations.

C. Locate chases, shafts, and openings required for the installation of the mechanical work during framing of the structure. Do any additional cutting and boring required due to improperly located or omitted openings without cost to the Owner under the supervision of the Owner's representative.

D. Size sleeves for below grade pipe a minimum of 2" beyond outside of pipe.

E. Provide Sleeves as Follows:

Sleeve Location	**Sleeve Material**
Interior Stud Partition Walls	Adjustable galvanized sheet metal with wall flanges and plaster lip, 2" and smaller – 22 gauge, 3" through 6" – 20 gauge, 8" and larger – 18 gauge.
Membrane Waterproof Floor and Roof Construction	Galvanized cast iron body with flashing clamp, threaded for sleeve riser. (J.R. Smith 1760 or equivalent by Ancon, Zurn or Josam).
Nonmembrane Floor, Construction	Non-adjustable galvanized sheet metal with deck flange and end cap, 2" and smaller – 22 gauge, 3" – 20 gauge, 4" and larger – 16 gauge.
Exterior Walls Below Grade	Standard weight galvanized steel pipe with a continuously welded water stop of ¼" steel plate extending from outside of sleeve a minimum of 2" all around. Provide modular mechanical–type seal consisting of interlocking synthetic rubber links with bolts shaped to continuously fill the annular space between the pipe and sleeve. Thunderline Corporation "Link-Seal" sealant assembly or equal by Metraflex "MetaSeal".
Floors of Mechanical Rooms, Concrete Walls or Masonry Walls Above Grade.	Standard weight galvanized steel pipe.

F. Length of Sleeves as Follows:

Location	**Sleeve Length**
Floors	Equal to depth of floor construction including finish. Extend minimum of 1" above finished floor level within partitions, mechanical rooms, pipe chases and finished areas.

Location	**Sleeve Length**
Roofs	Equal to depth of roof construction including insulation.
Walls	Equal to depth of construction.

3.5 FIRE STOPPING

A. Install firestopping materials in accordance with their UL and ASTM tested methods.

B. Coordinate required annular space with size of pipe and sleeve. Refer to Section 23 05 22.

C. Requirements for specific systems:

1. Cold piping - includes chilled water, domestic water, storm water and refrigerant: Insulation and vapor barrier shall be continued through wall and firestopping for "insulated piping" shall be provided.
2. Hot piping - to 250ºF -includes domestic hot water, steam to 15 psig and heating hot water: The Contractor has the option of continuing the insulation through the penetration and providing firestopping for "insulated piping", or stopping the insulation on either side of the penetration and using firestopping for "uninsulated piping".
3. High temperature piping, over 250ºF or over 15 psig steam: Contractor shall stop insulation and provide firestopping for "high temperature piping".

3.6 HEAT TRACE

A. Furnish and install a complete electric heating cable system as indicated on the mechanical and plumbing drawings.

B. Heat trace cable shall be installed by a licensed electrician.

C. Heat trace systems shall be installed per manufacturer's requirements in order to maintain system agency listings.

D. Minimum installation temperature shall be 0°F. Do not apply heat trace when pipe temperature, roof temperature, gutter temperature, or downspout temperature is below 0°F.

E. Apply the heat trace cable on the pipe after pressure testing.

1. Do not spiral wrap on pipe.
2. Make one wrap at valves.
3. Secure to pipe with methods approved by manufacturer.

F. Apply "Electrically Traced" signs on outside of insulation for heat traced piping. Provide one sign for every 10' of pipe length.

G. Heating cable circuit integrity shall be tested using a 2500 VDC megohmmeter at the following intervals. Minimum acceptable insulation resistance shall be 1000 megohms or greater.

1. Before installing the heating cable
2. After heating cable has been installed onto the pipe
3. After installing connection kits
4. After the thermal insulation is installed onto the pipe
5. Prior to startup

H. Heat trace shall be sized based on the application, and power shall be provided in accordance with manufacturer's recommendations for circuit quantity and power distribution.

I. Do not locate heat trace controllers in Class 1, Division 2 hazardous areas.

J. Startup shall be conducted by manufacturer's representative.

3.7 EQUIPMENT BASES AND SUPPORTS

A. Supporting Steel: Provide supporting steel not indicated on the Structural Drawings for equipment, pipe, ductwork, and other pieces of this Division's work requiring same.

1. Submit shop drawings and structural calculations to the Engineer for information and records.
2. Brace and fasten with flanges bolted to structure.
3. Paint supporting steel with one coat of primer paint in the shop after fabrication welding is complete. Paint completed field joints with one coat of matching primer.

B. Housekeeping Bases:

1. Concrete bases for pumps, boilers, tanks, fans, etc., including anchor bolts and inserts, will be provided in accordance with American Concrete Institute (ACI) and American Society for Testing and Materials (ASTM) Standards for housekeeping pads and equipment support bases.
2. The concrete shall be placed in accordance with setting diagrams and sizes furnished by the equipment installer.

C. Roof Curbs

1. All roof-mounted equipment to be provided with a roof curb in accordance with applicable codes and manufacturer's installation instructions. Height of curb to be a minimum of 14" or higher if required by local codes.
2. Curb height is defined as the dimension between finished roof level (inclusive any buildup of insulation, roofing materials, etc.) and the bottom of the associated equipment.

3.8 DRIP PANS

A. Drip Pans: Where possible to run mechanical piping elsewhere, do not run mechanical piping directly above electrical (or electronic) work which is sensitive to moisture. Otherwise, provide drip pans under mechanical piping, sufficient to protect electrical work from dripping.

1. Locate pan immediately below piping, and extend a minimum of 6” on each side of piping and lengthwise 18” beyond equipment being protected.
2. Fabricate pans 2” deep of reinforced sheet metal with rolled edges and soldered or welded seams; 22-gauge galvanized steel.
3. Provide ¾” copper drainage piping from pan to nearest floor drain or similar suitable point of discharge, and terminate pipe as an open-sight drainage connection.
4. Provide permanent support and anchorage to prevent displacement of drip pans.
5. Insulate bottom of pan as directed by Engineer.

3.9 LEED

A. Construction Indoor Air Quality Management: Manage indoor air quality in accordance with applicable LEED requirements.

B. Construction Waste Management and Disposal: Manage construction waste in accordance with applicable LEED requirements.

C. Paints and coatings must comply with Green Seal Standard GS-11, Green Seal Standard GC-03, and South Coast Air Quality Management District Rule 1113.

END OF SECTION 23 05 03

SECTION 23 05 13 - MOTORS AND STARTERS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data.

1. Motors: Identify by unit served. Include:

    a. Voltage
    b. Phase
    c. Horsepower
    d. Frame
    e. Insulating class
    f. Efficiency
    g. Power factor
    h. Index number
    i. Speed
    j. Starting characteristics

2. Starters: Identify by motor served. Include:

    a. Enclosure, NEMA Type
    b. NEMA size
    c. Accessories, switches, transformers, etc.
    d. Wiring diagram
    e. Auxiliary contacts
    f. Thermal overload size

3. Submit as part of packaged unit submittals when purchased as part of item of equipment.

1.2 SINGLE MANUFACTURER

A. Provide all motors, except those factory mounted, by a single manufacturer.

B. Provide all starters, except those factory mounted, by a single manufacturer.

C. "Factory mounted" means "as part of a packaged unit" where the motor is not purchased separately from the driven equipment.

PART 2 - PRODUCTS

2.1 MOTORS (OTHER THAN FACTORY MOUNTED)

A. Manufacturers:

1. Manufacturers:

    a. Century
    b. General Electric
    c. Louis Allis
    d. U.S. Motor
    e. Westinghouse

2. Factory-mounted motors may be by equipment manufacturer's standard supplier.

B. Bearings: Ball bearings, grease lubricated with grease fittings.

C. Enclosure: As required by location.

D. Service Factor: 1.15.

E. Full-Load Operation: At 105ºF and altitude of project.

F. Insulation:

1. Constant Speed: Class B.
2. Variable Frequency Controlled: Class F.

G. Efficiency Ratings:

1. All motors one horsepower and larger, except as noted, shall be premium efficiency motors, in accordance with NEMA Standard MGI-2003, Tables 12-12 and 12-13.

H. Electrical Characteristics:

1. Refer to sections 230501, Mechanical and Electrical Coordination.

I. Multi-speed Motors:

1. Type: Motors may be one of the following:

    a. Two speed, two winding 1800/900 rpm.
    b. Two speed, one winding 1800/900 rpm.

J. Variable Speed Drives:

1. All motors operated by a variable speed drive shall be rated for inverter duty.
2. Motor insulation shall be rated for 1200-Volt peak.
3. Provide shaft grounding Aegis SGR or equal on motors to be used with variable speed drives.

2.2 MOTORS (FACTORY MOUNTED)

A. Provide premium efficiency motors.

B. Variable Speed Drives:

1. All motors operated by a variable speed drive shall be rated for inverter duty.
2. Motor insulation shall have 1200-Volt peak capacity.
3. Provide shaft grounding or insulated bearings on motors to be used with variable speed drives.

2.3 STARTERS

A. Manufacturers:

1. Allen Bradley
2. Cerus
3. Cutler-Hammer
4. General Electric
5. Square D

B. General:

1. Starters shall be standard NEMA sizes and UL listed.

C. Type: Across the line except where noted.

D. Enclosure: NEMA Type as required for location.

E. Overload Protection:

1. Type: Trip-free thermal overload relay.
2. Location: Each ungrounded conductor.
3. Reset: Manual.
4. Ambient Temperature Compensation: Provide where required.
5. Overload protection to be sized for nameplate running amps.

F. Auxiliary Contacts:

1. Provisions to add three without removing starter from enclosure.
2. Number: Provide up to three per starter as required for control sequence, and one (1) auxiliary contact.
3. Switchable type, easily changed from N.O. to N.C. without removing from its mounting.

G. Switches in Cover:

1. Manually Controlled: Three wire start-stop.
2. Automatically Controlled: Hand-off-automatic.
3. Start and stop indicating lights.
4. Equipment used for life safety (smoke exhaust, etc.): Hand-Automatic.
5. Equipment not designed to run continuously: Off-Automatic.

H. Control Transformer:

1. Provide when line voltage exceeds 208-Volts.
2. Secondary wiring shall have one leg fused and the other grounded.
3. Secondary voltage not to exceed 120-Volts.

I. Provide starters for all motors as follows:

1. Single phase motors less than ½ hp.

    a. With internal overload protection: None.
    b. Without internal overload protection:

        1) Manually Controlled: Manual starter.
        2) Automatically Controlled: Magnetic starter.

2. Single phase motors ½ hp and larger:

    a. Manually Controlled: Manual starter.
    b. Automatically Controlled: Magnetic starter.

3. Three Phase Motors: Magnetic starter.

J. Soft Start Starters:

1. Provide Y-Delta or solid state reduced-voltage starters for all motors 5hp and larger.
2. Starter shall limit starting voltage to 200% of full load voltage.

K. Multi-Speed Starters:

1. Starters shall be suitable for the type multi-speed motor selected.
2. Provide time delay for automatic transfer from high to low speed.

L. Housing coils to be 120V.

M. Motor Protection: (above 20 hp)

1. Provide Single-phase protection.
2. Provide undervoltage protection.

PART 3 - EXECUTION

3.1 MOTORS

A. Install motors on motor-mounting systems so coupling or belt drive is properly aligned. Provide proper belt tension. Dowel direct coupled motors.

3.2 STARTERS

A. Deliver to installer of electrical work.

B. All safety devices shall be wired so that they will stop the motor with a hand-off-automatic switch in the hand as well as the automatic position.

END OF SECTION 23 05 13

SECTION 23 05 21 - PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Welder Qualifications: Welders, both on-site and off-site, shall be certified for the type of work being performed by one of the following:

1. National Certified Pipe Welding Bureau.
2. Intermountain Testing Company

B. Welder Certificates:

1. Submit one copy of certificate to Architect/Engineer.
2. Maintain one copy on project site.

C. LEED:

1. Adhesives and Sealants:

    a. Submit product data or other published information verifying the VOC (Volatile Organic Compound) content is less than or equal to the allowable VOC content established by the governing standard: South Coast Air Quality Management District (SCAQMD) Rule #1168, July 1, 2005 and Green Seal Standard for Commercial Adhesives GS-36, October 19, 2000.

2. Low-Emitting Paints and Coatings:

    a. Submit product data or other published information verifying the VOC (Volatile Organic Compound) content is less than or equal to the allowable VOC content established by the governing standards: Green Seal Standard GS-11, Paints, First Edition, May 20, 1993; Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997; South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, January 1, 2004.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Refer to the following sections:

1. 21 13 00 - Fire Protection
2. 22 10 00 - Plumbing Piping
3. 22 21 23 - Natural Gas Piping
4. 23 21 13 - Hydronic Piping
5. Other Divisions 21 through 23 sections after specific system requirements.

2.2 GROOVED PIPE COUPLING SYSTEMS

A. Manufacturers of Coupling System:

1. Basis of Design: Victaulic
2. Other Acceptable Manufacturers: Grinnell and Gruvlok. Alternate is to provide a system of standard weight black steel pipe with black steel standard weight butt weld or 125 lb. cast iron flanged fittings.
3. All couplings, gaskets and joining method adapters shall be provided by one manufacturer.
4. Training: A factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation.

B. Dimensional Standards:

1. All grooved pipe fittings, couplings, and specialties shall conform to standard dimensional standards ANSI/ANWA C-606 or MIL-P-11087C.

C. Acceptable Products:

1. Only the following grooved pipe products may be used:

   a. Gaskets: (ASTM D2000) EHP, for water service, with or without propylene glycol -30ºF to 250ºF, primary seal by compression of coupling housing, either pressure or vacuum shall assist in sealing force.
   b. Couplings - Steel Pipe: Ductile iron (ASTM A-536) or malleable iron (ASTM A-47), with enamel paint coating.

      1) Rigid Couplings: Style 107, 07, W07 zero flex.
      2) Flexible Couplings: Style 177, 77, W77.

c. Flange Adapters: Same materials as couplings. Provide for rigid connection to grooved pipe. Provide flange washers and/or flange gaskets as required for mating to non-standard flanges, such as butterfly valves with elastomeric face, or serrated face flanges.

1) ANSI Class 125 or 150: Style 741.
2) ANSI Class 300: Style 743.
3) Alternate to flange adapter: Flange by groove nipple #41 (Class 125), #45 (Class 150), #16 (Class 300).

d. Branch Outlet Couplings: Design similar to coupling with integral side outlet.
e. Fittings for steel pipe: Standard pattern fittings, ductile iron (ASTM A-536), malleable iron (ASTM A-47) or segmentally welded Schedule 40 steel (ASTM A-53) with enamel paint coating. All changes in direction greater than 22º shall be with R=1.5D radius elbow. All branches and changes in direction in drainage piping shall be made with sanitary type lateral branches and R=1.5D elbows.
f. Accessories: Other piping accessories such as strainers, suction diffusers and flow indicators may be provided with grooved ends, all such accessories shall comply with the applicable specification section.

2. All other pipe products shall conform to the requirements of other Divisions 21 through 23 sections. Acceptance of grooved pipe systems does not imply acceptance of the coupling manufactures valves, branch outlets, strainers, or other specialties.

2.3 PRESS FIT JOINING SYSTEM

A. Manufacturer

1. Viega ProPress
2. Nibco Press System
3. Other approved manufacturer

B. Material

1. Press Fittings: Copper press fittings. Must comply with ASME B16.18 or B16.22.
2. O-Rings: EPDM
3. Fittings shall be rated for 0°F to 250°F, and 200 psi.

C. Application

1. Domestic Water, 4” and smaller
2. Hydronic Systems, 4” and smaller

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. General:

1. Install pipe, tube and fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure.
2. Install each run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly, maintenance or replacement of valves and equipment.
3. Reduce sizes by use of reducing fittings.
4. Install piping without springing or forcing.
5. Provide sufficient swing joints, anchors, expansion loops and devices necessary to permit free expansion and contraction without causing undue stresses.
6. Support piping independently at equipment so its weight will not be supported by the equipment.
7. Support piping to maintain a consistent slope as indicated on the drawings without sagging or pocketing of any kind. Where not otherwise indicated, all horizontal piping shall slope a minimum of 1/16 inch per foot to drain at system low points.
8. Provide manual air vents at high points of all pumped piping systems. Provide drains at all low points.
9. Install horizontal piping parallel to building construction, make any changes in direction with fittings.

B. Location:

1. Locate piping runs, except as otherwise indicated, both vertically and horizontally to allow for complete drainage of piping system (pitched to drain).

    a. Avoid diagonal runs wherever possible.
    b. Orient horizontal runs parallel with walls and column lines.

2. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of the building.

    a. Limit clearance to 0.5” where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any.
    b. Where possible, locate insulated piping for 1.0” clearance outside insulation.

3. Wherever possible in finished and occupied spaces, conceal piping from view by locating in column enclosures, in hollow wall construction or above suspended ceilings.

    a. Do not encase horizontal runs in solid partitions, except as otherwise indicated.

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

1. Exception: where shown on drawings or where accepted by the Engineer, provide drip pan under piping, and conform to NEC.
2. In no case shall piping run directly above transformers, electrical panels or switchgear.

D. Dielectric Unions: Install dielectric unions to prevent galvanic action between ferrous and non-ferrous piping.

1. Install in an accessible location or provide access doors.

3.2 PLASTIC PIPE

A. Use:

1. Contractor shall take full responsibility that the plastic piping used and its installation meets with the approval of the local authorities.
2. Pipe shall be insulated in air plenums such that the entire installation meets ASTM E84 (NFPA 255) with regard to flame spread and smoke developed ratings suitable for plenum installation.
3. Provide pipe with U.V. inhibitors or paint (under Division 9):

a. For all plastic pipe exposed to sunlight or installed in exterior, exposed locations.
b. Store PVC without inhibitors indoors.

3.3 WELDING

A. Welding:

1. Conform to Code for Pressure Piping ANSI B31.
2. Machine cut and bevel piping ends for v-type joints.
3. Use recommended bevels and spacing between ends of pipe to assure full penetration complete to inside diameter of pipe.

B. Welded Joints:

1. Will be observed visually by the Architect/Engineer.
2. Any weld judged defective from a visual observation, shall be ordered tested at the expense of the Contractor or chipped out for full depth and re-welded.

C. Welding Fittings:

1. Unless otherwise noted, make all changes in direction and branch take offs with manufactured fittings.

    a. Use long radius (R=1.50) fittings wherever possible.

2. Shop Fabricated Fittings:

    a. Branches more than two pipe sizes smaller than main line may be made with "weld-o-let" type pre-manufactured saddle fittings.
    b. Where specifically allowed by the Engineer, angles of less than 22½º and branch piping from headers may be made by shop fabricated or manufactured metered fittings.
    c. Submit shop drawings.
    d. Thoroughly clean fittings to remove slag.
    e. Fittings shall be available for observation by the engineer prior to installation.

3. In no case will field made miters or weld-o-let fittings be allowed. Exception: Temperature control wells and water treatment taps may be made with weld-o-let fittings in pipe 3" or larger in diameter.

3.4 COPPER TUBING JOINTS AND FITTINGS

A. Unless otherwise noted, make all couplings, changes in direction, branch outlets, and transitions to other materials or joining methods with standard manufactured fittings.

B. Do not expand or swage piping in lieu of proper solder fittings.

C. Do not extrude or "pull" branch outlets with "tee-drill" type equipment.

D. Do not use self-tapping type branch outlets.

1. See "hot taps" below.

3.5 THREADED JOINTS AND FITTINGS

A. All threaded joints shall be made in accordance with American National Standard B2.1.

1. Do not overthread pipe.
2. Apply pipe joint compound on male threads only.
3. Do not use right and left hand threaded joints to make a "union".

B. Do not thread steel pipe schedule 10 or lighter.

1. UL listed light wall pipe may be threaded in accordance with its listing.

3.6 MECHANICAL COUPLING SYSTEMS

A. All changes in direction shall be made with radius type elbows.

1. Use long radius (R=1.5D) fittings wherever possible.
2. Angles less than 22½º may be made with pre-manufactured metered fittings.
3. Use of the angular deflection capabilities of grooved pipe couplings for intentional changes of direction shall not be allowed.

B. All branch outlets shall be made with pre-manufactured 3-way fittings.

1. Shop fabricated Weld-o-let style welded saddle fittings may be used for branches more than two pipe sizes smaller than the main.
2. Mechanical saddle tap fittings shall not be allowed.

C. Pipe shall be adequately laterally supported to prevent “pipe squirm”. Provide a minimum of one hanger per pipe section. No pipe section shall be left unsupported between any two couplings.

1. Rigid type couplings may be considered equivalent to welded or soldered pipe for the above requirements.

D. Risers more than 20’ high shall be made with rigid type couplings.

E. Grooved pipe systems shall not be considered to be electrically conductive.

1. Provide wire jumpers across all couplings where the piping system is required to be electrically conductive.
2. Cold water piping using grooved pipe systems shall not be used for building ground.

    a. Provide an engraved plastic sign at the building water entrance stating, “Mechanical Coupling System”. Not Electrically Conductive”.

F. Flexible couplings may be used for thermal expansion/contraction compensation.

1. Use a minimum of 1 flexible coupling for every 100 feet for chilled water and domestic cold-water piping.
2. Use a minimum of 1 flexible coupling for every 50 feet for hydronic hot water or domestic hot-water piping.
3. The above is for cut grooved pipe. Double the amount of the connectors with roll grooved pipe and fittings.

3.7 PRESS FIT SYSTEMS

A. Fittings and piping shall be joined in accordance with manufacturer's installation guidelines.

1. Tubing shall be fully inserted into fitting.
2. Mark all tubes at shoulder of fitting.
3. Press joints using manufacturer approved tool.

3.8 HOT TAPS

A. Installing a branch line in piping while under service or static pressure (hot taps) shall only be done where specifically authorized.

B. Submit the proposed method of procedure for each fluid service and pipe material.

1. Hot tap procedure shall remove a plug of main tap material and retrieve it. The plug shall be a maximum of 1 pipe size smaller than the branch size. Hang the removed plug by a chain at the completed tap.
2. Hot tap procedure shall not affect the temperature or pressure rating of the piping system.
3. Hot tap procedure shall be done through a gate or ball valve.

3.9 SENSOR WELL TAPS

A. Sensor wells shall be placed in taps made in accordance with the above requirements for branch outlets.

3.10 CLEANING, FLUSHING, INSPECTING

A. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings, if any.

B. Flush out water and piping systems with clean water before proceeding with required tests.

C. See specific pipe service section for further requirements.

3.11 PIPING TESTS

A. Provide temporary equipment for testing, including pump, thermometer and gauges.

B. Test piping system before insulation is installed wherever feasible, and remove control devices before testing.

C. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating.

D. Fill each section of water, drain or vent piping with water and pressurize for two hours at 150% of operating pressure, but not less than 25 psig for pressure piping, and ten feet of head for drain and vent piping.

E. Test fails if leakage is observed, or if temperature compensated pressure drop exceeds 1% of test pressure.

F. Disassemble and re-install sections which fail the test by using new materials to the extent required to overcome leakage.

1. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

G. After testing and repair work have been completed, drain test water from piping systems.

3.12 MECHANICALLY FORMED TEE CONNECTIONS (DOMESTIC WATER SYSTEMS ONLY)

A. Mechanically extracted collars shall be formed in a continuous operation consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the branch tube wall so as to comply with the American Welding Society lap joint weld. The collaring device shall be fully adjustable as to ensure proper tolerance and complete uniformity of the joint.

B. The branch tube shall be notched to conform with the inner curve of the run tube and have two dimple/depth stops (one ¼" atop the other) to ensure penetration of the branch tube into the collar is of sufficient depth for brazing, and that the branch tube does not obstruct the flow in the main line tube. Dimple/depth stops will be in line with the run of the tube. The second dimple shall be ¼" above the first and will serve as a visual point of inspection.

C. All joints shall be brazed in accordance with the Copper Development Association Copper Tube Handbook using BCuP series filler metal. NOTE: Soft soldered joints will not be permitted. Contractor assumes responsibility for joints being installed in accordance with code and manufacturer's recommendation.

D. All mechanically formed branch collars shall be listed by the Standard Plumbing Code, I.A.M.P.O., S.B.C.C. HUD, U.S. Army Corps of Engineers, NAVFAC, and Underwriters Laboratory. They shall also comply with the ASME Code for pressure Piping ANSI B31.5c.

3.13 PLASTIC PIPING

A. Do not test with air pressure.

B. Provide mineral wool fire blanket and tape sealant system to protect all plastic pipe in a return air system.

C. Support all plastic piping in anticipation of 120ºF pipe temperature.

3.14 PAINTING

A. Exposed piping shall be painted. Pipe shall be cleaned by this contractor and ready for priming and painting.

END OF SECTION 23 05 21

SECTION 23 05 22 - PIPING ACCESSORIES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Manufacturer's Data - Piping Accessories: Submit manufacturer's data on the following piping accessories:

1. Sealing compound for sleeves.
2. Expansion compensators.
3. Flexible pipe connections.
4. Guides.

B. LEED:

1. Adhesives and Sealants:

a. Submit product data or other published information verifying the VOC (Volatile Organic Compound) content is less than or equal to the allowable VOC content established by the governing standard: South Coast Air Quality Management District (SCAQMD) Rule #1168, July 1, 2005 and Green Seal Standard for Commercial Adhesives GS-36, October 19, 2000.

2. Low-Emitting Paints and Coatings:

a. Submit product data or other published information verifying the VOC (Volatile Organic Compound) content is less than or equal to the allowable VOC content established by the governing standards: Green Seal Standard GS-11, Paints, First Edition, May 20, 1993; Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997; South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, January 1, 2004.

PART 2 - PRODUCTS

2.1 MANUFACTURED PRODUCTS

A. Escutcheon Plates:

1. Type: Split ring
2. Construction: Brass

3. Finish:

    a. At Painted Surfaces: Prime coat
    b. At Other Surfaces: Nickel or Chrome plate

4. For Floor Sleeves: Where sleeves extend above floor surface, provide depth to cover sleeve.

B. Flexible Pipe Connectors, Rubber Type:

1. Manufacturers - Design Basis: Mason
2. Other Acceptable Manufacturers:

    a. Flexicraft
    b. Keflex
    c. Metraflex

3. Material: Two sphere EPDM construction with reinforcing ring.
4. Model: MFTNC, Twin Sphere 225 psi.

C. Flexible Pipe Connectors, Braided Hose:

1. Manufacturers - Design Basis: Mason
2. Other Acceptable Manufacturers:

    a. Flexicraft
    b. Keflex
    c. Metraflex

3. Material: Stainless steel braid with carbon steel connectors, threaded or flanged.

2.2 FABRICATED ACCESSORIES

A. Steel-Pipe Sleeves: Fabricate from Schedule 40 steel pipe. Remove burrs.

B. Iron-Pipe Sleeves: Fabricate from service weight cast-iron pipe. Remove burrs.

C. Sheet-Metal Pipe Sleeves: Fabricate from galvanized sheet-metal, closed with lock-seam joints.

1. For following pipe sizes, provide gauge indicated:

    a. Three-Inch Pipe and Smaller: 20 gauge
    b. Four-Inch to Six-Inch Pipe: 16 gauge
    c. Over Six-Inch Pipe: 14 gauge

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pipe Sleeves:

1. Install pipe sleeves where piping passes through walls, floors, ceilings, roofs and structural members, except soil pipe penetrations through concrete slab on grade.
2. Where possible pour sleeve in place or grout.
3. Provide sleeves of adequate size, accurately centered on pipe runs, so that piping and insulation (if any) will have free movement in the sleeve in non-fire rated penetrations.
4. In fire rated penetrations, size sleeves such that the resulting annular space is in accordance with the application requirements of the fire stopping system. Refer to Section 23 05 03. All above grade floor penetrations shall be considered to be fire-rated.
5. Install length of sleeve equal to thickness of construction penetrated, except extend floor sleeves 0.25” above floor finish and, where floor surface drains to a floor drain, extend floor sleeve 0.75” above floor finish.
6. Provide temporary support of sleeves during placement of concrete and other work around sleeves.
7. Provide temporary closure to prevent concrete and other materials from entering pipe sleeves.
8. Except as otherwise indicated, install steel pipe sleeves.
9. At interior partitions and ceiling, install sheet metal sleeves.
10. At exterior penetrations below grade, install iron pipe sleeves.
11. Seal exterior sleeve penetrations at grade weather tight.

B. Caulking:

1. Where water seal or sound seal, but not fire seal, is needed, (foundation walls, slab on grade): fiberglass backing and heavy bead of silicone caulking compound.
2. Where sleeve pierces a fire separation: Fire stop material in accordance with manufacturer’s directions and UL listing. Refer to Section 23 05 03.

C. Install escutcheon plates at pipe sleeves where piping is exposed to view in occupied spaces of the building, on the exterior, and elsewhere as indicated.

D. Compensators: Install where shown or where required because piping arrangement does not provide sufficient flexibility.

1. Protect compensators from over-travel and over-stress during remaining installation and testing.

E. Flexible Connectors: Install at right angles to displacement.

1. Install one end immediately adjacent to isolated equipment and anchor other end.

F. Guides: Install where shown and where required in accordance with expansion compensators published requirements.

1. As a minimum, install one guide within four pipe diameters of compensator, and one guide 14 pipe diameters from first guide.

END OF SECTION 23 05 22

SECTION 23 05 23 - VALVES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's product data including:

1. Dimensions
2. Sizes
3. End Connections
4. Weights
5. Installation instructions
6. Instructions on repacking and repairing valves.
7. Range of flow and full open (permanent) pressure loss for balancing valves and plug valves.
8. Differential pressure tables for flow measurement at venturi type balancing valves.

B. Valve Tag List: Refer to Section 23 05 53 of the Specifications.

PART 2 - PRODUCTS

2.1 VALVES TYPES AND SIZES

A. General:

1. Where type or body material is not indicated, provide valve with pressure class selected from MSS or ANSI standards, based on the maximum pressure and temperature in the piping system.
2. All valves in contact with domestic water shall meet the requirements of NSF/ANSI Standard 61.
3. Except for balancing or otherwise indicated, provide valve of same size as connecting pipe size.
4. Ball valves or butterfly valves may be used in lieu of gate valves when pressure and temperature ratings are adequate.
5. Where pipe sizes overlap, contractor has the option of threaded or flanged valves.
6. Where grooved pipe mechanical coupling systems are accepted, provide flange adapters to mate with valves as specified below. Valves by the mechanical coupling system manufacturer shall not be used unless they meet all of the specified requirements for a given valve.
7. All valves shall be domestically manufactured unless approved for use by Engineer.

8. Valves used for domestic water service shall be bronze or stainless steel. Iron and brass body valves are not acceptable.
9. All components in hydronic systems shall be compatible with propylene glycol and water solution.

B. Unless noted otherwise, the following table indicates valve types to be used for functions listed. Manufacturer listed is basis of design. Refer to specification section indicated for additional requirements.

Service	Chilled Water	Heating Hot Water	Domestic Hot and Cold Water
Shutoff/ Isolation	2-1/2" and larger: • Type BTV Butterfly Valve 2" and smaller: • Type BV Ball	2-1/2" and larger: • Type BTV Butterfly Valve 2" and smaller: • Type BV Ball	All sizes • Type BV Ball RE: 221000 Plumbing Piping
Check	2" and larger: • Type SWCV Silent/Wafer Check 1-1/2" and smaller: • Type SCV Swing Check	2" and larger: • Type SWCV Silent/Wafer Check 1-1/2" and smaller: • Type SCV Swing Check	2" and larger: • Type SWCV Silent/Wafer Check 1-1/2" and smaller: • Type SCV Swing Check RE: 221000 Plumbing Piping
Balance	2-1/2" and larger: • Type BLV Manual 2" and smaller: • Type BLV Manual	2-1/2" and larger: • Type BLV Manual 2" and smaller: • Type BLV Manual	All sizes • Type CS Circuit Setter RE: 221000 Plumbing Piping
Base Mounted Pump Discharge	All sizes: • Type TCS Combination Throttling/ Check Valve	All sizes: • Type TCS Combination Throttling/ Check Valve	N/A
Inline Pump Discharge	All sizes: • Type SWCV Silent/Wafer Check	All sizes: • Type SWCV Silent/Wafer Check	All sizes: • Type SWCV Silent/Wafer Check
Drain Valve	All sizes: • Type BV Ball	All sizes: • Type BV Ball •	All sizes: • Type BV Ball
Bypass	RE: Shutoff/Isolation	RE: Shutoff/Isolation	RE: Shutoff/Isolation RE: 221000 Plumbing Piping

1. Refer to section 22 10 00 Plumbing Piping for additional Domestic Water valve specifications and requirements.
2. Refer to Division 22 specifications for additional system valves and specialties not indicated in table above.

2.2 GLOBE AND ANGLE VALVES – TYPE GAV

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:

    a. Crane
    b. Gruvlok
    c. Nibco
    d. Powell
    e. Stockham
    f. Victaulic (for Grooved Pipe Systems)

B. Size 2" and Smaller: Bronze, 125 psi SWP, 200 psi WOG, rising stem, screwed bonnet. Bronze disk, MSS SP-80, Type 1.

1. Model:

    a. Globe, Solder Ends: 1502
    b. Globe, Threaded Ends: 502
    c. Angle: 504

C. Size 2½" and Larger: 125 psi SWP, 200 psi WOG, OS&Y bolted bonnet, gland packed, bronze disk, removable bronze seat ring, MSS SP-85.

1. Model:

    a. Globe: F-2981

2.3 SWING CHECK VALVES – TYPE SCV

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:

    a. Crane
    b. Gruvlock
    c. Nibco
    d. Powell
    e. Stockham
    f. Victaulic (for Grooved Pipe Systems)

B. Size 2” and Smaller: Bronze, 200 psi SWP, 400 psi WOG, straight or Y-pattern, Bronze Disk, MSS-SP80 Type 3.

1. Model: 508

C. Valves used for domestic water service shall be ANSI/NSF-61 certified.

2.4 SILENT/WAFER CHECK VALVES – TYPE SWCV

A. Manufacturers:

1. Design Basis: Metra Flex
2. Other Acceptable Manufacturers:

a. Cla-Val
b. GA Industries
c. Gruvlok
d. Nibco
e. Stockham
f. Tyco
g. Victaulic (for Grooved Pipe Systems)

B. Size 2” and Smaller: Bronze body, 200 psi @ 250 °F, threaded ends, resilient seats, center guided disk.

1. Model: 5700

C. Pipe size 2 1/2 “ and Larger: Iron body, bronze or stainless-steel trim, class 125, 316 stainless-steel spring, dual plate or tilting disk type, resilient seat, minimum C_V: 4”-280, 8”-1200, 12”-4000.

1. Model: 810

D. Valves used for domestic water service shall be ANSI/NSF-61 certified.

2.5 BUTTERFLY VALVES – TYPE BTV

A. Manufacturers:

1. Design Basis: Keystone
2. Other Acceptable Manufacturers:

a. Bray
b. Center Line
c. Crane

d. Gruvlok
e. Hammond Watts
f. Keystone
g. Milwaukee
h. Nibco
i. Stockham
j. Victaulic (for Grooved Pipe Systems)

B. Water Service (less than 250ºF): 200 psi WOG, cast or ductile iron fully lugged body, integral extended neck to clear insulation, integral top plate for actuator mounting, stainless-steel stem, upper and lower lubricated bushings, field replaceable hard back seat with integral stem and flange seals, machined disk seating areas, rated for minimum 150 psi dead end service with no downstream flange. Liner to be compatible with operating fluid. Conform to MSS-SP67.

1. Disk Material - 8” and Under and all sizes for domestic water: Aluminum bronze.
2. Disk Material, 10” and Larger: Nickel plated ductile iron.
3. Model: Figure 2-22.

C. Accessories:

1. 10 position locking lever handler for valves 6” and smaller.
2. Infinite position memory stop lever handle for all valves 6” and smaller used for balancing.
3. Hand wheel gear operator for valves 8” and larger.
4. Chain wheel operator where required.

2.6 GATE VALVES – TYPE GTV

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:

a. Crane
b. Gruvlok
c. Nibco
d. Stockham
e. Victaulic (for Grooved Pipe Systems)

B. Size 2” and Smaller: Bronze 125 psi SWP, 200 psi WOG, rising stem, threaded bonnet, gland packed MSS SP-80 Type 2.

1. Model: 148

C. Size 2½" and Larger: Cast iron, 125 psi SWP, 200 psi WOG, gland packed, bolted bonnet, OS&Y, solid wedge disk, either all bronze or with bronze face ring, bronze seat rings, brass back seat bushing, brass stem, bronze yoke bushing.

1. Model: F2885

2.7 BALL VALVES – TYPE BV

A. Manufacturers:

1. Design Basis: Nibco
2. Other Acceptable Manufacturers:

a. Apollo
b. Bray
c. Dyna Quip
d. Gruvlok
e. Hammond
f. Milwaukee
g. Stockham
h. Victaulic (for Grooved Pipe Systems)
i. Watts

B. Valve bodies must be cast bronze. Forged brass is not acceptable.

C. Bronze, 150, SWP, 600 WOG (min), chrome plated solid, tunneled bronze ball (stainless for steam service), two-piece design, blow-out proof stem, adjustable packing gland nut (allowing handle to be removed without leaking) TFE seats, MSS-SP-110.

1. Model: T-585-70 - full.port.

D. Valves used for domestic water service shall be ANSI/NSF-61 certified.

E. Options: Provide the following where required:

1. Extended stems for insulated valves.
2. Memory stop device for balancing applications.
3. Tee handle for tighter areas.
4. Hose end and cap for drain.
5. Mounting pads for actuator.

2.8 CIRCUIT SETTERS (CS) – DOMESTIC WATER APPLICATIONS ONLY – TYPE CS

A. Manufacturers:

1. Design Basis

    a. Bell & Gossett/ITT

2. Acceptable Manufactures:

    a. Victaulic
    b. Prior Engineer Approval for Substitutions

B. Construction:

1. All valves to be of brass body/brass ball construction with glass and carbon-filled TFE seat rings. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT insert and check valve. Valve bodies to have ¼" NPT tapped drain/purge port. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve setting. Valves to be leak-tight at full rated working pressure.

C. Valves ½" to 2" pipe size, NPT or sweat valves 2 ½' and 3" pipe size, NPT.

D. Pressure/Temperature 175 psig at 250°F.

E. ANSI/NSF-61 certified.

2.9 COMBINATION THROTTLING/CHECK VALVES – TYPE TCS

A. Manufacturers:

1. Basis of Design: Bell & Gossett Triple Duty Valve.
2. Other Acceptable Manufacturers:

    a. Armstrong
    b. Taco
    c. Victaulic (for Grooved Pipe Systems)
    d. Watts

B. Features:

1. 175 psi, 250ºF water working pressure.
2. Globe style valve with stainless-steel spring-loaded brass disk guided and limited by a brass or stainless-steel stem.

3. Resilient seat.
4. Able to be re-packed under pressure.

2.10 DRAIN VALVES – TYPE DV

A. Ball valve with hose end adapter and cap.

2.11 PLUG VALVES – TYPE PV

A. Manufacturers:

1. Design Basis: Keystone
2. Other Acceptable Manufacturers:

    a. Dezurik

B. Model: “Ballcentric”; cast-iron, full port body; EPDM coated plug; welded nickel seat; stainless-steel bearings; integral memory stop device; hand wheel operator for valves 6” and larger.

2.12 BALANCING VALVES – TYPE BLV

A. Manufacturers:

1. Design Basis: IMI Hydronic Engineering (Flow Design).
2. Other Acceptable Manufacturers:

    a. Armstrong
    b. Griswold
    c. Hays
    d. Nexus
    e. Nibco
    f. NuTech
    g. Tour and Andersson

B. Manual Balancing Valves (1/2" through 2"):

1. 400psi at 250°F, venturi type, with integral ball valve, brass body, EPDM O-ring seals, two pressure/temperature ports, and manual air vent. Memory stop with graduated markings. PTFE ball valve seats with blowout proof stem. Soldered or threaded connections.

2. Each valve shall provide four (4) functions:

    a. Precise flow measurement
    b. Precision flow balancing
    c. Positive shut-off with no drip seat, eliminating the need of an additional isolation valve.
    d. Manual air venting.

C. Balancing Valves (2-1/2" - 16"):

1. 240 psi at 250°F, venturi type, with integral butterfly valve, steel body, and two pressure/temperature ports. Flanged connections.
2. Butterfly valve: 200 psi WOG, cast or ductile iron fully lugged body, lever handle, infinite position adjustment, memory stop, integral extended neck to clear insulation, stainless-steel stem, upper and lower lubricated bushings, field replaceable hard back seat with integral stem and flange seals, machined disk seating areas, rated for minimum 150 psi dead end service with no downstream flange. Liner to be compatible with operating fluid. Conform to MSS-SP67.
3. Butterfly Valve Disk: Aluminum Bronze.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the following requirements:

1. Install valves except butterfly with stems pointing up, and as close to vertical as possible. Butterfly valves to be offset at least 10° from vertical.
2. Install valves at each piece of equipment, fixture or appliance so that the supply and return services can be shut off to remove the item without draining the remainder of the piping system.
3. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping.

    a. Locate valves so as to be accessible.

4. Combination balancing and shut-off valves may be used instead of a separate balancing valve and shut-off valve if the valve has a memory stop and the manufacturer lists its use as a leak-proof service valve.
5. Provide drain valves at main shut-off valves, low points of piping and apparatus.
6. Provide separate support where necessary.
7. Do not allow meter connections of balancing valves to point downward.
8. Install valves so bypass valves are accessible.

B. All valves of a given type shall be of one manufacturer.

C. Provide extended stems on insulated system to prevent interference of operator with insulation.

D. Provide chain wheel operators for valves more than 8' – 0" AFF in mechanical rooms and wherever shown on drawings.

3.2 CHECK VALVE INSTALLATION

A. Swing and Check Valves:

1. Install only in horizontal lines unless absolutely impractical. If installed vertically, flow shall be upwards.
2. Do not install in pump discharge piping.

B. Silent Check Valves:

1. Silent check valves may be installed in vertical pipes with flow down upon Engineer's review for each instance.

3.3 VALVES USED FOR THROTTLING/BALANCING

A. Balancing valves shall not be used for flow indication in pipes 2½" and larger, or in pump discharge piping.

B. Flow indication in piping 2½" and larger and in pump discharge piping, shall be by a venturi with a plug, butterfly, or globe valve for throttling.

C. Throttling/Balancing Valves shall be selected so that the maximum design flow causes between 1' and 10' W.G. pressure drop or meter reading with the valve wide open.

D. Install balancing valves used for flow indication with a minimum of five times the pipe diameter downstream and two times the pipe diameter upstream of a fitting or valve.

E. Globe, ball, butterfly, or plug valves may be used for throttling/balancing. Provide an infinitely variable, lockable memory stop device to allow the valve to be returned to the "balanced" position after closing, and to prevent movement of the disk or plug during operation. When ball valves are used for throttling, provide an additional valve for equipment isolation.

F. Balancing valve sized to flow.

G. Insulation: Provide pre-molded insulation conforming to the valve body. Material shall have a flame spread of 25 and a smoke development of 50.

3.4 COMBINATION THROTTLING/CHECK VALVES

A. Combination throttling/check valves may be used in lieu of separate throttling and check valves on pump discharge piping. However, they may not be used for flow measurement.

3.5 CIRCUIT SETTERS

A. All circuit setters shall be installed per manufactures recommendations. Provide manufacturers recommendation for required straight pipe for inlet and outlet connections to provide accurate ratings. Setting shall be 1 GPM unless otherwise noted on drawings.

END OF SECTION 23 05 23

SECTION 23 05 29 - PIPE SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 STANDARDS

A. Comply with MSS Standard Practice SP-69, published by Manufacturer's Standardization Society of the Valve and Fitting Industry for type and size.

1.2 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Hangers other than clevis type.
2. Anchors.

B. Submit structural calculations on trapeze type supports.

C. Submit product data and calculations to project structural engineer for review. Submittals shall document compliance with current Building Codes and maximum point loads listed in Structural plans.

PART 2 - PRODUCTS

2.1 PIPE HANGERS

A. General:

1. Use adjustable pipe hangers on suspended pipe. Trapeze hangers may be used at the Contractor's option. Contractor shall be responsible for sizing supports.
2. Chain, wire or perforated strap hangers will not be permitted.
3. Isolate hangers in contact with dissimilar materials with dielectric hanger liners. Tape is not acceptable.
4. Provide supports between piping and building structure where necessary to prevent swaying.

B. Hanger and Rod Material:

1. Exposed in public areas: Zinc electroplated steel.
2. Concealed or in service areas: Black threaded steel.

3. Outside, exposed to weather: Hot dipped galvanized.
4. Buried below structural slab: Stainless Steel

C. Cast-In- Place Inserts:

1. Cast-in-place inserts system shall be used.
2. Inserts to be UL and FM listed for their application.
3. Cast-In-Place Anchors shall be designed per ACI 318 Appendix D Strength Design methods as required by the IBC 2012 and ASCE 7-10. Where exempt from ACI 318 Appendix D, anchors shall be designed using Allowable Stress Service loads if allowed by the Building Code.
4. Cast In Place inserts shall be tested in accordance with current ICC-ES acceptance criteria A.C. 446 or ACI 355.2 where required.
5. Cast In Place inserts in concrete shall have a current ICC-ES or IAPMO-UES listed Research Report. Anchors shall be installed in strict accordance with approved ICC-ES or IAPMO-UES Research Report for the specific anchor used.
6. Threaded Inserts shall conform to ASTM A307.
7. Size inserts to match size of threaded hanger rods.
8. Manufacturers:

    a. DEWALT Bang-It+, Wood-Knocker II+, or DDI+
    b. Simpson Blue Banger Hanger

D. Channel Type Inserts:

1. Standard channel support with anchor tabs on 4” centers, and nail holes for attaching to forms.
2. Styrofoam inserts to prevent wet concrete seepage.
3. Minimum 2000 pounds/foot capacity.

E. Expansion Anchors or Screw Anchors:

1. For use only where modifications to piping layouts to change from pre-installed insert locations and only under approval from the Engineer.
2. Inserts shall be wedge-type or screw type and shall be designed per ACI 318 Appendix D Strength Design methods as required by the IBC 2012 and ASCE 7-10. Anchors shall be tested in accordance with current ICC-ES acceptance criteria A.C. 193 or ACI 355.2. Anchors in concrete shall have a current ICC-ES or IAPMO-UES listed Research Report. Anchors shall be installed in strict accordance with the approved ICC-ES or IAPMO-UES Research Report for the specific anchor used.
3. Manufacturers:

    a. DEWALT Power-Stud+ SD2 or Screw-Bolt+
    b. Hilti- Kwik-Bolt TZ
    c. Simpson Strong Bolt 2 or Titen HD Rod Hanger

4. Power driven fasteners are not acceptable.
5. "Drop-in" type anchors are not acceptable.
6. Anchors shall be installed with all required nuts, washers.
7. Install anchors per Manufacturer's recommendations with proper torque values where required.
8. Interior: Carbon steel anchors complying with ASTM A307.
9. Exterior or Wet Environment: Series 300 stainless-steel anchors, nuts and washers.
10. Anchors shall comply with loading requirements as designated by the Engineer of Record or per the Building Code.

F. Steel Structure Attachments:

1. Contractor may select welded or mechanically attached. All mechanically attached supports shall have jam nuts or other means to prevent loosening. Maximum loading requirements are as follows:

Rod Size	**Maximum Working Load**
3/8	600 pounds
½	1100 pounds
5/8	1800 pounds
¾	2700 pounds
7/8	3700 pounds

G. Single Hangers:

1. Piping 2" and smaller: MSS type 1, Clevis hanger or type 7 adjustable swivel ring hanger. Minimum 180 pounds design load.
2. Piping 2½" and larger: MSS type 1 Clevis hanger.
3. Bare copper pipe: Above hangers, plastic or Neoprene coating, sized for copper pipe O.D. and copper coated for identification.
4. Insulated pipe: Hangers to be sized for O.D. of insulation. Hangers shall not penetrate any insulation.

H. Trapeze hangers and wall supports:

1. Channel strut or structural steel shapes. Contractor shall follow channel strut manufacturers guidelines for loading or provide structural steel supports designed by a professional Engineer, licensed in the same state as where the project is located.
2. All piping shall be attached to the support by means of a channel strut clamp, U-bolt, or pipe rollers which will maintain lateral position of the pipe but allow longitudinal movement. Provide dielectric isolation between all dissimilar metals.
3. All insulation shall be continuous at supports. Do not notch or penetrate insulation.

I. Vertical Supports: Steel riser clamp at each floor penetration or every 14 foot supported from wall bracket. Do not anchor riser clamps.

J. Hangers:

1. General: Adjustable wrought steel clevis with locking nut attachment.
2. Multiple or Trapeze: Steel channels with welded spacers and hanger rods.
3. Hanger Sizes and Spacing:

   a. For gas, domestic water and drain piping, conform to the International Plumbing and Fuel Gas Codes for spacing, and the following table for hanger rod sizes.
   b. For hydronic piping, conform to the following table:

PIPE TYPE	PIPE SIZE	MAXIMUM SPACING	MINIMUM HANGER ROD SIZE
Steel Pipe	½"	6'-0"	3/8"
	¾" thru 1¼"	8'-0"	3/8"
	1½" and 2"	10'-0"	3/8"
	2½" thru 3½"	12'-0"	½"
	4" and 5"	15'-0"	5/8"
	6"	17'-0"	¾"
*	8" thru 12"	12'-0"	7/8"
*	14" thru 18"	10'-0"	1¼"
*	20" thru 30"	8'-0"	1½"
Copper Pipe	½" thru 1"	6'-0"	3/8"
	1¼" thru 2"	10'-0"	3/8"
	2½" thru 3"	10'-0"	½"
Cast Iron Soil	2"		3/8"
	3" to 5"		½"
	6"		5/8"
*	8" to 12"		¾"

* Submit routing and support plans to Architect/Engineer for review.

K. Insulated Pipe Supports:

1. Size pipe supports for outside diameter of pipe insulation.

L. Wall Supports:

1. ½" through 3": Unistrut type channel and steel clamp.

   a. Use Hydrosorb cushions on copper pipe.

2. 4" and Over: Welded steel bracket and wrought steel clamp.

M. Pipes over five inches and over 120º: Provide cast iron roller supports.

2.2 PIPE POSITIONING SYSTEMS AT FIXTURE LOCATIONS

A. Manufacturers:

1. Design Basis: Holdrite
2. Other Acceptable Manufacturers:

    a. Sioux Chief

3. In-wall plumbing systems serving fixtures and equipment shall be properly supported to prevent movement or vibration. The use of construction scrap materials for the purpose of supporting pipe and equipment is not allowed. All materials shall be new and manufactured for the purpose of supporting pipe and equipment.

2.3 INSULATION INSERTS

A. All insulated pipes shall be protected at the point of support by insulation inserts. Insert to be same thickness as adjoining pipe insulation. Materials shall be suitable for use in an air plenum.

B. Provide any of the following products:

1. High density, 100 psi, waterproofed calcium silicate, encased in a sheet metal shield. Shield shall extend one inch beyond sheet metal shield. If pipe hanger spacing exceeds ten feet and for all pipe roller applications, utilize double layer shield on bearing surface.
2. Trymer Polyisocyanurate Foam insulation (urethane). Provide compressive strength and temperature range as required for pipe served. Insert shall be provided with factory applied vapor barrier.

    a. Manufacturers: Snapp Itz Mechanical Pipe Shields (BBMI, LLC) or pre-approved equal.
    b. Not for use on steam piping or other piping above 225° F.

C. Provide 180º insulation inserts when utilizing clevis hangers. Provide 360º insulation inserts at all trapeze and wall supports.

2.4 PIPE ANCHORS

A. Manufacturers:

1. Anvil
2. Cooper Industries B-Line
3. Mason
4. Metraflex

B. Design Basis – Any of the following:

1. Pipe Riser Anchor Clamp: Metraflex Riser Anchor Clamp
2. Low Load Anchor Clamp: Metraflex Model PA Anchor Clamp
3. Pre-insulated Anchor Clamp: Metraflex Model PAPI
4. Welded Structural W-Section Anchor: Metraflex Model PAI Structural I-beam Anchor

C. Material:

1. Material in contact with pipe shall be steel for steel pipe, bronze for copper tubing. Where clamp anchors are a dissimilar metal to piping, provide FRP pad secured to the pipe with epoxy adhesive to prevent metal to metal contact between clamp and pipe.

D. Anchors may be field fabricated similar to manufactured products specified.

E. Submit pipe stress analysis for review prior to installation of pipe anchors.

2.5 PIPE GUIDES

A. Manufacturers:

1. Adsco
2. Anvil
3. Cooper Industries B-Line
4. Flexicraft
5. Keflex
6. Mason
7. Metraflex
8. PHD

B. Design Basis – Any of the following:

1. Spider Type: Metraflex Style IV Spider Type guide
2. Roller Type: Two sets of rollers on opposite sides of pipe
3. Slide Type: Cooper Industries B-Line B3893 with hold down lugs (not for use with cold piping)
4. Light duty, 1-1/2” and smaller copper: U-bolt or channel strut clamp allowing clearance from O.D. of pipe or insulation
5. Pipe Riser Guides: Metraflex Modular Riser Guide

C. Material: Material in contact with pipe shall be steel for steel pipe, bronze for copper tubing. Where guides are a dissimilar metal to piping, provide FRP pad secured to the pipe with epoxy adhesive to prevent metal to metal contact between guide and pipe.

2.6 EXPANSION COMPENSATORS

A. Expansion Compensators, Two Inch and Smaller, Loop Type:

1. Manufacturers - Design Basis: Metraflex
2. Other Acceptable Manufacturers:

    a. Adsco
    b. Flexicraft
    c. Keflex
    d. Mason

3. Model: Metraloop

B. Expansion Compensators, Bellows Type:

1. Manufacturers – Design Basis: Metraflex
2. Other Acceptable Manufacturers:

    a. Adsco
    b. Flexicraft
    c. Keflex
    d. Mason

3. Model: MNLC, 300 psi max. working pressure

2.7 ROOF-MOUNTED PIPING

A. Manufacturers:

1. B-Line Dura-Blok
2. Miro Industries, Inc.
3. PHD Manufacturing
4. PHP Systems/Design
5. Approved Equivalent.

B. Description: Piping on roof shall be supported by an engineered prefabricated portable pipe system specifically designed to be installed on the roof without roof penetrations, flashing or damage to the roofing material. The system shall consist of recycled rubber or plastic bases, hot dipped galvanized or stainless-steel frame with threaded rods and suitable pipe hangers and supports. The system shall be custom designed to fit the piping and conduits to be installed and the actual conditions of service.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPE SUPPORTS

A. Adequately support piping from the building structure with adjustable hangers to maintain uniform grading where required and to prevent sagging and pocketing.

1. Provide supports between piping and building structure where necessary to prevent swaying.
2. Do not support pipe from other pipe or equipment.
3. Provide thrust restraints at all changes in direction on 8" and larger cast iron piping with no hub or hub and spigot fittings.

B. Install hangers to provide minimum ½" clear space between finished covering and adjacent work.

1. Place a hanger within one foot of each horizontal elbow.
2. Space hangers generally as called for in Table in Part 2, Products.

C. Use hangers, which are vertically adjustable 1-½" minimum after piping is erected.

D. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

1. Set inserts in position in advance of concrete work.
2. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
3. Do not penetrate concrete "TT" legs for piping inserts. Do not penetrate the stressed (i.e. lower) chords of any structural member.

E. Expansion anchors or screw anchors: For use only where modifications to piping layouts to change from pre-installed insert locations and only under approval from the Engineer.

1. Installation shall be in strict compliance with ICC-ES or IAPMO-UES Research Report criteria.
2. Expansion anchors require periodic special inspection as required by their ICC-ES or IAPMO-UES Research Report.
3. Special inspector shall make periodic inspections of installation for compliance with manufacturer's installation instructions.

F. Provisions for Movement: Install hangers and supports:

1. To allow controlled movement of piping systems.
2. To permit proper movement between pipe anchors.
3. To facilitate the action of expansion joints, expansion loops, bends and offsets.
4. To isolate force due to weight or expansion from equipment connections.

G. In general, attach hangers to upper chord of roof trusses and floor joists, using long rods to facilitate pipe movement.

H. Anchors:

1. Use no pipe anchors. Arrange piping such that pipe expansion and contraction is accommodated by controlled movement of the pipe within the pipe supports. Provide sufficient offsets in branch piping to accommodate movement of main piping due to expansion and contraction.

END OF SECTION 23 05 29

SECTION 23 05 30 - ELECTRONIC SPEED CONTROLLERS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data for each unit. Include:

1. Capacity:

    a. Horsepower
    b. KVA
    c. Amps

2. Wiring Diagrams:

    a. Include diagrams for basic unit and for all required accessories.

3. Dimensions.
4. Installation instructions.
5. Description of diagnostic system.
6. Options provided.
7. Time-current curves for VFD circuit.

B. Show compliance with IEEE 519 – provide harmonic analysis for project jobsite including total harmonic-voltage distortion and total harmonic current distortion (TDD). The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic-voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFDs shall include a minimum of 5% impedance reactors, no exceptions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Manufacturer:

1. Manufacturers:

    a. ABB
    b. Cutler-Hammer
    c. Danfoss

d. Eaton
e. Franklin Controls Systems
f. General Electric
g. Hitachi
h. Honeywell
i. Magnetek
j. Mitsubishi
k. Reliance
l. Robicon
m. Square D
n. Toshiba
o. Trane
p. Yaskawa

B. Single Manufacturer

1. Provide all drives, except those factory mounted, by a single manufacturer.
2. "Factory Mounted" means as part of a packaged unit where the drive is not purchased separately from the driven equipment.

C. Drive shall convert the constant frequency AC line voltage to a variable frequency, variable voltage AC output suitable for control of a standard NEMA design B induction motor over a 10:1 speed range and with full load amp rating between 10% and 110% of the drive full load current capability and without modification to the motor or the drive.

D. Variable frequency drives for motors greater than 5 HP shall have the following features:

1. Drive input: 480-Volts +/- 10%, 3 phase, 60 Hz, 65 KAIC minimum or as shown on electrical drawings.
2. Drive output: 0-460-Volts, 3 phase, 0-80 Hz. For efficient operation of a variable torque load.
3. Drive type: Pulse width modulation type, designed to minimize harmonic generated noise in the motor.
4. Enclosure type: NEMA 1 or NEMA 4 depending upon mounting location. Unit to operate in ambient temperatures of -40F to 155F. Where variable frequency drive is located in an area that is subject to unauthorized access (i.e. parking garage, service corridor, storage room, etc.), provide tamper-proof enclosure by drive manufacturer or provide secondary lockable fan-vented enclosure to prevent unauthorized access. Secondary enclosure shall be approved by variable frequency drive manufacturer.
5. AC line fused disconnect or circuit breaker.
6. Metal oxide varistors on incoming line for transient protection.
7. Control power transformer with fused primary and 24V or 120V fused secondary.
8. Manual, speed adjustment potentiometer of keypad, HAND-OFF-AUTO switch, and 4-20 milliamp signal follower, fully isolated and suitable for grounded or ungrounded input signal. Drive manufacturer shall coordinate exact signal type with temperature control contractor.

9. Instantaneous overcurrent shutdown with indicator light when current exceeds 200%. Time-overcurrent overload protection for the motor.
10. Inverse characteristic time-overcurrent overload protection for the motor sized in accordance with NEC requirements.
11. Drive shall be capable of withstanding random application of an output short circuit without damage to drive components or fuses.
12. Input phase loss and undervoltage protection.
13. Torque/current limit control which will slow the motor without tripping when the motor is subjected to an overload, or slow the acceleration ramp when accelerating a high inertia load.
14. Drives shall be capable of "riding through" a momentary loss of power for up to 2 seconds.
15. AC line reactors in the drive cabinet for protection against line notching and surges without requirement for an input isolation transformer.
16. Power factor shall be minimum 95% at all speeds and loads.
17. Each drive shall have the following status and troubleshooting diagnostic features:

    a. Auto restart in "auto" mode. Certain drive faults shall be selectable to bypass the auto restart feature. Auto restart manual shall only be attempted 5 times.
    b. Exterior drive door mounted devices shall include"

        1) "Power On" pilot light.
        2) "VFD Run" pilot light.
        3) % full load digital display.
        4) Output frequency and/or % speed digital meter.

    c. Indicator lights on each power module to indicate correct operation (or failure) of individual owner switching devices.
    d. DRIVE/OFF/LINE test switch.

18. UL listed or ETL listed.
19. Minimum and maximum speed adjustment.
20. Factory Tests: The VFD shall be tested with the system logic and given complete factory tests including simulated operation.

    a. Provide certification this test has been made for the particular units shipped for this job.

21. Field Adjustments: Independent acceleration/deceleration rates: 0.5 – 120 seconds.
22. Provide a maximum of 1000-Volts at the motor terminals.
23. Provide LAN card connection to interface with Building Automation System. Coordinate control protocols with BMS contractor.
24. Where the VFD is used as part of a smoke control or pressurization systems:

    a. Provide a minimum of (6) six auxiliary contact(s) for connection to smoke control system.

b. VFD to be UUKL864 listed for smoke management.
c. Provide torque indication output on drive to verify airflow.
d. VFD shall not be equipped with bypass.

E. In addition to the above feature all drives shall have the following additional features:

1. Catch-a-spinning load capability.
2. Critical speed avoidance capability.
3. Where the building walls are not suitable for mounting drives a floor stand kit shall be provided.
4. Where required by Division 23 09 01, provide output isolator to provide VFD signal operation of frequency, and current to an isolated 4-20 mA signal for transmission to the building automation system for monitoring capability.

F. For variable frequency drives serving multiple motors, the following shall be provided:

1. Provide motor contactors for each motor for drives serving more than one motor, each contactor shall have auxiliary contacts to prevent drive damage if remote motor disconnect switch is open of closed.
2. Each drive shall have contactors for each motor it serves with individual thermal overload protection for each motor and H-O-A motor select switch.
3. All multiple motor variable speed controllers shall be capable of operating even if one of the motors is off.

G. For drive manufacturers who use portable test meter for diagnostics, provide not less than one test meter for each model or type used. Meters shall be supplied to the Owner upon completion of the project.

H. Provide one complete set of spare fuses for all variable speed controllers.

I. Interlock all disconnects with variable speed drive so variable speed drive opens before disconnect opens to prevent damage to the drive.

PART 3 - EXECUTION

3.1 GENERAL

A. Deliver units to installer of electrical work. Provide installation and wiring instruction and diagrams.

B. Provide wiring control diagrams and instructions to installer of automatic temperature controls.

C. Provide factory representative at start-up to check installation and instruct Owner.

END OF SECTION 23 05 30

SECTION 23 05 48 - VIBRATION CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract, and Division 1 Specification Sections (General Requirements), apply to this Section.

1.2 DESCRIPTION

A. Furnish and install vibration control devices, materials, and related items. Perform all work as shown on the drawings and as specified herein to provide complete vibration isolation systems in proper working order.

1.3 MATERIAL AND EQUIPMENT

A. Design Basis: Mason Industries

B. Alternate Manufacturers:

1. Amber/Booth Co.
2. California Dynamics
3. Kinetics
4. Korfund Dynamics Corp.
5. Vibration Eliminator Co.
6. Vibration Mountings & Controls, Inc.
7. Vibro-Acoustics

C. Unless otherwise specified, supply only new equipment, parts and materials.

1.4 QUALITY ASSURANCE

A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

B. Provide vibration isolators of the appropriate sizes, with the proper loading to meet the specified deflection requirements.

C. Supply and install any incidental materials needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim or additional payment.

D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

E. Should any rotating equipment cause excessive noise or vibration, the Contractor shall be responsible for rebalancing, realignment, or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

1.5 SUBMITTALS

A. Reference Division 1.

B. Prior to ordering any products, submit shop drawings or the items listed below. The shop drawings must be complete when submitted and must be presented in a clear, easily understood form. Incomplete or unclear presentation of shop drawings may be reason for rejection of the submittal.

1. A complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.
2. Detailed selection data for each vibration isolator supporting equipment, including:

    a. The equipment identification mark;
    b. A cut sheet of the isolated equipment showing equipment support points and operating weight at each point.
    c. The isolator type;
    d. The actual load;
    e. The static deflection expected under the actual load;
    f. Specified minimum static deflection;
    g. The additional deflection-to-solid under load;
    h. The ratio of spring height under load to spring diameter.

3. Steel rails, steel base frames, and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method, and location of equipment attachment bolts.
4. Special details necessary to convey complete understanding of the work to be performed.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION MOUNT TYPES

A. General:

1. All metal parts of vibration isolation units installed out-of-doors shall be cold-dip galvanized, cadmium plated, or neoprene coated after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 14.
2. All isolators installed out-of-doors shall have base plates with bolt holes for fastening the isolators to the support members.
3. Isolator types are scheduled to establish minimum standards. At the Contractor's option, laborsaving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations, and similar installation advantages. Accessories must not degrade the vibration isolation system.
4. Static deflection of isolators shall be as provided in SECTION 3 - EXECUTION. All static deflections stated are the minimum acceptable deflection for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be disapproved.

B. Type FSN (Floor Spring and Neoprene)

1. Spring isolators shall be freestanding and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Springs shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one (1). All mounts shall have leveling bolts.
2. Either the spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene, or each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, provide a rectangular bearing plate of appropriate size to load the pad uniformly within the manufacturer's recommended range.
3. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.
4. If the isolator is to be fastened to the building structure and Type NP isolator is used under the bearing plate, neoprene grommets shall be provided for each bolt hole in the base plate. Bolt holes shall be properly sized to allow for grommets. The hold down bolt

assembly shall include washers to distribute load evenly over the grommets. Bolts and washers are to be galvanized.

Type FSN isolators shall be Mason Type SLF with the appropriate neoprene pad (if used) selected from Type NP or approved equal.

C. Type FSNTL (Floor Spring and Neoprene Travel Limited)

1. Spring isolators shall be freestanding and laterally stable without any housing. Spring diameter shall not be less than 0.8 of the compressed height of the spring at the rate load. Spring shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one (1). All mounts shall have leveling bolts. All mounts shall have vertical travel limit stops to control extension when weight is removed. The travel limit stops shall be capable of serving as blocking during erection of the equipment. A minimum clearance of ¼" shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.
2. Either the spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene, or each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, provide a rectangular bearing plate of appropriate size to load the pad uniformly within the manufacturer's recommended range. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate, and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.
3. If the isolator is to be fastened to the building structure and Type NP isolator is used under the bearing plate, neoprene grommets shall be provided for each bolt hole in the base plate. Bolt holes shall be properly sized to allow for grommets. Hold down assembly shall include washers to distribute load evenly over the grommets. Bolts and washers are to be galvanized.

   Type FSNTL isolators shall be Mason Type SLR with the appropriate neoprene pad (if used) selected from Type NP or approved equal.

D. Type FN (Floor Neoprene)

1. Neoprene isolators shall be neoprene-in-shear type with steel reinforced top and base. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed. Bolt holes shall be provided in the base and the top shall have a threaded fastener. The mounts shall include leveling bolts that may be rigidly connected to the equipment.

   Type FN isolators shall be Mason Type ND or approved equal.

E. Type FNC (Floor Neoprene Chiller)

1. Neoprene isolators shall be double neoprene-in-shear type with steel reinforced top intermediate plates and base. Neoprene elements shall be ¾". Steel plates shall be ¼" and the top and bottom plates shall be ribbed. Bolt holes shall be provided in the base and the top shall have a threaded fastener. The mounts shall include leveling bolts that may be rigidly connected to the equipment.

   Type FNC isolators shall be Mason Type ND: Fabricate of type "Super W" pads, similar to Type ND otherwise.

F. Type NP (Neoprene Pad)

1. Neoprene pad isolators shall be one layer of ¼" to 3/8" thick ribbed or waffled neoprene. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.

   Type NP isolators shall be Mason Type W or approved equal.

G. Type DNP (Double Neoprene Pad)

1. Neoprene pad isolators shall be formed by two layers of ¼" to 3/8" thick ribbed or waffled neoprene, separated by a galvanized steel, stainless steel or aluminum plate. If the isolator is outdoors, the plate shall not be made of galvanized steel. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.

   Type DNP isolators shall be Mason Type WSW or approved equal.

H. Type HSN (Hanger Spring and Neoprene)

1. Vibration isolation hangers shall consist of a free standing and laterally stable steel spring and a neoprene element in series, contained within a steel housing. Spring diameters and hanger housing lower hole sizes shall be large enough to permit the hanger rod to swing through a 30º arc before contacting the housing. Hangers shall provide a means to adjust hanger elevation under load. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Spring elements shall have a minimum additional travel-to-solid equal to 50% of the rated deflection. The neoprene element shall be designed to have a 0.3" minimum static deflection. The deflection of both the spring element and the neoprene element shall be included in determining the overall deflection of Type HSN isolators.

   Type HSN isolators shall be Mason Type P30N or approved equal.

I. Type HN (Hanger Neoprene)

1. Vibration isolation hangers shall consist of a neoprene-in-shear element contained within a steel housing. A neoprene neck bushing shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30º arc before contacting the hanger housing.

   Type HN isolators shall be Mason Type HD or approved equal.

2.2 EQUIPMENT BASES

A. Type BIB (Base - Inertia Base)

1. Concrete inertia bases shall be formed of stone-aggregate concrete (150 lbs./cu.ft.) and appropriate steel reinforcing cast between welded or bolted perimeter structural steel channels. Inertia bases shall be built to form a rigid base which will not twist, deform, deflect, or crack in any manner which would negatively affect the operation of the supported equipment or the vibration isolation mounts. Inertia bases shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. Inertia base depth shall be at least 1/12 the longest dimension of the inertia base, but not less than 6” nor more than 12”. The base footprint shall be large enough to provide stability for supported equipment. Inertia bases shall include side-mounting brackets for attachment to vibration isolators. Mounting brackets shall be located on the sides of the base that are parallel to the axis of rotation of the supported equipment.
2. The steel frame and reinforcement shall be supplied by the vibration isolator manufacturer. Concrete may be provided by the General Contractors.
   Frame and reinforcement for Type BIB bases shall be Mason Type KSL or approved equal.

B. Type BC-1 (Base - Curb)

1. Curb type isolation bases shall be a prefabricated assembly consisting of an extruded aluminum frame and steel spring isolation system that fits over the roof curb and under the isolated equipment. The aluminum frame shall be sufficiently rigid to support the equipment load without detrimental twist or deflection. Spring isolators shall be selected and positioned along the curb to achieve the minimum static deflection called for in the schedule. The static deflection shall be constant around the entire periphery of the base. Springs shall be free standing, laterally stable with a diameter of not less than 0.8 times the compressed height, and have additional travel-to-solid that is at least 50% of the rated deflection. Resilient neoprene snubbers shall be provided at the corners of the base to limit the movement of the equipment under wind load to ¼”.

2. The isolation curb base shall be made weather tight by sealing all around the periphery with closed cell neoprene or flexible vinyl. This shall in no way inhibit the vibration isolation of the spring elements. A closed cell sponge gasket or field caulking shall be used between the equipment unit and the isolation curb base and between the isolation curb and roof curb to form a weather-tight seal.
3. Each spring isolator used in the curbs shall be weather protected as described above.

Type BC-1 vibration isolation curb bases shall be Mason Type CMAB or approved equal.

2.3 RESILIENT LATERAL GUIDES

A. These units shall either be a standard product of the vibration isolation mounting manufacturer, or be custom fabricated from standard components. These units shall incorporate neoprene isolation elements similar to Type FN which are specifically designed to provide resilient lateral bracing of duct or pipe risers.

Resilient lateral guides shall be Mason Type ADA.

2.4 FLEXIBLE DUCT CONNECTORS

A. Refer to section 23 33 00 Ductwork Accessories for flexible duct connector specifications.

B. The clear space between connected parts shall be a minimum of 3” and the connection shall have 5” minimum of slack material.

2.5 FLEXIBLE PIPE CONNECTIONS

A. Flexible pipe connection shall be fabricated of multiple plies of nylon cord, fabric, and neoprene; and shall be vulcanized so as to become inseparable and homogeneous. Flexible connections shall be formed in a double sphere shape, and shall be able to accept compressive, elongative, transverse, and angular movements.

B. The flexible connections shall be selected and specially fitted, if necessary, to suite the system temperature, pressure, and fluid type. In addition, suitable flexible connections should be selected which do not require rods or cables to control extension of the connector.

C. Connectors for pipe sizes 2” or smaller shall have threaded female union couplings on each end. Larger sizes shall be fitted with metallic flange couplings.

D. Flexible pipe connections shall be Mason Industries Type SFDEJ; Metraflex DoubleSphere; or Amber/Booth Type 2600 or 2655.

2.6 RESTRAINTS

A. Snubber:

1. Snubbers shall be custom fabricated using Type FN isolators mounted to steel angle brackets. The steel angle shall be sufficiently rigid and the mounting sufficiently secure to resist excessive movement of equipment during on-off cycle.

B. Thrust Restraints:

1. Thrust restraints shall consist of a spring element in series with a neoprene pad. The unit shall be designed to have the same deflection due to thrust-generated loads as specified for the isolators supporting the equipment. The spring element shall be contained within a steel frame and be designed so it can be precompressed at the factory to allow for a maximum of ¼" movement during starting or stopping of the equipment. Allowable movement shall be field-adjustable.
2. The assembly shall be furnished complete with rods and angle brackets for attachment to both the equipment and the adjacent fixed structural anchor.
3. Thrust restraints shall be Mason Industries Type WB, Kinetics Noise Control Type HSR, Amber/Booth Type TRK or an equal product of the manufacturer supplying the isolators.

2.7 GROMMETS

A. Grommets shall either be custom made by combining a neoprene washer and sleeve, be Isogrommets as manufactured by MBIS, Inc. (Bedford Heights, Ohio), or be Series W by Barry Controls (Watertown, Mass.). Grommets shall be sized so that they will be loaded within the manufacturer's recommended load range. Grommets shall be specially formed to prevent both from directly contacting the isolator base plate.

2.8 ACOUSTICAL SEALANT

A. Sealants for acoustical purposes as described in this specification shall be silicone or one of the non-setting sealants indicated below:

Acoustical Sealant	D.A.P
BR-96	Pecora
Acoustical Sealant	Tremco
Acoustical Sealant	U.S.G.

PART 3 - EXECUTION

3.1 APPLICATION

A. General:

1. Refer to SECTION 2 - PRODUCTS of this specification for vibration isolation devices identified on the drawings or specified herein.
2. The static deflection values of all isolators specified herein are the minimum acceptable deflections for the mounts under actual load. Isolators selected solely on the basis of rated deflection are not acceptable and will be disapproved.

B. Major Equipment:

1. Unless otherwise shown or specified, all floor-mounted major equipment shall be set on 4" high concrete housekeeping pads. See architectural or structural drawings for details.
2. Types and minimum static deflections of vibration isolation devices for major equipment items shall be as scheduled on the drawings or specified hereunder.
3. Flexible duct connectors shall be installed at all fan unit intakes, fan unit discharges, and wherever else shown on the drawings unless noted otherwise. Individual fan units with motors rated at less than ¾ hp do not require a flexible connector. Do not install flexible duct connectors in grease exhaust systems.
4. Flexible pipe connections shall be installed at all pipe connections to vibration-isolated equipment in the positions shown on the drawings.
5. Thrust restraints shall be installed on all floor-mounted fans developing 4" or more of static pressure, all suspended fans developing 2" or more static pressure, and wherever else called for on the drawings.
6. Snubbers shall be installed as called for on the drawings.

C. Miscellaneous Mechanical Equipment:

1. Miscellaneous pieces of mechanical equipment such as converters, pressure reducing stations, dryers, strainers, storage tanks, condensate receiver tanks, and expansion tanks which are connected to isolated piping system shall be vibration isolated from the building structure by Type NP or Type HN isolators (selected for 0.1" static deflection) unless their position in the piping system requires a higher degree of isolation as called for under Pipe Isolation.

D. Pipes:

1. All chilled water, condenser water, heating water, drain and engine exhaust piping that is connected to vibration-isolated equipment shall be isolated from the building structure within the following limits:

    a. Within mechanical rooms.
    b. And within 50’ total pipe length of connected vibration-isolation equipment (chillers, pumps, air handling units, pressure reducing stations, etc.):

2. Piping shall be isolated from the building structure by means of vibration isolation mounts, resilient pipe guides, and resilient penetration sleeve/seals.
3. Isolators for the first three support points adjacent to connected equipment shall achieve one half the specified static deflection of the isolators supporting the connected equipment. When the required static deflection of these isolators is greater than ½” Type FSN or HSN isolators shall be used. When the required static deflection is less than or equal to ½”, Type FN or HN isolators shall be used. All other pipe support isolators within the specified limits shall be either Type FN or HN achieving at least ¼” static deflection.
4. Where lateral support of pipe risers is required within the specified limits, this shall be accomplished by use of resilient lateral supports.
5. Pipes within the specified limits that penetrate the building construction shall be isolated from the building structure by use of resilient penetration sleeve/seals.
6. Provide flexible pipe connections on all piping connected to all isolated equipment and wherever shown on the drawings.

3.2 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General:

1. Locations of all vibration isolation devices shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with the manufacturer’s instructions.

B. Isolation Mounts:

1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.
2. Isolators for equipment with bases shall be located on the sides of the bases, which are parallel to equipment shaft unless this is not possible because of physical constraints.
3. Locate isolators to provide stable support for equipment, without excess rocking. Consideration shall be given to the location of the center of gravity of the system and the location and spacing of the isolators. If necessary, a base with suitable footprint shall be

provided to maintain stability of supported equipment, whether or not such a base is specifically called to herein.

4. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plates shall rest entirely on the pad.
5. Hanger rods for vibration-isolated support shall be connected to structural beams or joists, not the floor slab between beam joists. Provide suitable intermediate support members as necessary.
6. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360º about the rod axis without contacting any object.
7. Parallel running pipes may be hung together on a trapeze, which is isolated from the building. Isolator deflections must be the greatest required by the provisions for pipe isolation for any single pipe on the trapeze. Do not mix isolated and non-isolated pipes on the same trapeze.
8. Pipes, ducts and equipment shall not be supported from other pipes, ducts and equipment.
9. Resiliently isolated pipes, ducts and equipment shall not come in rigid contact with the building construction or rigidly supported equipment.
10. The installed and operating heights of equipment vibration-isolated with Type FSNTL isolators shall be identical. Limit stops shall be out of contact during normal operation. Adjust isolators to provide ¼” clearance between the limit stop brackets and the isolator top plate, and between the travel limit nuts and travel limit brackets.
11. Adjust all leveling bolts and hanger rod bolts so that the isolated equipment is level and in proper alignment with connecting ducts or pipes.

C. Bases:

1. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer’s requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.
2. Unless otherwise indicated, there is to be a minimum operating clearance of 1” between inertia bases or steel frame bases and the floor beneath the equipment. Position isolator mounting brackets and adjust isolators so that the required clearance is maintained. The clearance space shall be checked by the Contractor to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.

D. Flexible Duct Connections:

1. Sheet metal ducts and plenum opening shall be squarely aligned with the fan discharge, fan intake, or adjacent duct section prior to installation of the flexible connection, so the clear length is approximately equal all the way around the perimeter. Flexible duct

connections shall not be installed until this provision is met. There shall be no metal-to-metal contact between connected sections, and the fabric shall not be stretched taut.

E. Flexible Pipe Connections:

1. Install flexible pipe connections in strict accordance with the manufacturer's instructions.

F. Restraints:

1. Snubbers shall be adjusted to clear the equipment base and to provide lateral restraint during on-off cycling, but be out of contact during normal operation of the equipment.
2. Thrust restraints shall be attached at the centerline of thrust and symmetrically on each side of the unit. The two rods of the thrust restraint shall be axially aligned. This may require modified brackets or standoffs. The body of the thrust restraint shall not come in contact with the connected elements. Thrust restraints shall be adjusted to constrain equipment movement to the specified limit.

G. Resilient Penetration Sleeve/Seals:

1. Maintain an airtight seal around the penetrating element and prevent rigid contact between the penetrating element and the building structure. Fit the sleeve tightly to the building construction and seal airtight on both sides of the construction penetrated with acoustical sealant.

    a. At minimum, provide resilient penetration seals at all Mechanical, Equipment and Fan Room Penetrations.

3.3 ISOLATOR SCHEDULE

UNIT	ISOLATOR TYPE	MINIMUM STATIC DEFL.(IN.)	REMARKS
Energy Recovery Ventilators			Internally isolated
Air Cooled Chiller	FSNTL	2	
Inline Fans	HSN	2	
Fan Coil Units	(Note 2)	(Note 2)	
Ceiling-suspended Inline Pumps	HSN	0.75	
Floor-supported Inline Pumps	FN	0.35	
Pumps (Basemount)	BIB (Note 3)	1.5	
Ice Plant Outdoor Condenser	FSNTL	2	

UNIT	ISOLATOR TYPE	MINIMUM STATIC DEFL.(IN.)	REMARKS
Boiler	FN	0.35	
Utility Set Fans	FSNTL	2	
Makeup Air Units			Internally isolated

Notes:

1. External isolator may be omitted if units have internally isolated fans and no other rotating or reciprocating components.
2. Isolators for fan coil units should be either HSN with 0.75" minimum static deflection or be equivalent to Mason Industries Type HN with 0.35" minimum static deflection.
3. For slab-on-grade installations isolators are not required. Refer to Section 23 21 23.

END OF SECTION 23 05 48

SECTION 23 05 49 - SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including general and supplementary conditions and Division 01 specification sections, apply to this Section.

1.2 SUMMARY

A. Routt County is currently identified as a Seismic Category C. Provide seismic bracing/support for applicable building(s) with an importance factor above 1.0 as defined by the IBC. Detailed selection data for seismic restraints for buildings including:

1. Submit manufacturer's data for all manufactured restraints.
2. All submittals shall be stamped and certified by a Structural Engineer registered in the State of Colorado with a minimum of 5 years experience in the design of seismic restraints.
3. Submit shop drawings for all fabricated restraints.
4. Show restraint type and location on the installation shop drawings. Drawings to include:

    a. All seismic brace locations.
    b. All seismic restraint connections to structure and vertical support anchorage at seismic locations and all other vertical support anchorage connections. Including but not limited to Quantity, Size, and Embedment.
    c. Brace reaction at all connection points to the structure for Structural Engineer of Record use in checking suitability of the building structure.
    d. Type and size of brace member.
    e. Suspended utility maximum lbs. per linear foot or maximum conduit size at all seismic locations.
    f. Minimum all thread rod size at all seismic locations.
    g. Size all horizontal support members taking into account, but not limited to, deflection and load.
    h. Registered Colorado Engineer stamp and signature.

5. Submit calculations for all seismic restraint systems that are not preapproved.
6. Job site conditions not covered by the manufacturer's seismic bracing guidelines shall be engineered by the manufacturer.

B. Provide complete seismic anchorage and bracing for mechanical equipment, including air terminal units and sound traps, to resist seismic forces acting in any direction using the criteria outlined in ASCE 7-10, Chapter 13. Refer to ASCE 7-10, Table 13.6-1 for application values and horizontal force factors "Ap" and Rp." Consider the effect of temperature change in preparation of anchorage and bracing details. Provide anchorage calculations and details certified by structural engineer registered in the State of Colorado. Where anchorage details are not shown on the drawings, the field installation shall be subject to the approval of the structural engineer of record prior to installation.

C. At seismic restraint installation locations, provide vertical supports and attachments engineered to accommodate dead load plus seismic force reactions.

D. Provide engineered seismic restraint systems compliant with the International Building Code for ductwork and piping. Location of seismic restraints shall be based on Contractor's coordinated shop drawings.

E. Provide seismic joints/loops for piping crossing building seismic separations.

1.3 RELATED APPLICABLE SECTIONS

A. Section 23 05 02, BASIC HVAC REQUIREMENTS.

B. Section 23 05 03, BASIC HVAC MATERIALS AND METHODS.

C. Section 23 05 48, VIBRATION CONTROL.

1.4 REFERENCES

A. Publications, codes and standards listed below form a part of this specification to the extent referenced.

1. 2018 International Building Code
2. ASCE 7-10, Chapter 13, Minimum Design Loads For Buildings and Other Structures, American Society of Civil Engineers (ASCE).
3. ACI 318, Building Code Requirements for Structural Concrete, American Concrete Institute (ACI).

1.5 COMPONENT IMPORTANCE FACTOR

A. Refer to project structural drawings for required building importance factor.

1.6 SUBMITTALS

A. Submitted systems shall be per Mason Industries, ISAT, or B-Line/Tolco. Contractor shall identify and convey each deck condition to which seismic attachments will be made. Information shall include type and size of steel member and any point load limitations or restrictions.

B. All post installed anchors shall be ICC approved and seismically qualified in cracked concrete as reflected in the anchor manufacturers ICC report.

1. DEWALT Power-Stud+ SD2
2. Hilti KB-TZ
3. Approved Equal

C. All cast in place anchors shall be ICC approved and seismically qualified in cracked concrete as reflected in the anchor manufacturers ICC report. If the product accepts multiple rod sizes, the ICC report must verify the shear load for the rod size chosen.

1. DEWALT Bang-It+, Wood-Knocker II+, DDI+
2. Simpson Blue Banger
3. Approved Equal

D. Provide Seismic Design Force calculations per ASCE 7-10, Formula 13.3-1 stamped by a civil or structural engineer licensed to practice in the State of Colorado. Calculations shall utilize correct Seismic Coefficients per ASCE 7-10, Table 13.6-1 for the component and installation condition.

E. Per ASCE 7, the results of Formula 13.3-1 need not be greater than Formula 13.3-2 and may not be less than Formula 13.3-1.

F. Submit seismic restraint layouts stamped by a civil or structural engineer licensed to practice in the State of Colorado. Seismic restraint layouts to show:

1. All vertical support and seismic brace locations.
2. All anchorage connections to structure. Anchor brand, type, quantity and size.
3. Vertical support and brace reaction point load at all connections to structure. For review by engineer of record in checking suitability of the building structure to accommodate imposed loads.
4. Plan set sheets showing appropriate installation details reflecting actual job site conditions.

G. Include cover sheet with Seismic Restraint Bracing Legend delineating:

1. Maximum Allowable Size or Utility Weight (Lbs/Lf).
2. Minimum Vertical Support Rod Diameter.
3. Support Rod Total Vertical Load.

4. Maximum Allowable Transverse Brace Spacing.
5. Transverse Brace Reaction.
6. Maximum Allowable Longitudinal Brace Spacing.
7. Longitudinal Brace Reaction.
8. Minimum Required Seismic Restraint Brace Arm Assembly.
9. Minimum Required Seismic Restraint Anchorage To Overhead Structure.
10. Installation Detail Drawing References.

1.7 QUALITY ASSURANCE

A. Project structural engineer of record to check suitability of structure to accommodate applied seismic loads.

B. The representative of the seismic restraint system manufacturer (the Seismic Vendor) shall walk the job site and provide documentation indicating conformance to the approved project shop drawing seismic restraint layout.

C. Contractor responsible for the construction of a “designated Seismic System” or a seismic resisting component listed in the “Statement of Special Inspections” shall submit to the Building Official and Owner’s Representative prior to the commencement of work, on the system or component, a written “statement of Responsibility” per CBC Section 1706A. Consult the Seismic Vendor for assistance in meeting this requirement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Seismic restraint hardware and engineering shall be furnished by Mason Industries, or equivalent by International Seismic Application Technology, B-Line/Tolco. Referred to in this specification section as the Seismic Vendor.

2.2 SEISMIC SWAY BRACES

A. Seismic sway braces shall consist of galvanized steel aircraft cables, steel angles or steel struts.

B. Cable braces shall be designed to resist seismic tension loads and steel braces shall be designed to resist both tension and compression loads. Brace end connections shall be steel assemblies that swivel to the final installation angle.

C. Cable brace assemblies shall have published strength and stiffness ratings based on testing per FM-1950 standards.

D. Angle or strut bracket assemblies shall be FM Approved, except as noted below.

E. Steel angles or struts, when required, shall be clamped to the threaded hanger rods at the seismic sway brace locations utilizing a minimum of two ductile iron clamps.

F. Cable brace bracket assemblies shall be Type SCB or SCBH. Solid brace bracket assemblies shall be Type SSB-FM, SSBS-FM or SHB-FM. All bracket assemblies shall have published strength and stiffness values based on testing per FM-1950.

G. Rod clamps shall be type SRC or UCC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Vertical support and seismic restraint anchorages shall be per IBC and the Seismic Vendor's applications, design and inspection manual.

B. For conditions not covered within the Seismic Vendor's applications, design and inspection manual, the required engineering shall be performed by the Seismic Vendor.

C. The Seismic Vendor shall provide field installation training prior to commencement of install.

D. Field relocation of any seismic installation points away from that shown on the Seismic Vendor furnished shop drawing layouts shall be coordinated with the Seismic Vendor's Technical Service.

E. Consult the Seismic Vendor's Technical Service when field conditions prohibit compliance with the supplied installation details.

F. The allowable brace spacing for piping systems shall be as determined by analysis per ASCE 7-10 Section 13.6.8 or ASME B31E.

G. Any utilities crossing building seismic separations shall be provided with seismic joints/loops. Provide seismic restraints at both sides of the separation.

3.2 EQUIPMENT CONNECTIONS

A. Where seismic bracing is allowed by code to be omitted due to component size or proximity to overhead deck, all terminations to fixed equipment, coils, etc. or to other portions of the system requiring seismic restraint shall utilize flexible connectors.

3.3 INSPECTION

A. Where seismic bracing is allowed by code to be omitted due to size or proximity to overhead deck, the inspector of record and contractor shall be responsible for assuring that damaging impact or vertical support failure cannot occur.

3.4 SPECIAL INSPECTION

A. Seismic Restrain Special Inspection Requirements: All designated seismic systems and all seismic resisting components listed in the "statement of special inspections" are subject to Special Inspection. The Seismic Vendor shall provide a special inspection plan to the contractor for submittal to the Owner's Representative and design team for use by the project's special inspectors. The plan shall include the following:

1. A list of all components of the seismic system that require inspection or testing.
2. The required frequency of testing and inspection.
3. Type and nature of testing required.

B. Special inspection for mechanical components shall be provided as follows:

1. Periodic special inspection during the installation for flammable, combustible or highly toxic piping systems and their associated mechanical units in Seismic Design Categories C, D, E, or F.
2. Periodic special inspection during the installation of HVAC ductwork that will contain hazardous materials in Seismic Design Categories C, D, E, or F.
3. Periodic special inspection during the installation of vibration isolation systems where the construction documents indicate a maximum clearance (air gap) between the equipment support frame and restraint less than or equal to 1/4".

C. In compliance with each anchor manufacturer's ICC Report, post installed anchors shall be specially inspected.

D. Upon completion of construction, a Quality Assurance Representative of the Seismic Vendor shall review the installation of the seismic force resisting system and provide documentation indicating general conformance to seismic restraint layout drawing.

END OF SECTION 23 05 49

SECTION 23 05 53 - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Plastic Pipe Markers and method of application.
2. Engraved Plastic Laminate Sign.

B. LEED

1. Adhesives and Sealants:

a. Submit product data or other published information verifying the VOC (Volatile Organic Compound) content is less than or equal to the allowable VOC content established by the governing standard: South Coast Air Quality Management District (SCAQMD) Rule #1168, July 1, 2005 and Green Seal Standard for Commercial Adhesives GS-36, October 19, 2000.

2. Low-Emitting Paints and Coatings:

a. Submit product data or other published information verifying the VOC (Volatile Organic Compound) content is less than or equal to the allowable VOC content established by the governing standards: Green Seal Standard GS-11, Paints, First Edition, May 20, 1993; Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997; South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, January 1, 2004.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products.

B. Where more than a single type is specified for an application, selection is Installer's option, but provide a single selection for each application.

2.2 PLASTIC PIPE MARKERS (TYPE A)

A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.

B. For Pipes Less Than Six Inches (including insulation if any): Provide full-band pipe markers, extending 360º 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. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than ¾" wide; full circle at both ends of pipe marker, tape lapped 1-½".

C. For Pipes Six Inches and Larger (including insulation if any): Provide either full-band or strip-type markers, but not narrower than 3 x letter height, taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-½" wide; full circle at both ends of pipe marker, tape lapped 3".

D. Lettering: Manufacturer's pre-printed wording which conforms to contract document system descriptions.

E. Match existing terminology for systems which are modified by this work.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering or as a separate unit of plastic (to accommodate both directions).

2.3 STENCILING (TYPE B)

A. Using a color contrasting to the surface to identify, spray or brush paint through neatly cut stencils.

B. Lettering shall conform to wording on contract documents. Size shall be in accordance with ANSI A13.1.

2.4 BACKGROUND COLOR AND STENCILING (TYPE C)

A. In addition to the requirements above, paint a background color band in accordance with ANSI A13.1.

2.5 VALVES TAGS

A. Brass Valve Tags: Provide manufacturer's standard 19 ga brass tag; approximately 1-½" round with ½" high, black-filled numbers and 3/16" top hole.

1. Numbers shall be sequential in accordance with schedule below.
2. Provide separate numbering for each legend sequence. Provide separate sequences for the following:

    a. Gas (GAS)
    b. Plumbing (PLBG)
    c. Heating Water (HTG)
    d. All other systems (No legend)

B. Valve Tag Fasteners: Manufacturer's standard chain (wire link or beaded type), or S-hooks.

2.6 VALVE SCHEDULE

A. Provide schedule for each piping system, as defined on the drawings, and below, typewritten and reproduced on 8-½" x 11" bond paper.

B. Tabulate valve number, piping system, system legend (as shown on tag), location of valve (room or space), and variations for identification (if any).

C. Provide piping schematic for each system as defined below in Part 3.

D. In addition to mounted copies, furnish extra copies for maintenance manuals as specified.

E. Valve Schedule Frames: For each page of the valve schedule, provide a glazed frame, with screws for removable mounting on masonry walls.

2.7 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, 1/16" thick, black with white core (letter color).

B. Fastening:

1. Screws
2. Rivets
3. Permanent Adhesive

C. Lettering and Graphics:

1. Coordinate names, abbreviations and other designations used in the mechanical identification work, with the corresponding designations shown, specified or scheduled in the construction documents.
2. In addition, for heating or cooling units and exhaust fans, identify area served.

PART 3 - EXECUTION

3.1 GENERAL

A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, install identification after completion of covering and painting.

B. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. **General:** Identify air supply, return, exhaust, intake and relief ductwork with stenciled signs and arrows, showing ductwork service and direction of flow, in black or white, whichever provides most contrast with ductwork color.

B. **Location:** In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50’ spacing along exposed runs.

C. **Access Doors:** Provide stenciled or plastic laminate type signs on each duct or equipment-mounted access door in ductwork and housings, indicating the purpose of the access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers on piping of the following systems and include arrows to show normal direction of flow.

1. Domestic water piping (hot, cold, tempered; 120º hot, 180º hot, hot water recirculating, etc.).
2. Plumbing vent and sanitary (above grade) piping.
3. Storm piping.
4. Heating water piping (supply and return).
5. Chilled water piping (supply and return).

6. Natural gas piping, (indicate pressures).
7. Ice plant brine water (supply and return).
8. Refrigerant piping (suction, liquid, hot gas bypass).
9. Beverage CO_2 piping
10. Fire protection.
11. Any other piping system as indicated on the drawings, or as required to match existing.
12. See Section ___for identification of medical gas piping.

B. Locate pipe markers and color bands, as follows, on all piping exposed to view, above an accessible ceiling, and in accessible maintenance spaces (including chases and near access panels). In spaces exposed to view in public areas, effort is to be made to coordinate exact locations with architect.

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 a question of flow pattern.
3. Near locations where pipes pass through walls, floors, or ceilings, or enter non-accessible enclosures.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 50’ along each piping run.
6. Within 6’ of access doors above otherwise non-accessible ceilings and chases.

C. Type:

1. Normally exposed to view - Type A or C.
2. Normally concealed from view - Type B.

3.4 VALVE IDENTIFICATION

A. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, plumbing fixtures faucets, 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 in valve schedule for each piping system.

B. Mount framed valve schedules with piping schematics where directed by Architect.

C. Identify each valve tagged on as-built drawings.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. Install an engraved plastic laminate sign on or near each scheduled item of mechanical equipment.

B. Provide engraved plastic laminate nameplate on every new piece of equipment not already provided with one in accordance with Section 23 05 02 of the specifications.

C. Identify area served, if applicable.

3.6 NON-POTABLE WATER IDENTIFICATION

A. Provide an engraved plastic laminate sign.

1. Legend: “Non-Potable Water”.
2. Location: At each outlet of piping downstream of backflow preventer, (e.g., Boiler Room hose bibb).

END OF SECTION 23 05 53

SECTION 23 05 93 - TEST-ADJUST-BALANCE

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. The Balancing Contractor shall be a sub-contractor, directly working for the General Contractor.

B. The Balancing Contractor shall not be a sub-contractor of any other Division 21, 22 or 23 Contractor.

1.2 QUALITY ASSURANCE

A. Qualification:

1. Work shall be done by a firm certified by the National Environmental Balancing Bureau (NEBB), or the Associated Air Balance Council (AABC), or the firm shall have technicians certified by the “National Training Fund Sheet Metal & Air Conditioning Industry”.
2. The firm shall be an independent testing and balancing form specializing in testing and balancing of environmental systems.
3. The firm shall have an experience record of not less than five (5) years of experience in the TAB industry.

B. Industry Standards: Comply with the following:

1. HVAC Systems-Testing, Adjusting, Balancing published by Sheetmetal and Air Conditioning Contractors National Association, Inc. (SMACNA).
2. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems published by National Environmental Balancing Bureau. (NEBB).
3. ASHRAE Systems Handbook. Testing, Adjusting and Balancing.

C. Registration: Work shall be done under the supervision of a professional engineer registered in Colorado. Engineer shall be available for all meetings and interpretation of all materials in the report.

D. Pre-qualification of TAB Contractor.

1. The firm must have experience and qualifications satisfactory to the consulting mechanical engineer and must be accepted by him prior to bidding.
2. Firms desiring approval to provide work under this section shall submit a booklet indicating procedures and data forms that they would use in the performance of the work.

3. Submittals shall be in accordance with Division 1.
4. Only firms which have been approved by the mechanical engineer prior to bid date may provide work under this section.

PART 2 - PRODUCTS

2.1 PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL

A. Sequence work to commence after completion of system and start-up procedures and schedule completion of work before Substantial Completion of Project.

B. Examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable.

C. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjust-balance work.

1. Do not proceed with the work until unsatisfactory conditions have been corrected.
2. Provide Engineer/Architect with a copy of the notification.

D. Adjust air flows and heating water systems to within 10% of values shown. Adjust chilled water systems to within 5% of values shown. If design flows cannot be obtained within specified limits the Balancing Contractor will perform the following (at the minimum):

1. Measure and record major pressure drops in the system.
2. Consult with the Engineer and Installer as required.
3. Upon receiving written directions to proceed and after any corrections are performed, re-balance affected portion of system.

E. Optimization: Work closely with the Section 23 09 00 contractor to optimize setpoints.

1. Establish the minimum air static pressure or water differential pressure for variable or bypass flow system.
2. Establish the position of minimum outside air dampers, damper/valve and sequencing relays.

F. Calibration: Be responsible for calibration of flow measurement devices used as input to the temperature control system. All air systems flow measurement stations including VAV terminals shall be calibrated against a pitot tube traverse or air diffuser capture hood. Balancing

contractor shall assure accuracy of all flow measurement devices or shall report on their failure to be accurate.

G. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommended by the original Installer.

H. Make all final readings for each system at the same time, and after all adjustments have been made.

I. Mark equipment settings, including damper control positions, balancing cocks, circuit setters, valve indicators, fan speed control settings and similar controls and devices, to show final settings at completion of test-adjust-balance work.

1. Mark with paint or other suitable permanent identification material.

J. Check all new thermal overloads.

1. Identify improperly protected equipment in report.

3.2 AIR SYSTEMS

A. Scope: All air systems are to be balanced.

B. Before any adjustments are made, check for:

1. Dirty filters, coils, or air intakes
2. Duct leakage
3. Filter leakage
4. Damper leakage, or blockage
5. Equipment vibrations
6. Correct damper operation

C. Simulate a pressure drop across filters equal to that when 50% loaded with dust.

1. Check fan motor amps with clean filters and simulated loaded filters, and report.

D. Procedure:

1. Measure and report the following for all supply, return, exhaust, and outside air systems:

a. Individual air inlets and outlets.
b. Pitot traverses of main supply, return, exhaust and outside air ducts.
c. Rotating valve or velocity grid traverse of coils or filters.
d. Plot operating point on fan curve. Include compensation for effects of altitude and inlet vanes.

2. Above measurements shall be made with system in normal, full load condition.

    a. Systems with economizers shall be measured at minimum outside air and 100% outside air.
    b. Systems with 100% outside air capability or evaporative cooling sections shall be measured at maximum outside air.
    c. VAV systems shall be measured at the zone level at maximum air condition, and at the main at the system diversity condition.

3. Make main duct traverses or coil/filter traverses and report operation at all other operating conditions (as applicable).

    a. Economizer operation
    b. Unoccupied mode
    c. Smoke evacuation mode
    d. Pre-cool mode
    e. Fail over mode
    f. Two-speed fans
    g. All VAV terminals driven to maximum position

4. Set fan speed such that under no condition will the motor exceed the service factor rating when operating in any of the above possible modes.
5. Measure fan motor amps in each of the above possible operating modes (clean filters).

E. Adjust Air Systems to provided proper air pressure relationships as shown by relative air quantities or as indicated on the drawings.

F. Adjust distribution system for uniform space temperatures free from objectionable drafts and noise.

1. Division 233300 to provide orifice plates or dampers where required.

G. Exchange sheaves and belts as required to adjust the rpm of all fans so they handle specified air quantity.

H. Set minimum outside air quantities.

3.3 DOMESTIC WATER SYSTEM

A. Scope: Balance all domestic hot water and hot water re-circulation systems.

B. Before any adjustments are made:

1. Check temperature control device operation (mixing valves, external temperature control devices, etc.).

2. Check rotation of pumps.
3. Adjust pressure reducing valves.
4. Verify proper operation of ASME pressure and temperature relief valves.

C. Using flow meters, adjust the quantity of water circulated by each pump and the flow in each branch of the hot water re-circulation systems.

3.4 HYDRONIC SYSTEMS

A. Scope: Balance all hydronic systems.

B. Before any adjustments are made:

1. Check temperature control valve operation.
2. Check pump rotation.
3. Adjust pressure reducing valve.
4. Remove any roughing strainer screens in systems.

C. Using system flow meters, adjust the quantity of fluid handled by each pump and supplied to each coil, piece of radiation, heat exchanger, cross-over bridge, bypass, etc., to meet design requirements.

D. Procedure:

1. Measure and report all hydronic and domestic water recirculation systems by all of the below means which are applicable.

    a. System, pump, branch, or terminal flow measuring stations.
    b. Terminal or heat exchanger pressure drop, compare to submittal data.
    c. Plot operating point on pump curve. Include compensation for effects of temperature, viscosity and density.

2. Above measurements to be made and reported at full heating/cooling load.

    a. For 3-way valve terminals/heat exchangers set bypass flow to equal coil flow.
    b. For primary/secondary systems, set crossover/bridle to have constant flow at all conditions.

3.5 DETAILED REQUIREMENTS

A. Measure, adjust and report the following:

1. Energy Recovery Ventilator Systems:

    a. Total supply air CFM, fan speed, inlet pressure, outlet pressure, amp draw.
    b. Total exhaust air CFM, fan speed, inlet pressure, outlet pressure, amp draw.
    c. Filter pressure drop.
    d. Energy recovery wheel RPM, inlet pressure, outlet pressure, and amp draw.
    e. Coil airflow.
    f. Coil entering and leaving air temperature.
    g. Coil entering and leaving air pressure.
    h. Coil water flow.
    i. Coil entering and leaving water temperature.
    j. Coil entering and leaving water pressure.
    k. Duct temperature at duct mounted temperature sensor.
    l. Duct static pressure at supply and exhaust duct mounted pressure sensors.

2. Ductwork Systems:

    a. Airflow at each inlet and outlet.
    b. Airflow at supply, return, outside air, and exhaust mains to determine total airflow.
    c. VAV box entering and leaving air temperature.
    d. VAV box entering and leaving static pressure.
    e. VAV box airflow at minimum position, maximum position, and heating position.

3. Fan Coil Unit Systems:

    a. Supply fan airflow, fan speed, total static pressure, and amp draw.
    b. Coil entering and leaving air temperature.
    c. Coil water flow.
    d. Coil entering and leaving water temperature.
    e. Coil entering and leaving water pressure.
    f. kW draw on electric coils.
    g. Space temperatures at thermostats or sensors.

4. Environmental Fans:

    a. Total fan CFM.
    b. Fan speed.
    c. Fan total static pressure.

5. Gas-fired Makeup Air Units:

    a. Air flow.
    b. Entering and leaving air temperature.
    c. Entering and leaving static pressure.
    d. Gas pressure.
    e. Combustion air fan operation.
    f. Flue temperature.
    g. Start/stop controls.

6. Coils:

    a. Coil airflow.
    b. Coil entering and leaving air temperature.
    c. Coil entering and leaving air pressure.
    d. Coil water flow.
    e. Coil entering and leaving water temperature.
    f. Coil entering and leaving water pressure.

7. Heat Exchangers:

    a. Cooler fluid entering temperature, leaving temperature, and fluid flow.
    b. Warmer fluid entering temperature, leaving temperature, and fluid flow.

8. Air-cooled Chiller:

    a. Cooling water flow.
    b. Cooling water temperature entering and leaving.
    c. Cooling water pressure entering and leaving.
    d. Evaporative-pre cooling system booster pump amp draw.
    e. Compressor safety and operating controls.
    f. Compressor amps and kW draw.
    g. Capacity reduction controls.
    h. Free cooling coil operation.
    i. Refrigerant suction pressure.
    j. Low ambient controls for packaged chiller systems.

9. Boilers:

    a. Heating water temperature entering and leaving.
    b. Heating water flow.
    c. Heating water pressure entering and leaving.
    d. Boiler safety and operating controls.
    e. Capacity reduction controls.
    f. Stack temperatures.
    g. Gas pressure and cubic feet of gas per hour.

h. Combustion efficiency.
i. If boiler is equipped for variable firing rates, include data for a. through h. for maximum and minimum firing rates.
j. Manufacturer's start-up report may be substituted if all above measurements are included.

10. Pumps:

    a. Water flow.
    b. Entering and leaving water pressure.
    c. Motor amps and kW draw.
    d. Installed impeller diameter.

11. Split system air conditioners and heat pumps:

    a. Refrigerant suction pressure.
    b. Fan operation.
    c. Compressor operation.
    d. Low ambient controls.
    e. Automatic restart upon loss and regain of electrical power.

12. Controls:

    a. Operational setting of controllers and instruments.
    b. Positioning and function of valves and dampers.
    c. Interlock and operation of systems (HVAC and Fire).

13. Cabinet Heaters and Unit Heaters:

    a. Entering and leaving air temperature.
    b. Entering and leaving water temperature.
    c. Water flow.
    d. kW draw on electric coils.
    e. Room air temperature.

14. Existing & New Perimeter Fin Tube:

    a. Entering and leaving water temperature.
    b. Entering and leaving water pressure.
    c. Water flow.
    d. Room air temperature.

3.6 REPORT

A. Provide a general information sheet listing:

1. Instruments used:

    a. Most recent calibration date.

2. Method of balancing.
3. Altitude correction.
4. Manufacturer's performance data for all air devices used.

B. Provide data sheets for all equipment, including motors and drives, listing:

1. Make
2. Size
3. Serial number
4. Capacity Rating
5. Amperage
6. Voltage input
7. Thermal heater size for each motor
8. Operating speed of driver and driven devices
9. Any additional pertinent performance data

C. Include design and final values for all items listed in Detailed Requirements, and totals for each system.

D. Provide data sheets showing:

1. Air flow at each inlet and outlet
2. Instrument used
3. Velocity reading
4. Manufacturer's free area factors

E. Provide recap sheet with explanation for each device not meeting specified performance.

F. Provide a set of prints with equipment, inlets and outlets marked to correspond to data sheets.

3.7 COMMISSIONING

A. Reference Section 23 08 00 for commissioning scope.

B. Provide all necessary personnel, tools and equipment to comply with the commissioning scope.

END OF SECTION 23 05 93

SECTION 23 07 00 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Insulation.
2. Jackets, coatings and protective finishes.
3. Sealers, mastics and adhesives.
4. Fitting covers.
5. Manufacturer's installation details for fire rated duct wrap.
6. Low-Emitting Adhesives and Sealants EQc4.1 requirements for LEED submittals.

1.2 FLAME AND SMOKE RATINGS

A. Provide insulation tested on a composite basis (insulation, jacket, covering, sealer, mastic and adhesive) complying with the following:

1. Flame Spread: 25 or Less
2. Smoke Developed: 50 or Less
3. Method: ASTM E84 (NFPA 255)

1.3 PRODUCT DELIVERY

A. Deliver insulation products in factory containers bearing manufacturer's label showing fire hazard rating, density and thickness.

1.4 DEFINITIONS

A. Exposed Location: Located in mechanical rooms or other areas exposed to view.

B. Concealed Location: Located in pipe chases, furred spaces, attics, crawl-spaces, above suspended ceilings, or other locations not exposed to view.

1.5 STANDARDS

A. Comply with the latest edition of National Commercial and Industrial Insulation Standards.

B. Comply with the latest edition of the California Energy Commission Title 24 requirements.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

A. Manufacturers:

1. 3M
2. Aeroflex
3. Armacell
4. ITW
5. Johns-Manville
6. K-Flex
7. Knauf
8. Manson Insulation
9. Owens-Corning
10. Unifrax

B. Materials:

1. **Type FP** - Fiberglass Pipe Insulation: Johns-Manville Micro-Lok heavy density pipe insulation with AP-T jacket.
2. **Type FPF** - Fiberglass Pipe Fitting Insulation: Johns-Manville “Zeston” fitting covers with factory-cut fiberglass insulation insert.
3. **Type FCCP** - Flexible Closed Cell Pipe Insulation: Armacell AP Armaflex, Aeroflex Aerocel, or K-Flex Insul-Tube. Compliant with ASTM E 84, NFPA 90A, and NFPA 90B.
4. **Type FCCP**-O – UV Resistant Flexible Closed Cell Pipe Insulation: Armacell UT Solaflex, Aerocel AC, K-Flex Insul-Tube with AL Clad System.
5. **Type CGP** - Cellular glass with vapor barrier coating: Owens Corning FOAMGLAS.
6. **Type RCCP** - Rigid Closed Cell Insulation (not for use indoors): ITW Trymer 2000XP, Dyplast ISO-C1/2.0, or GLT Products ISO-C1.
7. **Type PFW** - Plenum Fire Wrap: 3M Fire Barrier Plenum Wrap 5A+ or Unifrax FyreWrap 0.5 Plenum Insulation.

Materials indicated are provided as design basis. Equivalent insulation product by manufacturer indicated above is acceptable.

C. Insulation thickness and conductivity: (Thickness and conductivity listed below are minimum required. Provide thickness and conductivity required by Local Building or Energy Codes).

1. Service (Domestic) Water Piping:

a. Hot, 140ºF and under: (Insulation conductivity: 0.21–0.28 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1-½": 1"
2) Sizes 1-½" and larger: 1-½"

b. Cold, 40ºF to 60ºF: (Insulation conductivity: 0.21–0.27 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1-½": ½"
2) Sizes 1-½" and larger: 1"

2. Heating Hot Water

a. All heating hot water piping: (Insulation conductivity: 0.25–0.29 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1-½": 1-½"
2) Sizes 1-½" and larger: 2"

3. Chilled Water, Brine and Refrigerant:

a. 40ºF to 60ºF: (Insulation conductivity: 0.21–0.27 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1-½": ½"
2) Sizes 1-½" and larger: 1"

b. 40ºF and under: (Insulation conductivity: 0.20–0.26 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1": ½"
2) Sizes 1" and larger but smaller than 8": 1"
3) Sizes 8" and larger: 1-½"

4. Storm Water:

a. All Sizes: 1"

5. Refrigerant Suction Lines:

a. 40ºF to 60ºF: (Insulation conductivity: 0.21–0.27 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1-½": ½"
2) Sizes 1-½" and larger: 1"

b. 40ºF and under: (Insulation conductivity: 0.20–0.26 (Btu x in.)/(h x ft^2 x ºF))

1) Sizes smaller than 1": ½"
2) Sizes 1" and larger but smaller than 8": 1"
3) Sizes 8" and larger: 1-½"

6. Refrigerant Liquid Lines:

a. All Sizes: ½" (1" for fiberglass)

7. Refrigerant Hot Gas Lines:

a. Sizes smaller than 1-½": ½"
b. Sizes 1-½" and larger: 1"

8. Repairs to Existing Insulation: Match thickness of existing insulation.
9. All Heat Traced Piping: (Insulation conductivity: 0.27 or less (Btu x in.)/(h x ft^2 x ºF))

a. Refer to specification section 230503 Basic Mechanical Materials and Methods for insulation thickness.

10. Condensate Drain Piping:

a. All sizes: ½" (1" for fiberglass)

11. PVC pipe in plenums or above noise sensitive areas:

a. All sizes: See Part D.

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

1. Inside, above ground: **Type FP** fiberglass.
2. Inside exposed: **Type FP** fiberglass with PVC jacket (jacket not required in mechanical rooms).
3. Outside building envelope:

a. Insulation thickness 1-1/2" and larger **or** line size 2-1/2" and larger: **Type RCCP** rigid closed cell with aluminum jacket.

1) Provide sealant at all point joints to maintain vapor barrier.
2) Sealant shall be per insulation manufacturer recommendation.
3) Sealant submittal shall include a letter from the insulation manufacturer verifying that proposed sealant is compatible with insulation.

b. Insulation thickness less than 1-1/2" **and** line size less than 2-1/2": **Type FCCP-O** UV resistant flexible closed cell with aluminum jacket or flexible PVC insulation protector, Airex E-Flex or approved equal.

4. Below grade or slab:

   a. Pipe size 1½" and less: Single piece of **Type FCCP** flexible closed cell insulation slipped over soft annealed copper tube without slitting insulation.
   b. Pipe size 2" and larger: **Type RCCP** rigid closed cell insulation with shrink fit jacket.

5. PVC piping in return air plenum: **Type PFW** plenum fire wrap to meet ASTM E84 (NFPA 255) flame spread and smoke developed ratings. Thickness to be provided in accordance with manufacturer's literature
6. Acid waste/vent in return air plenums: **Type FCCP** flexible closed cell insulation.
7. Refrigerant piping, inside, above ground: **Type FCCP** flexible closed cell insulation.
8. Refrigerant piping, outside building envelope: **Type FCCP-O** UV resistant flexible closed cell insulation.
9. Condensate drain piping: **Type FCCP** flexible closed cell or **Type FP** fiberglass insulation.

2.2 DUCT INSULATION

A. Manufacturers:

1. Aeroflex
2. Armacell
3. Certainteed
4. Johns Manville
5. K-Flex
6. Knauf
7. Owens-Corning

B. Materials:

1. **Type FDL** – Fiberglass Duct Liner: See Section 23 31 13, for duct liner requirements.
2. **Type FCCL** – Flexible Closed Cell Duct Liner: See Section 23 31 13, for duct liner requirements.
3. **Type FDW** - Flexible Faced Fiberglass Ductwork Insulation Wrap: Johns-Manville Microlite, with FSK factory applied foil-scrim-kraft facing. ASTM E 84 compliant.
4. **Type RDB** - Rigid Fiberglass Ductwork Insulation: Johns-Manville 800 Series, Spin-Glas Type 814, 3 lb. Density rigid board with FSK jacket.
5. **Type RDB-O** - Rigid Glass Mineral Wool Ductwork Insulation: Knauf Earthwool with all service jacket (ASJ).

6. **Type FD** - Flexible Plain Fiberglass Ductwork Insulation: Johns-Manville Microlite .75 lb/cu. Ft. unfaced.
7. **Type FCCD** - Flexible Closed Cell Duct Insulation: Armacell AP Armaflex, Aeroflex Aerocel, or K-Flex Insul-Sheet. ASTM E 84 compliant. Where located outside the building envelope, provide UV resistant paint.
8. **Type CGD** - Cellular Glass Ductwork Insulation: Owens Corning FOAMGLAS with vapor barrier.
9. **Type ALJ** - Outdoor Aluminum Jacket: 3M Venturclad 1579 GCW-WME with white finish, Polyguard Alumaguard Cool Wrap with white finish, or MFM Flex Clad 400 with white finish.
10. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles, and similar accessories as recommended by the insulation manufacturer for the applications indicated.

Materials indicated are provided as design basis. Equivalent insulation or jacketing product by manufacturer indicated above is acceptable.

C. Application:

SYSTEM	EXPOSED	CONCEALED	OUTDOOR
Supply (Note 7)	None	1 ½" **Type FDL** duct liner	1 ½" **Type FDL** internal liner + 1 ½" Type **RDB-O** external rigid + **Type ALJ** jacket (Note 4)
Return (Note 8)	1 ½" **Type FDL** duct liner	1 ½" **Type FDL** duct liner	1 ½" **Type FDL** internal liner + 1 ½" **Type RDB-O** external rigid + **Type ALJ** jacket (Note 4)
Exhaust (Note 8)	None (Note 6)	None (Note 6)	1" **Type RDB-O** external rigid + **Type ALJ** jacket (Note 4)
Outside Air (Note 7 & 9)	1" **Type RDB** external rigid	1 ½" **Type FDW** duct wrap	2" **Type RDB-O** external rigid + **Type ALJ** jacket (Note 4)

1. Reference 23 07 00/ Duct Insulation and 23 31 13/ Duct Liner.
2. Where energy codes require additional insulation over that listed above, provide insulation in accordance with those codes.
3. Insulate all accessories and components (fire dampers, silencers, air valves, etc.) of the duct systems noted above as requiring insulation. Where lined systems contain components that cannot be lined or have not been provided with liner, insulate them. That insulation shall overlap the lined portion of the system by at least 12 inches.
4. Build up and pitch insulation to prevent water ponding on rectangular ductwork 36" or greater in width.
5. Round ducts concealed above ceilings and serving individual terminal units or diffusers may be wrapped in lieu of liner.
6. Provide insulation of exhaust louver plenums and exhaust ductwork for first 20' from perimeter louvers or from perimeter louver to motorized damper or gravity damper.

Provide **Type FDL** duct liner for exposed exhaust louver plenums and ductwork. Provide **Type FDW** duct wrap for concealed exhaust louver plenums and ductwork.

7. Ductwork downstream of 100% outside air units with heating and cooling shall be treated as supply air.
8. All negative pressure ductwork of energy recovery ventilators shall be treated as return air.
9. Boiler plant combustion air ductwork shall be insulated as outside air ductwork. Round ductwork may be wrapped in lieu of external rigid insulation.

2.3 EQUIPMENT INSULATION

A. Manufacturers:

1. Aeroflex
2. Armacell
3. Certainteed
4. Johns Manville
5. K-Flex
6. Knauf
7. Manson Insulation
8. Owens-Corning

B. Materials:

1. **Type FE** – Fiberglass Pipe and Tank Insulation: Johns-Manville Micro-Flex Large-diameter Pipe and Tank Fiberglass Insulation. Insulation shall be designed to conform to curved surfaces while maintaining insulation thickness and high compressive strength.
2. **Type FCCE** - Flexible Closed Cell Insulation: Armacell AP Armaflex, Aeroflex Aerocel, or K-Flex Insul-Sheet, sheet form. ASTM E 84 compliant.
3. Jacketing Material: PVC roll jacketing. Seal all joints.
4. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, metal covers, adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

C. Application:

1. Thickness: Refer to Part 3.
2. Inside, above ground: **Type FE** pipe and tank insulation.
3. Inside, exposed: **Type FE** pipe and tank insulation with PVC jacket (jacket not required in mechanical rooms).

4. Outside building envelope: **Type FCCE** flexible closed cell with UV resistant painted finish, white in color unless otherwise noted. Paint shall be by same manufacturer as insulation.

    a. Provide sealant at all point joints to maintain vapor barrier.
    b. Sealant shall be per insulation manufacturer recommendation.

2.4 KITCHEN GREASE HOOD EXHAUST DUCT INSULATION/FIRE BARRIER DUCT WRAP

A. Manufacturers (all components to be by one manufacturer):

1. 3M
2. ETS Schaefer
3. Nelson
4. Pyroscat
5. Thermal Ceramics
6. Unifrax
7. Vesuvius

B. Materials:

1. Lightweight, non-asbestos, high temperature inorganic ceramic fiber blanket wrap.
2. Insulation to be fully encapsulated in reinforced foil.
3. Double layer, two (2) hour fire resistant enclosure.
4. Fibers to be non-carcinogen and soluble in human lung tissue.
5. Zero clearance to combustibles rating.
6. Provide rated access doors (as required) insulated to maintain two (2) hour rating and required clearance.
7. Provided fire barrier sealant, tape, rods, pins, clips, bands and other components as required to provide fully functioning system.
8. Systems using spray applications or combination ratings of duct material and spray are not acceptable.

C. Listings and Testing:

1. ISO 6944: Fire resistance tests – Ventilation ducts
2. ASTM E84: Standard Test Method for Surface Burning Characteristics of Building Materials

    a. Surface burning characteristics:

        1) Flame Spread: 0
        2) Smoke Developed: 0.

3. ASTM E814: Standard Test Methods for Fire Tests of Through-Penetration Firestops
4. ASTM E119: Standard Test Methods for Fire Tests of Building Construction Materials

5. NFPA 96.
6. NFPA 101.
7. Submit written approval from authority having jurisdiction for use of system at specified clearance.

D. Application:

1. Insulate duct systems as indicated on drawings. Insulate life safety ductwork as indicated in Section 23 09 03.
2. Wrap duct supports for two (2) hour rating.
3. Install per manufacturer's recommended installation guidelines.
4. Provide Manufacturers approved transition between fire wrap and gypsum board rated enclosures where both systems are used. Do not transition from gypsum enclosure system back to fire wrap.
5. Use bands and/or welded pins as required. Adhesives are not acceptable.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify acceptability of all materials which are to be used in air plenums (above ceiling, etc.). Materials must meet all requirements of Local Building Code and Authority having jurisdiction.

3.2 PIPE INSULATION

A. Insulate the following:

1. Domestic hot water piping.
2. Domestic cold-water piping above ground and under slab.
3. Heating piping.
4. Chilled water piping.
5. Roof drain bodies and all horizontal storm water piping.
6. Refrigerant hot gas, liquid, and suction lines.
7. All existing piping which is currently insulated and which is modified as a result of this work.
8. Condensate drain piping.
9. Heat traced piping.
10. Storm and sanitary piping where subject to freezing conditions.
11. All PVC piping located in return air plenums.

B. Installation:

1. Install insulation on pipe system subsequent to testing and acceptance of tests.
2. Install insulation materials with smooth and even surfaces.

    a. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete the run.
    b. Do not use cut pieces or scraps abutting each other.

3. Clean and dry pipe surfaces prior to insulating.

    a. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

4. Extend piping insulation without interruption through pipe clamps, hangers, walls, floors and similar piping penetrations, except where otherwise indicated. **Hangers and supports must be installed outside, not through, insulation.**
5. Install protective metal shields and saddles where needed to prevent compression of insulation. Refer to Section 23 05 29.
6. Except as noted, cover valves, flanges, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run.

    a. Install factory-molded, pre-cut or job-fabricated units (at Installer's option), except where a specific form or type is indicated.
    b. Do not cover:

        1) Valve operators.

    c. Provide removable access for:

        1) Strainers.
        2) Other components requiring access for service.

7. Mark location of unions and flanges covered by insulation with permanent paint or ink, or approved label.
8. Maintain integrity of vapor-barrier jackets on insulation of cold pipes and storm drainage piping, and protect to prevent puncture or other damage.
9. Insulate between pipe and pipe saddles. Provide suitable saddles.
10. Seal ends of sections with vapor barrier cement to crate moisture dams at:

    a. 21 ft. intervals.
    b. Valves and fittings.
    c. All hangers and supports.

11. On underground pipe insulation, install unicellular insulation on pipe without slitting insulation.

    a. Seal all transverse joints with adhesive.

12. Replace existing insulation removed or damaged because of work of this project.
13. Insulate new pipes and replace insulation on existing pipes to remain where insulation was removed or damaged by demolition or revisions.
14. Do not insulate basket access flange of flanged strainers.
15. Do not insulate steam traps.
16. Insulate between fingers of spiders in alignment guides.
17. Insulate between pipe and pipe slide.
18. Perform all work in a neat and workmanlike manner. Poor work (as determined by Architect or Engineer) will be cause for rejection.

3.3 UNDERGROUND HYDRONIC PIPE INSTALLATION

A. Portions of the chilled water and heating water water piping systems shall be insulated below grade.

B. The installed piping system shall have the following characteristics.

C. Insulating Value: The system shall provide a conductivity of 0.165 Btu-in/hr ft^2 F^o at 75^{o}F (r-value of 6).

1. The insulation shall be Foamglass Pittwrap SS II, waterproof (not lose insulating value when saturated with liquid water or completely sealed against the introduction of water) and 2” thick.
2. The exterior of the pipe shall be completely sealed against the introduction of moisture when the system has been installed in ground water saturated fill.
3. The system shall be compatible with the excavation and backfilling methods and materials used.
4. The system shall be able to sustain medium duty tract loading (1000 lb wheel loading at the surface) without damage.

D. Minimum burial depth shall be 5’-0” below finished grade.

E. The actual system used shall be at contractor’s option as long as the above criteria is met, and may be a pre-fabricated or field built system. However, if the system submitted by the Contractor does not meet the criteria (as determined by Engineer), the Contractor shall supply a double pipe pre-fabricated system equivalent to that manufactured by Ricwil or Perma-Pipe.

3.4 OUTDOOR PIPE INSULATION

A. Install rigid insulation with butt joints of half pipe sections staggered. Insulation shall be held in place with strapping tape.

B. Install aluminum jacket with all joints lapped to shed water. Apply a bead of silicone sealant at all transverse and longitudinal seams. Secure with aluminum bands, minimum of 2 per jacket section. Contractor to verify that sealant has been applied per sealant and insulation manufacturer recommendations for proper vapor barrier.

C. Install flexible PVC insulation protector per manufacturer's installation requirements. Contractor to verify that insulation protector has been applied per insulation protector and insulation manufacturer recommendations for proper vapor barrier.

3.5 DUCTWORK INSULATION

A. Install insulation materials with smooth and even surfaces.

B. Clean and dry ductwork prior to insulating.

1. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

C. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated. **Hangers and supports must be installed outside, not through, insulation.**

D. Except as otherwise indicated, do not insulate lined ducts. However, extend duct insulation 12" beyond start of lining where lined ductwork meets insulated ductwork.

E. Maintain integrity of vapor-barrier on insulation of ducts carrying cold air, and protect it to prevent puncture and other damage.

F. For Outdoor Insulation:

1. Stagger joints on multilayer applications.
2. Locate joints at sides of ducts whenever possible.
3. Utilize adhesive and vapor retarder as indicated by manufacturer for outdoor applications.
4. Use full coverage adhesive to adhere external insulation to ductwork. For flexible closed cell insulation, adhesive shall be by insulation manufacturer.
5. Vapor retarders shall overlap a minimum of 2" at all seams.
6. Cover flexible connections.
7. Extend covering to inside face of wall/roof.

8. Provide all exposed rigid insulation surfaces with protective aluminum jacket. Provide backing and aluminum jacketing tape at all sharp edges and fasteners. Do not puncture aluminum jacket.
9. Provide all outdoor flexible closed cell insulation with UV resistant painted finish, white in color unless otherwise noted. Paint shall be by same manufacturer as insulation.

3.6 EQUIPMENT INSULATION

A. Install insulation materials with smooth and even surfaces and on clean and dry surfaces.

1. Re-do poorly fitted joints.
2. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

B. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

C. Apply insulation using the staggered joint method for both single and double layer construction, where feasible.

1. Apply each layer of insulation separately.

D. Do not insulate handholes, cleanouts, ASME stamp and manufacturer's nameplate.

1. Provide neatly beveled edge at interruptions of insulation.

E. Chilled Water Pumps:

1. Do not insulate. Provide drain pan and drain to collect condensate formed on pump body. Pipe drain line to nearest floor drain and provide air gap.

F. Hot Equipment (Above Ambient Temperature):

1. Includes hot and heating water as well as steam equipment such as air release tanks, air separators, expansion tanks, flash tanks, vessels etc.
2. Insulate with 3" thick equipment insulation.
3. Do not apply insulation to equipment while hot.

G. Heat Exchanger:

1. Cover top and both sides of exchanger with 24-gauge galvanized steel panels with ½" **Type FCCE** flexible closed cell equipment insulation cemented to the inside of the panels.
2. Panels shall be easily removable and easy to re-install.
3. Adhere flexible closed cell insulation to end plates with Armacell Armaflex No. 520 adhesive or equivalent by selected insulation manufacturer.

H. Domestic Water Tanks:

1. Insulate domestic hot water tanks with 2 inches of equipment insulation or 1½ inches of rigid fiber glass board (if not originally insulated from the factory).

I. Cold Equipment (At or below ambient equipment):

1. Includes chilled, domestic cold, condenser water system equipment such as air release tanks, air separators, expansion tanks, flash tanks, vessels, etc.
2. Insulate air release tanks (air separators) with 2 inches of equipment insulation or 1½ inches of cellular glass insulation.

3.7 FIRE RATED DUCT WRAP

A. Remove dirt and dust and clean all duct surfaces.

B. Install per manufacturer's instructions and referenced standards. Where pins are required, they shall be tack welded to duct.

C. Repair any damage in accordance with manufacturer's instruction.

3.8 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily. Including units with vapor barrier damage and moisture saturation.

B. Protection: The insulation installer shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

3.9 ASBESTOS REMOVAL

A. It is understood and agreed that this work does not contemplate handling of, or design including use of, asbestos or any hazardous waste material. Therefore, Owner and Contractor agree to hold harmless, defend and indemnify consultant (A/E) for all claims, lawsuits, expenses or damages arising from or related to the handling, use, treatment, purchase, sale, storage or disposal of asbestos, asbestos products or any hazardous waste materials.

B. In the event asbestos is encountered the Contractor shall immediately cease work in the area of the asbestos shall contact the Engineer and Owner for instructions.

C. Regulations:

1. Follow Section 1910.1001 Code of Federal Regulations Title 29, Part 1910 (OSHA Asbestos Regulations).
2. Provide daily sampling during removal instead of at six month intervals.
3. Stop work and notify Architect immediately if levels exceed those of Subparagraphs b (2) or b (3) of regulations.
4. Dispose of material containing asbestos using methods approved by EPA at sites approved by EPA.

END OF SECTION 23 07 00

SECTION 23 08 00 - BUILDING MECHANICAL SYSTEM COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplemental Conditions and Section 23 05 02 apply to all work specified in this section.

B. Refer to Specification Section 23 05 93, title “Test and Balance” for interface requirements with test and balance contractor.

1.2 DESCRIPTION OF WORK

A. This specification covers the start-up, operating performance test and commissioning of the HVAC systems. The purpose of this effort is to bring the project mechanical systems to a state of dynamic operation in accordance with the contract documents by verifying the operation of individual components, subsystems and systems.

B. The Owner will retain the services of an independent commissioning agent (CxA) separate from the work of this Contract. As herein specified the Owner and CxA shall develop detailed commissioning procedures, equipment checkout procedures and data forms for recording compliance with contract documents, performance and punchlist deficiencies, and will assist in developing schedules for checkout and Owner acceptance, at a future date during the construction phase.

C. The Division 23 Mechanical Contractor and the General Contractor shall include as part of the work of this contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to accomplish the work and labor and material for execution, monitoring and printing data forms necessary to verify and record system observations.

D. The Test and Balance Contractors shall include as part of the work of this contract, labor and material to provide manpower, equipment, tools, ladders, instruments, etc. necessary to execute and accomplish the work.

E. At the completion of the start-up, operations performance test and test and balance, the Contractor shall conduct a 72 hour dynamic mode demonstration of the systems in the presence of the Owner/Architect/Engineer and CxA.

1.3 COMMISSIONED EQUIPMENT

A. All equipment requiring commissioning as indicated in the 2018 International Energy Conservation Code.

1.4 COMMISSIONED SYSTEMS

A. All systems requiring commissioning as indicated in the 2018 International Energy Conservation Code.

PART 2 - PRODUCTS

2.1 MATERIALS, LABOR, INSTRUMENTS, TOOLS, LADDERS AND APPARATUS

A. The Contractor shall provide all materials, labor, instruments, tools, ladders and apparatus necessary to start-up, perform operating performance test and systems conditioning.

B. The Contractor shall be responsible for maintaining the commissioning documentation until final acceptance of the project. Final checklists will be produced by the CxA and provided prior to beginning commissioning. The commissioning documentation shall be kept current by the Contractor and shall be available for inspection at all times. At the time of acceptance of the project, the Contractor shall surrender 3 completed copies of the commissioning documentation to the Owner’s representative.

PART 3 - EXECUTION

3.1 START-UP AND OPERATING PERFORMANCE TEST

A. Before request for contract compliance inspection and system commissioning all equipment, components, and systems shall be started-up, adjusted, calibrated; set, test and check all electric disconnect, fuses, circuit breakers, valves, dampers, temperatures and pressures of all systems for proper operation and performance. After completion of the start-up and operating performance test, the Contractor will notify the Owner in writing that the system is ready for commissioning.

B. Information, date, etc. from start-up and operating performance test may be utilized, as appropriate, to execute preliminary commissioning documentation, however, certification of equipment and systems for the preliminary commissioning phase shall be completed in accordance with paragraph 3.2 of this section of the specifications.

C. Start-up and operating performance test documentation shall include the following:

1. Energy Recovery Ventilator Systems:

    a. Total supply air CFM, fan speed, inlet pressure, outlet pressure, amp draw.
    b. Total exhaust air CFM, fan speed, inlet pressure, outlet pressure, amp draw.
    c. Filter pressure drop.
    d. Energy recovery wheel RPM, inlet pressure, outlet pressure, and amp draw.
    e. Coil airflow.
    f. Coil entering and leaving air temperature.
    g. Coil entering and leaving air pressure.
    h. Coil water flow.
    i. Coil entering and leaving water temperature.
    j. Coil entering and leaving water pressure.
    k. Duct temperature at duct mounted temperature sensor.
    l. Duct static pressure at supply and exhaust duct mounted pressure sensors.

2. Ductwork Systems:

    a. Airflow at each inlet and outlet.
    b. Airflow at supply, return, outside air, and exhaust mains to determine total airflow.
    c. VAV box entering and leaving air temperature.
    d. VAV box entering and leaving static pressure.
    e. VAV box airflow at minimum position, maximum position, and heating position.

3. Fan Coil Unit Systems:

    a. Supply fan airflow, fan speed, total static pressure, and amp draw.
    b. Coil entering and leaving air temperature.
    c. Coil water flow.
    d. Coil entering and leaving water temperature.
    e. Coil entering and leaving water pressure.
    f. kW draw on electric coils.
    g. Space temperatures at thermostats or sensors.

4. Environmental Fans:

    a. Total fan CFM.
    b. Fan speed.
    c. Fan total static pressure.

5. Gas-fired Makeup Air Units:

    a. Air flow.
    b. Entering and leaving air temperature.
    c. Entering and leaving static pressure.

d. Gas pressure.
e. Combustion air fan operation.
f. Flue temperature.
g. Start/stop controls.

6. Coils:

a. Coil airflow.
b. Coil entering and leaving air temperature.
c. Coil entering and leaving air pressure.
d. Coil water flow.
e. Coil entering and leaving water temperature.
f. Coil entering and leaving water pressure.

7. Heat Exchangers:

a. Cooler fluid entering temperature, leaving temperature, and fluid flow.
b. Warmer fluid entering temperature, leaving temperature, and fluid flow.

8. Air-cooled Chiller:

a. Cooling water flow.
b. Cooling water temperature entering and leaving.
c. Cooling water pressure entering and leaving.
d. Evaporative-pre cooling system booster pump amp draw.
e. Compressor safety and operating controls.
f. Compressor amps and kW draw.
g. Capacity reduction controls.
h. Free cooling coil operation.
i. Refrigerant suction pressure.
j. Low ambient controls for packaged chiller systems.

9. Boilers:

a. Heating water temperature entering and leaving.
b. Heating water flow.
c. Heating water pressure entering and leaving.
d. Boiler safety and operating controls.
e. Capacity reduction controls.
f. Stack temperatures.
g. Gas pressure and cubic feet of gas per hour.
h. Combustion efficiency.
i. If boiler is equipped for variable firing rates, include data for a. through h. for maximum and minimum firing rates.
j. Manufacturer’s start-up report may be substituted if all above measurements are included.

10. Pumps:

    a. Water flow.
    b. Entering and leaving water pressure.
    c. Motor amps and kW draw.
    d. Installed impeller diameter.

11. Split system air conditioners and heat pumps:

    a. Refrigerant suction pressure.
    b. Fan operation.
    c. Compressor operation.
    d. Low ambient controls.
    e. Automatic restart upon loss and regain of electrical power.

12. Controls:

    a. Operational setting of controllers and instruments.
    b. Positioning and function of valves and dampers.
    c. Interlock and operation of systems (HVAC and Fire).

13. Cabinet Heaters and Unit Heaters:

    a. Entering and leaving air temperature.
    b. Entering and leaving water temperature.
    c. Water flow.
    d. kW draw on electric coils.
    e. Room air temperature.

14. Existing & New Perimeter Fin Tube:

    a. Entering and leaving water temperature.
    b. Entering and leaving water pressure.
    c. Water flow.
    d. Room air temperature.

3.2 SYSTEM COMMISSIONING

A. All systems, components, equipment, etc. furnished as part of this Contract shall be subjected to system commissioning as hereinafter specified. All systems, components, equipment, etc. commissioned in this section of the Specifications shall be evaluated based on the sequences of control/operation, performance characteristics, and equipment schedules, etc. as specified in other sections of the Specifications and as shown on the contract drawings. Systems, components, equipment, etc. that does not have specified operating sequence, etc. shall be operated and evaluated based on its use and function for this project.

B. Commissioning Documentation: The Contractor shall maintain the commissioning documentation in 3-ring binders. The commissioning documentation shall be organized by system when practicable. All pages shall be numbered and a table of contents page shall be provided. The commissioning documentation shall include, but not be limited to, the following:

1. Design Criteria provided by the A/E.
2. Approved Test and Balance Report for the system or component being commissioned, provided by Test and Balance Contractor.
3. Approved submittals for all equipment to be commissioned, provided by Mechanical Contractor.
4. All approved shop drawings of equipment to be commissioned. Shop drawings shall be full size sheets folded as required to fit in binders. Provided by Mechanical Contractor.
5. All pre-commissioning checklists initialized by indicated personnel organized by system and subsystem.
6. All functional performance test checklist initialized by indicated personnel organized by systems and subsystems.
7. Three copies of the Operation and Maintenance Manuals specified in other sections of these specifications shall be reviewed by the CxA for completeness and for applicability. The manuals shall be incorporated in the Commissioning Documentation prior to the commencement of the training required in other sections of the specifications. Preparation of Operation and Maintenance Manuals shall be as specified in other sections of these specifications.

C. Shop Drawings and As-Built Drawings and Specifications shall be assembled by the Contractor after completion of the pre-commissioning phase and turned over to the Owner's representative. Changes as a result of subsequent Commissioning procedures will be incorporated (as required) at the conclusion of final Commissioning.

D. Commissioning Schedule:

1. Phase 1 - Preliminary Commissioning: All shop drawings, including but not limited to, equipment, controls, test and balance reports, and operation and maintenance manuals, shall be submitted and approved by the CxA. In addition, all pre-commissioning checklists shall be completed (initialed by all parties).
2. Phase 2 - Functional Performance Testing shall be performed as indicated on the Functional Performance Test Checklists. Functional Performance Testing shall not begin until Phase 1 of the commissioning process is complete. Owner's operation and maintenance personnel shall observe the function performance testing. The Contractor may perform initial system familiarization and training of Owner's operating and maintenance personnel required under other sections of the Specification during the functional performance testing.
3. Functional Performance Test Notification: The Contractor shall notify the CxA 2 weeks before functional performance testing is to begin.
4. Phase 3 - System training and operating instructions shall be conducted by the Contractor as indicated in the specifications of each item of equipment. The Contractor shall be responsible for specified training and operating instructions being observed by the CA.

E. Pre-Commissioning Checklists:

1. Pre-Commissioning Checklists shall be developed by the CxA and shall be executed and certified prior to the commencement of functional performance testing. The indicated initial is required in each location for all items, except where an "X" is shown indicating an initial is not required. See initials legend below for required initials. The pre-commissioning checklist will not be accepted as complete until all items have been initialed signifying this portion of the project is ready for Functional Performance Testing. The Contractor shall provide the CxA with the completed Pre-Commissioning Checklists for his review and initials. The CxA shall be the last person to initial each checklist item. The Contractor shall submit for approval a list of all contractor and subcontractor representatives responsible for the completion of the pre-commissioning checklist phase of the project. This list of representatives shall be submitted 2 weeks prior to commencement of any pre-commissioning activities of any systems or equipment. Representatives may be replaced only after written approval from the CxA.
2. Initials Legend:

    a. Construction Manager.
    b. Mechanical Contractor's representative.
    c. Electrical Contractor's representative.
    d. Commissioning Agent.
    e. Balancing Contractor's representative.
    f. Controls Contractor's representative.

3. Blank Example Pre-Commissioning Checklists are in Appendix, located at the end of this section of the specifications. A separate Pre-Commissioning checklist shall be provided for each system and piece of HVAC equipment to be Commissioned.

F. Functional Performance Test Checklist:

1. Functional performance testing shall be performed by the Contractor as directed by the CA and observed by a commissioning team consisting of the individuals indicated on the Functional Performance Test Checklists. The Contractor shall submit in writing a list of all contractor and subcontractor representatives responsible for the functional performance testing phase of the project. This list of representatives shall be submitted 2 weeks prior to the commencement of functional performance testing of systems and equipment. All representatives shall remain on the commissioning team throughout functional performance testing. Substitutions will not be permitted. Functional performance test checklists shall be completed in the presence of all commissioning team personnel at the time of the functional performance test.
2. Upon failure of completion of a functional performance test checklist, the Contractor shall provide a written report to the CxA listing the deficiencies causing the failure and remedies to correct all deficiencies. After the Contractor has corrected all deficiencies, the entire functional performance test checklist for the item of equipment shall be repeated. If possible, corrections can be accomplished during the functional performance testing of equipment in other non-related systems. In any case, no system will be

accepted until all equipment items in the system have complete functional performance test checklists thereby demonstrating satisfactory performance.

3. Failure to complete 2 functional performance test checklists constitutes failure of Phase 2 of the HVAC Commissioning process. The Contractor shall provide a written report to the CxA listing the deficiencies causing all failures and remedies to correct all deficiencies. After correction of all deficiencies, Phase 2 of the HVAC Commissioning process shall be repeated in its entirety. The Contractor shall give the CxA 2 weeks notice before repeat functional performance testing is scheduled. Should the first or one subsequent functional performance test fail, the Owner reserves the right to obtain compensation from the Contractor for fees and expenses incurred in conjunction with having to perform more than two (2) functional performance tests.
4. Blank examples functional performance test checklists are in the Appendix 2 located at the end of this section of the specifications. A separate Functional Performance Checklist shall be provided for each system and piece of equipment to be Commissioned.

3.3 DEMONSTRATION TEST

A. After completion of system start-up, operating performance test and commissioning, but before Owner acceptance, the Contractor shall conduct a 72 hour dynamic mode demonstration of the systems provided under this Contract. The intent of the 72 hour dynamic test is to verify that the mechanical and electrical equipment will respond as designed to meet the changes that may occur under varying indoor/outdoor conditions including seasonal variations and occupancy loads.

B. A detailed procedure and sequence of events shall be developed by the Contractor and submitted to the Owner and CxA for review and approval. Procedures and sequence of events should contain as a minimum the following activities:

1. Hours 1-4: Bring all systems online for standard operations and parameters.
2. Hours 5-28: Operate all systems under normal parameters and verify proper operation.
3. Hours 29-52: Validation of systems operation through indoor/outdoor changes to include heating, cooling, ventilation, humidity control, domestic and control systems.
4. Hours 69-72: Return of systems to normal operation.

C. Systems and their associated equipment which are to be included in the dynamic test are all systems and components furnished under this Contract and as a minimum will include, but are not limited to the following:

1. Pressurization Air Handling Systems
2. Air Handling Systems
3. Chilled Water Systems
4. Domestic Water Systems
5. Fan Coil Systems
6. Pumping Systems
7. Exhaust Systems

8. Air Filtration Systems
9. Building Management and Control Systems

D. Contractor shall notify the Owner and CxA in writing that the project is completed and ready for the demonstration test. Schedule for test will then be established and documented. Initiation of the 72 hours dynamic test will not occur until all systems are balanced, operational and incorporated into the building management and control system. Should the demonstration test fail for any reason, the problems shall be corrected and another demonstration test conducted. Should the first or one subsequent demonstration test fail, the Owner reserves the right to obtain compensation from the Contractor for fees and expenses incurred in conjunction with having to witness more than two (2) 72 hour demonstration tests.

E. The attendees of each 72 hour demonstration test shall include representative from the following organizations:

1. General Contractor
2. Mechanical Contractor
3. Electrical Contractor
4. Test and Balance Contractor
5. Building Management and Control System Contractor
6. Architect of Record
7. Mechanical Engineer
8. Electrical Engineer
9. Commissioning Agent

Minor problems are anticipated and the necessary personnel required to correct problems and adjust systems need to be available to insure continuation of the dynamic testing process. If major problems are encountered, at the discretion of the Owner and CxA, the testing will be terminated and rescheduled.

The Contractor shall notify any external organizations, which would include but not be limited to, the Owner and Fire Department which are not directly involved in the testing, but might be affected due to interface to insure that alarms do not occur.

F. During the demonstration test all systems shall operate in the “hands-off” automatic mode in accordance with the requirements of the Contract Documents. Changes in operating modes required to simulate load shifting, seasonal changeover, emergency modes, etc. will be accomplished by changing set points and equipment operating status at the BMS central control console as required to observe capacity control and monitoring. Provide a readout of space temperature at each thermostat building relative humidity, building pressurization, chilled water supply and return temperatures and chiller capacity.

END OF SECTION 23 08 00

SECTION 23 08 01 - COMMISSIONING AGENT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to section 23 08 00 for commissioning requirements and Division 1 for additional information.

1.2 DESCRIPTION OF THE WORK

A. This Section covers the Scope of Work for the Commissioning Agent (CxA) who will be hired by the Owner.

B. The Commissioning Agent shall oversee the commissioning of the HVAC systems as described in Section 23 08 00. The CxA shall prepare precommissioning and functional performance test checklists to be used by the Contractor. Prepare and publish a commissioning plan. Witness startup and operational tests of equipment and systems. Perform observations of the mechanical systems throughout construction and prepare the final commissioning document.

C. The CxA shall have authority to direct and schedule test. The CxA shall have no authority to direct changes to the systems, or provide design related review comments.

1.3 COMMISSIONING PLAN

A. The CxA shall prepare a plan listing the parties involved with their responsibility, scope, definitions, safety concerns, design criteria, attendance schedules, commissioning schedules, and commissioning manual requirements.

1.4 COMMISSIONING FORMS

A. Review 100% CD’s. Provide written summary of how each commissioned item of equipment, should operate include calculations verifying scheduled capacity.

B. The CxA shall develop forms similar to that in Section 23 08 00 for the Contractors use during the commissioning process. The forms shall become part of the final commissioning manual. Forms shall be provided for each piece of commissioned equipment and system. Any deviations from the design shall be noted and proved by the Owner prior to acceptance. Each form shall be signed by the Contractor, CxA and Owner prior to acceptance of a system or piece of equipment.

1.5 PROJECT OBSERVATIONS

A. The CxA shall perform observations of the commissioned equipment and systems twice a month at a minimum and more as required to keep pace with construction. The CxA shall note progress and any deviations of the construction documents shall be brought to attention of the Contractor and Owner for resolution. The CxA will have no authority to direct changes or corrections to the system. Observation reports shall be published to the Owner, Architect and Contractor and shall be part of the final commissioning manual.

1.6 OPERATIONAL AND START-UP TESTS

A. The CxA shall witness start-up tests and collect documentation of the tests. The CxA shall notify the Architect and Contractor of any deviations from the contract documents. Any deviations shall be corrected or accepted by the Owner prior to acceptance.

B. After the Contractor has submitted in writing that the systems are completed, the CxA shall schedule and direct operational tests of the systems. These tests shall be as described in Section 23 09 00 and 23 08 00. The results shall be documented and made part of the commissioning manual. Any deviations from the design shall be brought to the attention of the Architect and Contractor. Any deviations shall be corrected or accepted by the Owner prior to acceptance.

1.7 COMMISSIONING MANUAL

A. The CxA shall prepare the final commissioning manual. The manual shall provide a complete history of the commissioning process and shall include:

1. Design and Energy Codes.
2. Commissioning Plan.
3. Completed Commissioning Forms.
4. Completed Observation Reports.
5. Completed Start-up Reports.
6. System Operational Tests.
7. Final sequence of operation to be achieved.
8. Summary of building operation as commissioned, noting deviations from design.
9. Design Criteria (extended from Design Documents by CxA).
10. Written summary of normal startup and operating procedures for each commissioned item of equipment.

The manual shall be a three ring binder with tabs for each section. Provide 5 copies.

END OF SECTION 23 08 01

SECTION 23 09 01 – BUILDING A TEMPERATURE CONTROLS SYSTEM

PART 1 - GENERAL

1.1 GENERAL DESCRIPTION

A. Provide a new Building Management System (BMS) to integrate and control all mechanical equipment associated with the Building A scope of work.

1. The Building Management System shall be as indicated on the drawings and described in these specifications. System must be fully integrated and coordinated with mechanical equipment DDC controllers. The intent of the BMS is to integrate all mechanical equipment into one system for global monitoring, control, and alarming associated with the building. It is the BMS manufacturer's responsibility to provide all the design, engineering, and field coordination required to ensure all equipment sequence of operations are met as specified and the designated BMS operators have the capability of managing the building mechanical system to ensure occupant comfort while maintaining energy efficiency.
2. The BMS shall meet open standard protocol communication standards (As defined in System Communications Section) to ensure the system maintains "interoperability" to avoid proprietary arrangements that will make it difficult for the Owner to consider other BMS manufacturers in future projects.
3. Direct Digital Control (DDC) technology shall be used to provide the functions necessary for control of mechanical systems and terminal devices on this project.
4. The BMS shall accommodate simultaneous multiple user operation. Access to the control system data should be limited only by the security permissions of the operator role. Multiple users shall have access to all valid system data. An operator shall be able to log onto the control system and have access to all appropriate data.

PART 2 - PRODUCTS

2.1 APPROVED CONTROL SYSTEM MANUFACTURERS

A. Approved Manufacturers

1. Trane Tracer® Concierge – Basis of Design
2. Approved equal

2.2 SYSTEM COMMUNICATION

A. System Communications

1. Each workstation, building controller, and equipment controller communication interface shall utilize the BACnet™ protocol with an Ethernet (IEEE 802.3, 802.11), RS485 (EIA-485), or Zigbee® (802.15.4) physical interface and an appropriate data link technology as defined in ANSI®/ASHRAE® Standard 135-2012. (e.g., BACnet IP, BACnet IPv6, BACnet TP [EIA-485 token passing], BACnet Zigbee).
2. All system controllers shall be BTL listed as a BACnet Building Controller (B-BC) as defined in ANSI®/ASHRAE® Standard 135-2012.
3. All documented status and control points, schedule, alarm, and data-log services or objects shall be available as standard object types as defined in ANSI®/ASHRAE® Standard 135-2012.
4. Each System Controller shall communicate with a network of Custom Application and Application Specific Controllers utilizing one or more of the interfaces documented within Field Bus Communications below.

B. Field Bus Communications

1. BACnet™

a. All equipment and plant controllers shall be BTL listed as a BACnet Application Specific Controller (B-ASC) or a BACnet Advanced Application Controller (B-AAC) as defined in ANSI®/ASHRAE® Standard 135-2012.
b. All communication shall conform to ANSI®/ASHRAE® Standard 135-2012.
c. System Controller shall function as a BACnet router to each unit controller providing a globally unique BACnet Device ID for all BACnet controllers within the system.
d. BACnet Zigbee®

1) Communication between System Controller and equipment/plant controllers shall utilize BACnet Zigbee as defined in ANSI®/ASHRAE® Standard 135-2012.
2) Each equipment controller wireless communication interface shall self-heal to maintain operation in the event of network communication failure.
3) Each zone sensor wireless communication interface shall be capable of many-to-one sensors per controller to support averaging, monitoring, and multiple zone applications.

e. BACnet TP (EIA-485 Token Passing)

1) Communication between System Controller and equipment/plant controllers shall utilize BACnet TP (EIA-485 token passing) as defined in ANSI®/ASHRAE® Standard 135-2012.

2.3 OPERATOR INTERFACE

A. Provide Building Operator Web Interface

1. Manufacturer shall provide a user interface with time-of-day schedules, data collection, dashboards, reports and building summary, system applications, and self-expiring timed overrides. Manufacturer shall provide a published user and applications guide(s) that detail the system application operation, configuration, setup and troubleshooting.
2. The building operator web interface shall be accessible via a web browser without requiring any "plug-ins" (i.e., JAVA Runtime Environment (JRE), Adobe Flash).
3. User Roles

    a. The system shall include pre-defined "roles" that allow a system administrator to quickly assign permissions to a user.
    b. User logon/logoff attempts shall be recorded.
    c. The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user definable.

4. On-Line Help and Training

    a. Provide a context sensitive, on line help system to assist the operator in operation and configuration of the system.
    b. On-line help shall be available for all system functions and shall provide the relevant data for each particular screen.

5. Equipment and Application Pages

    a. The building operator web interface shall include standard pages for all equipment and applications. These pages shall allow an operator to obtain information relevant to the operation of the equipment and/or application, including:

        1) Animated Equipment Graphics for each major piece of equipment and floor plan in the System. This includes:

            a) Each Rooftop Unit, VAV Terminal, and Fan. These graphics shall show all points dynamically as specified in the control diagrams.
            b) Animation capabilities shall include the ability to show a sequence of images reflecting the position of analog outputs, such as valve or damper positions. Graphics shall be capable of launching other web pages.

        2) Alarms relevant to the equipment or application without requiring a user to navigate to an alarm page and perform a filter.
        3) Historical Data (As defined in Trend Logs section of CONTROLLER SOFTWARE) for the equipment or application without requiring a user to navigate to a Data Log page and perform a filter.

6. System Graphics. Building operator web interface shall be graphically based and shall include at least one graphic per piece of equipment or occupied zone and graphics that summarize conditions on each floor of each building included in this contract. Indicate thermal comfort on floor plan summary graphics using colors to represent zone temperature relative to zone set point.

    a. Graphic imagery – graphics shall use 3D images for all standard and custom graphics. The only allowable exceptions will be photo images, maps, schematic drawings, and selected floor plans.
    b. Animation. Graphics shall be able to animate by displaying different Image lies for changed object status.
    c. Alarm Indication. Indicate areas or equipment in an alarm condition using color or other visual indicator.

7. Graphics Library. Furnish a library of standard HVAC equipment such as terminals, rooftop units, and VAV boxes, in 3-dimensional graphic depictions. The library shall be furnished in a file format compatible with the graphics generation package program.
8. Manual Control and Override

    a. Point Control. Provide a method for a user to view, override, and edit if applicable, the status of any object and property in the system. The point status shall be available by menu, on graphics or through custom programs.
    b. Temporary Overrides. The user shall be able to perform a temporary override wherever an override is allowed, automatically removing the override after a specified period of time.
    c. Override Owners. The system shall convey to the user the owner of each override for all priorities that an override exists.
    d. Provide a specific icon to show timed override or operator override, when a point, unit controller or application has been overridden manually.

9. Scheduling. - The scheduling application shall provide graphical representation of the day, week, month and exception events.
10. Alarm/Event Notification

    a. Alarm/Event Log. The operator shall be able to view all logged system alarms/events from any building operator web interface.

        1) The operator shall be able to sort and filter alarms from events. Alarms shall be sorted in a minimum of 4 categories based on severity.
        2) The operator shall be able to acknowledge and add comments to alarms
        3) Alarm/event messages shall use full language, easily recognized descriptors.

11. Reports and Logs.

    a. The building operator web interface shall provide a reporting package that allows the operator to select reports.

b. The building operator web interface shall provide the ability to schedule reports to run at specified intervals of time.
c. The following standard reports shall be available without requiring a user to manually configure the report:

1) All Points in Alarm Report: Provide an on demand report showing all current alarms.
2) All Points in Override Report: Provide an on demand report showing all overrides in effect.
3) Commissioning Report: Provide a one-time report that lists all equipment with the unit configuration and present operation.
4) Points report: Provide a report that lists the current value of all points

B. Provide Mobile App Interface

1. Provide mobile (smart phone or tablet) interfaces to the building management system, compatible with iOS and Android™ operating systems.
2. Controls manufacturer shall provide a phone/tablet interface with the ability to view/override status and setpoints, view/change schedules, view/acknowledge/comment on alarms, and view graphics for all spaces and equipment.
3. This phone/tablet interface shall resize itself appropriately for the size of the interface (i.e., no "pinching and zooming" required).
4. This phone/tablet interface shall function remotely from the facility while following IT security best practices (e.g., no ports exposed to the internet).
5. The operator interface shall support system access on a mobile device via a mobile app to:

a. Alarm log
b. System Status
c. Equipment status
d. Space Status
e. Standard Equipment graphics
f. Override set points
g. Override occupancy
h. Acknowledge Alarms
i. Add Comment(s) to Alarms

C. Provide Local Operator Interface – Touch sensitive display

1. Provide a color touch sensitive display that allows the building occupants to accomplish the following tasks:

a. Control the set points for multiple pieces of equipment with a single touch. Set point adjustment by the occupant shall be bound by editable limits.

b. Occupant override of the system/equipment operating mode shall be possible with a single touch on the local operator display. With the ability to set up point overrides to expire at designated times
c. The local operator display shall provide occupant access to system time of day scheduling. Occupants shall have the ability to schedule events more than one year in advance. Exception schedules and holidays shall be shown clearly on the calendar, visible to the occupant on the touchscreen display.
d. The local operator display shall offer PIN control, which shall limit system control access to only those with proper login credentials.
e. The local operator display shall display the alerts that require service of the connected equipment.

2. To ensure interoperability with the Building Management System (BMS), the local operator display shall be provided by the BMS solution provider associated with this project.
3. Local operator display shall be a minimum of 10 inches in size and be provided with mounting hardware to allow it to be installed on an office wall or control panel door.

2.4 BUILDING / SYSTEM CONTROLLERS

A. There shall be one or more independent, standalone microprocessor based System Controllers to manage the global strategies described in CONTROLLER SOFTWARE section.

1. The controller shall provide a USB communications port for connection to a PC.
2. The operating system of the Controller shall manage the input and output communications signals to allow distributed controllers to share real and virtual point information and allow central monitoring and alarms.
3. All System Controllers shall have a real time clock and shall be able to accept a BACnet time synchronization command for automatic time synchronization.
4. Data shall be shared between networked System Controllers.
5. Serviceability – The System Controller shall have a display on the main board that indicates the current operating mode of the controller.

B. Controls manufacturer shall provide secure remote access to the Building Management System (BMS). Secure remote access shall not require IP ports to be "exposed" (i.e., port-forwarded or external public IP addresses) to the Internet. Controls manufacturer shall update secure remote access software as necessary to follow cyber security best practices and respond to cyber security events.

2.5 CONTROLLER SOFTWARE

A. Manufacturer shall provide standard applications to deliver HVAC system control. Standard applications include Time of Day Scheduling with Optimal Start/Stop, VAV Air Systems Control, Chiller Plant Control, Historical Trend Logs and Trim and Respond. Manufacturer

shall provide system optimization strategies for functions such as fan pressure optimization and ventilation optimization.

B. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the building operator interface.

1. Trend Logs

a. The system shall harvest trend logs for defined key measurements for each controlled HVAC device and HVAC application. Trend logs shall be captured for a minimum of 5 key operating points for each piece of HVAC equipment and HVAC application and stored for no less than 1 year at 15-minute intervals. Data Logs shall be capable of being configured on an interval or change of value basis.

1) Air Handling Unit/Rooftop (VAV)

a) Discharge Air Temperature
b) Discharge Air Temperature Setpoint Active
c) Space Temperature Active
d) Cooling Capacity Status
e) Outdoor Air Damper Position

2) VAV box

a) Discharge Air Temperature
b) Space Temperature Active
c) Space Temperature Setpoint Active
d) Air Flow Setpoint Active
e) Discharge Air Flow

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide all components necessary to achieve the Sequences of Operation listed on the mechanical drawings.

B. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings, and equipment details. Install electrical components and use electrical products complying with requirements of applicable Division 26 sections of these specifications.

C. Control wiring shall be run in conduit where located within walls, above drywall ceilings, in other inaccessible areas, or in areas subject to damage (i.e., below 8' in mechanical rooms).

Conduit to meet requirements of Division 26. Wiring above lay-in acoustical ceilings may be run loose and not in conduit. Where not in rigid conduit, bundle wiring neatly and support with J-hooks form structure.

D. Conduit shall be run parallel to building lines properly supported and sized at a maximum of 40% fill. In no cases shall field installed conduit smaller than ½" trade size be allowed.

E. Where conductors are not in conduit (as allowed through an owner accepted substation request) cable rated for use in return air plenums shall be used in all locations.

F. BMS/ATC division shall provide all control transformers and all control wiring (including low-voltage actuator power wiring). This division shall also provide power wiring from the control circuits to the transformer locations and all other temperature control devices requiring power wiring. Division 26 shall furnish appropriate control circuits (both normal and emergency) in suitable panelboards located throughout the project.

G. BMS/ATC division shall provide UL listed surge protectors for all control circuits upstream of control transformers.

H. IDENTIFICATION

1. Devices Inside Panels: Either of the following:

    a. Engraved labels.
    b. Lettered in permanent ink with felt tip marker.

2. Exposed Devices: Engraved labels.
3. Location: On the body of the device or on the surface to which it is mounted.

    a. Do not put identification on removable covers.

4. Label each remotely-mounted control panel as to the device it controls.

I. RECORD DOCUMENTS

1. Electronic Media As-Built Documentation: After a successful acceptance demonstration, the Contractor shall submit as-built drawings of the completed project for final approval. After receiving final approval, supply complete 11X17 hard copy as-built drawing sets, together with electronic copy to the owner.

J. WARRANTY

1. All BMS/ATC devices and installation shall be warranted to be free from defects in workmanship and material for a period of one year from the date of job acceptance by the

owner. Any equipment, software, or labor found to be defective during this period shall be repaired or replaced without expense to the owner.

END OF SECTION 23 09 01

SECTION 23 21 13 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. This Section covers water piping carrying water at 200ºF or less, used in the following systems:

1. Heating system
2. Cooling system
3. Condensate drain system

1.2 SUBMITTALS

A. Detailed piping shop drawings, which include sizes, layouts, and materials, must be properly submitted. Any piping installed without prior written approval by the engineer of record shall be replaced at the expense of the contractor.

B. Submit manufacturer’s product data on the following:

1. Strainers
2. Expansion tanks
3. Air purgers
4. Air vents
5. Pressure reducing fill valves
6. Pressure temperature taps
7. Balancing valves
8. Thermometers
9. Flow indicating devices
10. Pot feeders
11. Automatic flow control valves
12. Relief valves
13. Glycol

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Size 2" and Smaller: Any of the following:

1. Steel pipe, Schedule 40 with 125-lb. cast iron threaded fittings (ASTM A-53).
2. Copper tube, hard temper, Type L with wrought copper fittings.

    a. Solder for copper tube joints:

        1) 30 psig to 175 psig: 95-5 tin antimony.
        2) Above 175 psig: Brazed joints.

    b. Grooved Copper

B. Size 2½" and Larger: Steel pipe (ASTM A-53), standard schedule, with any of the following fittings:

1. Black steel standard weight butt weld.
2. 125-lb cast iron flanged.
3. Malleable or ductile iron grooved pipe fittings, designed for roll or cut grooved joint (grooved piping 24" and larger to be Schedule 40).

2.2 PREINSULATED/BURIED PIPE

A. Pipe Materials: Pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight indicated for each service.

B. Pipe/Tube Fittings: Factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size.

C. A preinsulated piping system consists of carrier pipe, insulation, protective jacket, connectors, supports and appropriate fittings.

D. All straight sections, fittings, anchors and other accessories shall be factory fabricated to job dimensions and designed to minimize the number of field welds. One square cut, plain end for field cutting and beveling is allowed per straight run of pipe. Other ends shall be factory square cut and factory beveled such that the field welds have the capability of being welded to pass x-ray testing.

E. The system design shall be in strict conformance with ASME/ANSI B31.1, latest edition, and stamped by a registered professional engineer.

F. Manufacturers:

1. Perma-Pipe
2. Thermal Pipe System
3. Thermacor

G. Accessories:

1. End seals, fittings and anchors shall be designed and factory fabricated to prevent the ingress of moisture into the system during shipping, outdoor storage, installation and operation. End caps on the ends of the service pipe are required to prevent debris from entering the pipe for the period of time up until installation.

H. Protective Jacket:

1. All straight sections of the factory preinsulated piping system shall be jacketed with a High Density Polyethylene jacket conforming to ASTM D1248. PVC jackets shall not be allowed.
2. All HDPE jacketing material shall have minimum wall thickness as specified below. The wall thickness shall not be less than indicated in these specifications.

Jacket O.D.	Jacket Thickness
O.D. ≤ 12”	0.125”
12”, O.D. ≤ 24”	0.150”
O.D. 24”	0.175”

3. All fittings of the factory preinsulated piping system shall be jacketed with the same material used for the straight sections of pipe and prefabricated to minimize field joints. Fittings shall be jacketed using a molded HDPE cover over polyurethane foam. Fittings shall be waterproof from the factory without the use of any type of tape, cellophane (or other non-HDPE plastic) wrap, mastic, glue or hot air welds.

I. Field Joints:

1. All field joints shall be made in straight sections of pipe. Field joints other than at straight sections shall not be acceptable.
2. The method of field joint closure is as follows:

    a. The field joints are pressure tested and inspected for leaks.
    b. A split sleeve with holes in the top is placed around the joint area and secured with straps and sealed to the jacket with tape.
    c. Two-part polyurethane foam is mixed properly and poured into the holes on the top of the split sleeve.
    d. After the foam insulation has expanded and cured, any excess foam shall be removed.

e. An adhesive backed heat shrinkable sleeve is then placed around the field joint area making sure to overlap the sleeve onto the HDPE jacketing by at least 3" on each side. This 3" overlap is to be completely on the HDPE and does not include the length of overlap of the split sleeve or tape.
f. Heat is applied using a rosebud torch to the heat shrinkable sleeve slowly and evenly across the length of the sleeve until the sleeve has drawn tight.
g. Any spots that pucker up during the shrinking process shall be covered with a thick-bodied asphaltic mastic (black roofing compound).
h. Backfilling of the trench shall not begin until the area has cooled to the touch.

3. The piping systems manufacturer shall furnish all the foam insulation, split sleeves and heat shrinkable jacketing materials for making the field joints. The contractor shall furnish the straps, tape, knives, saws, torch, gas and mastic materials.

2.3 STRAINERS

A. Manufacturers:

1. Armstrong
2. Gruvlok
3. Hoffman
4. IMI Flow Design
5. Metraflex
6. Mueller
7. Sarco
8. Victaulic

B. Size 2" and Smaller: 250-lb cast iron, threaded.

C. Size 2½" and Larger: 125-lb cast iron, flanged or grooved.

D. Screens:

1. Final Screen:

a. Material: Type 304 stainless steel.
b. Perforations: 0.045" diameter, 233 holes per square inch.

2. Roughing Screen:

a. Material: Carbon steel.

3. Provide roughing screens at all circulation pumps and at any additional strainers upstream of primary plant equipment such as boilers, chillers, etc.

2.4 EXPANSION TANKS

A. Manufacturers:

1. Amtrol
2. Apollo
3. Armstrong
4. ITT Bell & Gossett
5. John Wood
6. Taco
7. Wessels

B. Type: Bladder.

C. Design Temperature: Refer to schedule.

D. Maximum working pressure: 125 psi.

E. Design pre-charge pressure: Same as make-up water PR fill valve. Refer to schedule.

F. Bladder Material: EPDM, compatible with propylene glycol.

2.5 AIR PURGERS

A. Manufacturers:

1. Amtrol
2. Armstrong
3. ITT Bell & Gossett
4. Spirotherm
5. Taco
6. Thrush

B. Model: ITT Bell & Gossett 107A

C. Float actuated, non-modulating, rated at 175 psig at 150 ºF and 150 psig at 250ºF.

2.6 AIR VENTS

A. Manufacturers:

1. Amtrol
2. Armstrong
3. ITT Bell & Gossett
4. Spirotherm

5. Taco
6. Thrush

B. Resilient Parts: EPDM

C. Vents on Pipes Size 2" and Smaller: ITT Bell & Gossett Model 4V

D. Vents on Pipes Size 2½" and Larger: ITT Bell & Gossett Model 107A

E. Vents on Air Purgers: ITT Bell & Gossett Model 97

F. Automatic Air Vents: ITT Bell & Gossett Model 97

2.7 PRESSURE REDUCING FILL VALVES

A. Manufacturers:

1. Apollo
2. ITT Bell & Gossett
3. Taco
4. Thrush
5. Watts

B. Size: ¾"

C. Model:

1. 8 psig to 25 psig: ITT Bell & Gossett Model 7-12
2. 25 psig to 60 psig: ITT Bell & Gossett Model 7

2.8 PRESSURE TEMPERATURE TAPS

A. Manufacturers:

1. Omega
2. Petes Plug
3. Sisco
4. Trerice
5. Watts

B. Construction:

1. Body and Cap: Brass
2. Pressure: 500 psig
3. Temperature: 350ºF

4. Core: EPDM, self-sealing.
5. Cap: Gasketed, threaded.
6. Size: 1/4" NPT or 1/2" NPT.

C. Thermometer:

1. Number required: 1
2. Dial diameter: 2"
3. Range: 0º to 220º

D. Pressure Gauge Adapter:

1. Number required: 1
2. Model: GA-125

E. Pressure Gauge:

1. Number required: 1
2. Dial diameter: 4½"
3. Range: 0 to 100 psig
4. Accuracy: ½%

2.9 BALANCING VALVES

A. See Section 23 05 23.

2.10 THERMOMETERS

A. Manufacturers:

1. Dwyer
2. Ernst
3. Marsh
4. Trerice
5. Winters

B. Housing: 9" adjustable angle stem.

C. Tube: Lens front, red or blue liquid.

D. Range:

1. Chilled water, condenser water, 0ºF to 100ºF.
2. Hot water, 30ºF to 240ºF.

2.11 PRESSURE GAUGES

A. Manufacturers:

1. Dwyer
2. Ernst
3. Marsh
4. Trerice
5. Winters

B. Construction:

1. Liquid filled.
2. Minimum 3 1/2" diameter face with 270 degree arc.
3. Range: As required to keep normal operating point in mid 2/3 to 3/4 of dial.

    a. Use 30" vacuum to 100 psi gauge for pumps designed to operate at pressures up to 75 psig total pressure. (Total pressure = required pump-off static pressure plus scheduled pump head).

4. Use higher pressure ranges as required such that scheduled total pressure does not exceed an operating point above ¾ range of dial.

C. Accuracy: 1% of full scale over middle of range.

2.12 POT FEEDERS

A. Manufacturers:

1. Griswold
2. J.L. Wingert
3. Neptune
4. Wessels

B. Construction: Minimum 200 psi at 200 degrees F.

C. Size: 2 gal.

2.13 AIR SEPARATORS

A. Manufacturers:

1. Amtrol
2. Armstrong
3. ITT Bell & Gossett

4. John Wood
5. Spirotherm
6. Taco
7. Wessels

B. Constructed and nameplated for 125 psig working pressure and stamped in compliance with ASME boiler and pressure vessel code.

C. Provide blow-down connection.

D. Provide integral strainer.

2.14 RELIEF VALVES

A. Manufacturers:

1. Apollo
2. ITT Bell & Gossett
3. Kunkle
4. Spence
5. Taco
6. Thrush
7. Watts

B. Type: ASME

C. Size: Maximum input capacity of system at design pressure.

D. Setting: Operating pressure of system plus 2 psi unless otherwise noted.

2.15 PROPYLENE GLYCOL

A. Manufacturers:

1. Dow Chemical Company
2. Dupont
3. Dynalene
4. Interstate Chemical Company, Inc.

B. Model: Dow Chemical Company Dowfrost

C. Type: Propylene Glycol with corrosion inhibitors. For glycol concentrations less than 30%, provide additional inhibitors per manufacturer’s recommendations for adequate corrosion and microbial growth protection. Added inhibitors must be compatible with the glycol and its inherent inhibitors.

2.16 REDUCED PRESSURE BACKFLOW PREVENTER

A. See Section 22 10 00.

2.17 VENTURI FLOW MEASUREMENT DEVICES

A. Manufacturers:

1. Gerand
2. Hyspan
3. Presso
4. Veris

B. Identification:

1. Provide engraved metal tag indicating Beta Ratio or flow curve.
2. Hang on chain to clear insulation.

C. Size:

1. Select Beta ratio to provide 10” to 30” water gauge meter reading.

2.18 COIL CONNECTION KITS

A. Manufacturers:

1. Hays.
2. IMI Flow Design.
3. Victaulic 78Y/78U.

B. Combination Y-Strainer, union, PT port, and ball valve

1. 400 psi maximum CWP, available as sweat x sweat; sweat x female threaded; female threaded x sweat; female threaded x female threaded; DZR brass body consisting of a full port ball valve and strainer with flow measuring ports.
2. Ball valve shall be complete with double 0-ring seal, plated ball, blow-out proof stem, and steel handle with vinyl grip. Strainer shall be Y-pattern, with 20 mesh stainless-steel screen and blow-down port. Strainer/ball combination shall provide a simplified hookup to protect the coil and modulating valve. To be suitable for operating temperatures up to 230'F.

C. Coil Hoses

1. 375 psi maximum CWP (varies by size), stainless-steel braided hose and a synthetic polymer core with stainless ferrules; available as male by female swivel and male by

male swivel and in three lengths: 12", 24" or 36". Suitable for operating temperatures up to 230 degrees F.

2. Install hoses free of kinks and coordinated with other equipment/accessories.
3. Hoses shall be insulated to meet requirements of 23 07 00 (Mechanical Insulation).
4. Provide air vents at all high points in piping systems. If the rigid pipe connection to the hose is higher than the coil air vent, provide additional air vent at high point.

D. Combination Union Port fitting with PT Port and Manual Air Vent

1. 400 psi maximum CWP, available as sweat x male threaded; female threaded x male threaded; DZR brass body with manual air vent port and pressure/temperature port, with EPDM seals. Union port fitting shall provide a simplified terminal hookup for installation at coil outlets. Suitable for operating temperatures to 230°F.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

A. Install horizontal piping level (except drain piping and as otherwise noted) and parallel to building construction. All vertical piping to be plumb.

B. Make any changes in direction with fittings, do not kink or bend piping. Elbows are to be long radius type wherever possible.

C. Where pipes pass expansion joints or structural elements subject to movement, provide flexible expansion compensators and supports or piping expansion loops to allow for movement without adverse effects.

D. Regardless of how shown on schematic piping diagrams, do not install a tee so that flow enters from opposite directions.

E. Do not rearrange piping in a manner to increase pressure drop without written approval from Architect/Engineer.

F. Install drains at all low points of the system.

3.2 EQUIPMENT CONNECTIONS

A. Do not allow weight of piping or expansion of piping to put stress on equipment connections.

B. Pipe equipment to allow for servicing (coil pull, tube pull, etc.) with minimum of disruption to piping.

C. Provide unions or flanges at all equipment connections.

3.3 FREEZE PROTECTION

A. Fill systems with indicated solution by volume of propylene glycol and water.

B. Pre-mix all solutions before injection into system.

3.4 AIR VENTS

A. Install automatic air vents at high points in equipment rooms.

B. Install manual air vents at high points not in equipment rooms.

3.5 RELIEF VALVES

A. Install pressure relief valves on all vessels, which may be isolated from other relief valves by closing valves. Pipe discharge full size to nearest floor drain.

3.6 PRESSURE TEMPERATURE TAPS

A. In Pipes 2” and Smaller: Install taps in tee at change in direction so inserted thermometer stem will be parallel to center line of pipe.

1. Add extra change in direction if necessary.
2. Allow clearance for insertion of thermometer.
3. Ensure that gauge or thermometer will be in a readable position.

3.7 HOT TAPS

A. Hot taps are to be used only after written permission by the Architect/Engineer. Submit intended procedure with request.

3.8 CLEANING

A. Flush the system thoroughly with clear water.

1. Drain system.
2. Clean all strainers.

B. Refill system with solution of 1 lb. trisodium phosphate to 50 gal of system water.

1. Heat system to design temperature.
2. Circulate as required to fully clean the piping system. Continuously check strainers and verify they have been clean for a minimum of two hours.
3. Stop circulation and drain system.
4. Clean all strainers.

C. Fill system with fresh water or water/glycol mixture.

3.9 CORROSION PROTECTION

A. Provide dielectric unions at unions between piping of different materials.

B. See Section 23 25 13 for water treatment program to be provided.

C. All components of system shall be compatible with propylene glycol and water solution.

3.10 PREINSULATED/BURIED PIPE

A. Provide closed cell insulation, seal joints with waterproof mastic. Minimize joints below grade.

B. Provide thrust blocks at all changes in direction for pipe 8” and larger.

C. Comply with Division 2 and Section 23 05 03 for excavation and backfill requirements.

D. The installing contractor shall handle the system in accordance with the directions furnished by the manufacturer and as approved by the engineer.

E. A minimum of six inches (6”) of sand or fine gravel bedding shall be placed all around the pipe in the trench. This bedding/fill shall be hand tampered and compacted around the pipes in six-inch (6”) lifts until the fill is six inches (6”) above the top of the jacketing material. The remaining height of the trench shall be evenly and continuously backfilled and compacted in uniform six-inch (6”) lifts with suitable clean excavated soil.

3.11 PRESSURE GAUGES

A. Pump assemblies: Use a single gauge with multiple taps to pumped system (strainer inlet, strainer outlet, pump suction and pump discharge) per the detail on the drawings.

B. Allow clearance for removal of gauge.

C. Ensure that gauge will be in a readable position.

END OF SECTION 23 21 13

SECTION 23 23 00 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

A. Installer: A firm with at least five years of successful installation experience on projects with refrigerant piping similar to that required for this project.

1.2 REGULATORY/REQUIREMENTS

A. Comply with applicable requirements of the Clean Air Act, State of Colorado and Routt County Regulations concerning handling of refrigerants.

PART 2 - PRODUCTS

2.1 REFRIGERANT PIPING

A. Type ACR copper tube with wrought copper fittings.

B. End Caps:

1. Provide factory applied plastic end caps on each length of pipe and tube.
2. Maintain end caps through shipping, storage and handling as required to prevent pipe end damage and eliminate dirt and moisture from inside of pipe and tube.

2.2 SHUT-OFF VALVES

A. Manufacturers:

1. Design Basis: Henry
2. Other Acceptable Manufacturers:

    a. Imperial
    b. Mueller
    c. Superior

B. Size 7/8 Inch and Smaller:

1. Model: Series 600.
2. Type: Pack-less diaphragm.
3. Material: Forged bronze.
4. Flow: Non-directional.
5. Servicing: Diaphragm changeable under line pressure.

C. Size 1-1/8 Inch and Larger:

1. Model: Series 200.
2. Type: Wing cap, back seating.
3. Material: Bronze.

2.3 FLEXIBLE PIPE CONNECTORS

A. Manufacturers:

1. Design Basis: Mason
2. Other Acceptable Manufacturers:

    a. Flexonics
    b. Metraflex

B. Braided bronze with copper tube ends, compatible with refrigerant type for system

C. Flexible connector shall be line size or connection size, whichever is larger.

2.4 REFRIGERATION SPECIALTIES

A. Filter Drier:

1. Conform to ARI Standard 710.
2. Sizes ½" and larger - interchangeable core, full flow.
3. Sizes smaller than ½" - sealed type.
4. Minimum burst pressure - 1500 psig.

B. Sight Glass:

1. Double port moisture indicating, reversible color indicator.
2. Removable sight glass and moisture indicating element.
3. Furnish with a protective cover.

C. Expansion Valve:

1. Thermostatic type, diaphragm or bellows operated.
2. External superheat adjustment factory set for 10ºF superheat (adjustable).
3. Compatible with refrigerant type for the project.
4. Pressure rated per project requirements.
5. Power elements and valve size shall be as recommended by the manufacturer, for the service intended.

D. Solenoid Valve:

1. Provide solenoid valve for systems 25 tons and larger.
2. Compatible with refrigerant type for the project.
3. Valve shall fail in closed position (power open).

E. Acceptable Manufacturers:

1. Alco
2. Sporlen

PART 3 - EXECUTION

3.1 INSTALLATION

A. Run piping level or plumb, except slope gas piping to compressor with a minimum number of elbows.

B. Provide oil traps at bottom of suction risers. Size risers for proper oil return.

C. Size lines for total pressure drop not to exceed 2ºF saturation temperature.

D. Provide necessary flexibility for vibration and expansion with offsets and loops, not expansion joints.

E. Provide flexible connectors at all unit connections.

F. Replace air in pipe with dry nitrogen to prevent corrosion during soldering.

G. Install valves, sight glasses, filter-driers, and accessories, furnished by equipment supplier, but not factory installed.

H. Insulate all underground refrigerant lines with ½" flexible foam.

1. Use un-slit covering.
2. Carefully cement all joints.

3.2 HANGERS

A. For insulated piping, provide hangers of size to fit outside insulation.

B. For non-insulated piping, provide hangers with elastomer insert to prevent damage to piping from vibration.

3.3 TESTING AND DEHYDRATION

A. Use the following procedure to test and hydrate the systems:

1. Isolate any elements which would be damaged by test pressures.
2. Test system with trace gas using an appropriate leak detector.
3. Repair or replace leaking elements of system and re-test.
4. After system has been proven to be free of leaks, evacuate it with a high efficiency vacuum pump to 2.5 mm of mercury absolute.
5. Allow the system to stand under vacuum for 24 hours.
    a. Then, if a vacuum of 2.5 mm can be drawn within 30 minutes, the system shall be considered dry.
    b. If not, the procedure shall be repeated.
6. Break the final vacuum by charging with the correct refrigerant.

END OF SECTION 23 23 00

SECTION 23 25 13 - HVAC SYSTEM CHEMICAL TREATMENT

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install chemical treatment systems for closed hydronic systems where shown on the Drawings and as specified in this section.

B. Work under this section shall include providing equipment, chemicals, and service related to alter treatment for the chilled and heating water systems.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 23 05 21 Pipe and Pipe Fittings.

B. Section 23 21 13 Hydronic Piping.

1.3 QUALITY ASSURANCE

A. The chemical treatment program shall be administered by a firm regularly engaged in the field of water treatment with a minimum of five years of experience in the immediate area of the job site location, and similar sized projects.

B. The water treatment contractor shall have laboratory facilities, both central and field, to service the Owner’s account.

C. The water treatment contractor shall have local warehousing and will not be allowed to overstock chemical on premises.

D. A single water treatment company shall be responsible for all products and services.

E. Comply with the requirements of the following agencies:

1. The applicable water quality control district.
2. The local sanitation district or sewage agency.
3. Applicable industrial waste regulations.
4. The California State Water Resources Board.
5. Conform to OSHA Standards for the handling and storage of hazardous chemicals.

1.4 SUBMITTALS

A. Provide product data for each piece of equipment installed the system and for each chemical used.

B. Provide shop drawings for control panel, including internal and external wiring diagrams, dimensions, etc.

C. Provide operation and maintenance manuals for all equipment.

D. Material Data Safety Sheets shall accompany all chemicals delivered to the job site.

PART 2 - PRODUCTS

2.1 PRE-STARTUP CLEANER

A. Furnish pre-startup liquid detergent dispersant cleaner for flushing and cleaning of water systems to remove oil and foreign matter from piping and equipment prior to final filling of systems. Chemical shall not be injurious to persons, piping, pipe joint compounds, packings, coils, valves, pumps, and their mechanical seals, tubes, or other parts of the system.

B. Furnish complete instructions dictating quantities of cleaner to use, method of cleaning, duration or operation.

2.2 CHEMICALS

A. A buffered Molybdate and/or Nitrite based corrosion inhibitor shall be provided to initially treat the closed systems and added as required for 1 year from date of owner acceptance. This treatment must contain a copper inhibitor and a borate buffer.

B. Any treatment must be compatible with glycol installed in glycol/water systems.

2.3 POT FEEDER

A. Provide a five (5) gallon pot feeder piped around the main closed loop system circulating pumps as indicated on the drawings. The feeder shall consist of a steel tank with operating pressure of 200 psi. A 3½" quick open cap with "O" ring seal shall be provided to add water treatment chemicals.

2.4 COUPON HOLDER

A. Provide coupon rack with coupon holders, flow control and isolation valves. Coupon racks shall be installed in all closed and open hydronic piping systems.

B. Coupon Holders shall be similar to Pulsafeeder, Inc. Model CCR-4.

C. The Water treatment contractor shall install the coupons in the coupon holders and submit a written report to the Owner at the end of each 90 days, during the one year warranty period as to the condition of each system being treated.

2.5 CLOSED SYSTEMS – GLYCOL FEEDER

A. Glycol Feeder Assembly

1. Manufacturers:

    a. Advantage Controls
    b. J.L. Wingert
    c. Neptune
    d. Approved equal

2. Provide and install equipment for the automatic feed of a glycol solution. System components shall be as specified.
3. Glycol feeder shall be a packaged system consisting of a storage tank assembly, positive displacement pump, control panel, pressure relief valve, adjustable pressure switch, and low-level switch.
4. Feeder storage tank assembly shall consist of one (1) 50 gallon polyethylene tank with cover equipped with two (2) 3/4” bulkhead fittings located 3” from the bottom of the tank for pump suction and drain. The storage tank shall be mounted on a steel tank stand equipped with a side-mounting platform for the glycol pump.
5. Glycol control panel with red low-level warning light, alarm bell, alarm silence switch and hand/off/auto switch, prewired with terminal strip connections in NEMA 4X enclosure.
6. Pressure relief valve which shall be set at 75 psi, with relief setting adjustable up to 100psi with an Allen wrench.
7. Pressure switch for glycol pump control shall be adjustable to provide glycol pump start/stop. Ranges: 5 to 65 psi.
8. Low level drum caddy shall shut off glycol pump in the event of low glycol level in storage tank. Caddy shall be wired for pump disconnect and warning device activate circuits.

B. Glycol: An inhibited industrial grade propylene glycol shall be furnished for proper percentage of glycol solution within the system. Refer to Section 23 21 13 for glycol requirements.

C. Test Equipment: Furnish a hydrometer type test kit for the determination of percent/freeze point of propylene glycol solutions.

PART 3 - EXECUTION

3.1 Provide a one year supply, from date of startup, of the recommended formulas for the prevention of scale, corrosion, and biological growth in the recirculating system.

3.2 All formulations must be compatible with system construction materials and meet or exceed all environmental requirements.

3.3 The water treatment company will supply all testing equipment and reagents, necessary to properly maintain the treatment program.

3.4 The water treatment company will provide a water treatment service program for a period of one year from system startup. This program shall include: startup assistance, plant personnel training, monthly service calls and inspection of system equipment. Provide owner with copy of field service report including performance test required levels vs. Field measurements.

3.5 Provide quarterly laboratory analysis and report of coupons.

END OF SECTION 23 25 13

SECTION 23 31 13 - DUCTWORK

PART 1 - GENERAL

1.1 INDUSTRY STANDARDS

A. Construct ductwork to meet all functional criteria defined in Section 11 of the 2005. SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Third Edition. Comply with SMACNA recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.

B. Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE), except as otherwise indicated.

C. Comply with SMACNA "HVAC Air Duct Leakage Test Manual" for testing of duct systems.

1.2 SUBMITTALS

A. Detailed ductwork shop drawings, which include sizes, layouts, and pressure classifications, must be properly submitted. Any ductwork installed without prior written approval by the engineer of record shall be replaced at the expense of the contractor.

B. Shop Drawings: Submit shop drawings for:

1. Transition elbows.
2. Seal and reinforcing schedule for all ductwork fabrication types.
3. Turning vane and turning vane installation.

C. Product Data: Submit manufacturer's product data on the following:

1. Duct lining.
2. Duct lining adhesive.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. All interior ducts shall be constructed with G-90 or better galvanized steel (ASTM A653/653M) LFQ, chem treat. Exterior ductwork or duct exposed to high humidity conditions (i.e., kitchen exhausts) shall also be G-90 or better galvanized steel LFP, chem treat.

B. Stainless-steel duct shall be fabricated from lock forming grade, 300 series, ASTM-AI67, No. 4 general purpose finish. Protect finish with mill applied adhesive protective plastic/paper throughout construction.

C. Aluminum duct shall be fabricated from lock forming grade, alloy 3003-HI4, ASTM B209. Reinforcing angles, bars, tie rods, and other structural members shall be alloy 6061-T6. Hangers shall be 6061-T6 aluminum, or galvanized or painted steel with a dielectric isolation pad between the dissimilar metals.

D. PVC coated ductwork shall be fabricated from galvanized steel; cleaned and primed with a baked-on PVC coating. PVC coating shall be minimum 0.035 lbs./Sq. Ft. at 5 Mills, 90 units a scale shore durometer, flame spread rating 25, smoke developed 50, UL 181, Class I duct. Provide compatible touch up paint to repair damage.

E. Ungalvanized carbon steel shall be lockforming grade, hot rolled steel conforming to ASTM A366 or A619.

F. Ductwork designated for painting (by Others) shall be provided with “Paint Lock” finish to accept primer and paint. See Architectural and mechanical documents for designated locations.

2.2 RECTANGULAR DUCT

A. Construct rectangular ductwork to meet all functional criteria defined in Section 11, of the SMACNA “HVAC Duct Construction Standards Metal and Flexible” 2005 Edition. All ductwork must comply with all local, state and federal code requirements.

B. Where the standard allows the choice of external reinforcing or internal tie rods, only the external reinforcing options shall be used.

C. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

D. Ductmate or W.D.C.I. proprietary duct connection systems will be accepted. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

E. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) shall be constructed as SMACNA T-25 flanges, whose limits are defined on Page 2.76 2005 SMACNA Manual, Third Edition. No other construction pertaining to formed on flanges will be accepted. Formed on flanges shall include the use of corners, bolts and cleat.

F. Ductmate type systems that use a butyl Rubber Gasket which meets Mil-C 18969B, Type II Class B, TT-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other

type vehicle that will support fungal and/or bacterial growth (as defined in 21CFR 177, 1210 closures with sealing gaskets for food containers).

G. Aluminum duct shall be fabricated using the aluminum thickness equivalence table in the standard. Simply increasing the thickness by two gauges is not acceptable.

H. Fittings shall be constructed and reinforced as ductwork according to the longest span.

2.3 ROUND AND OVAL DUCT

A. Round and oval duct shall be galvanized steel, constructed in accordance with Section 11 of the 2005 SMACNA "Duct Construction Standards, Metal and Flexible", except as noted.

1. Lighter gauge factory made duct with an Intermediate standing rod may be used. Submit product data sustaining the equivalency of such duct into SMACNA standard duct.

B. Minimum duct gauge shall be 26 gauge.

C. Round ductwork shall be spiral lock seam construction only. Longitudinal seam duct is not acceptable. Gauges shall be in accordance with SMACNA Duct Construction Standard and fittings in accordance with SMACNA Duct Construction Standard, except as noted:

1. Joints 0"-20" diameter, interior slip coupling beaded at center, fastened to duct with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3-inch wide duct tape.
2. Joints 21"-72" diameter, use 3-piece, gasketed, flanged joints consisting of 2 internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges. Example: Ductmate Spiralmate or equal.
3. Joints 73" diameter and up, use companion angle flanged joints only as defined on page 3-6 of the SMACNA Manual. Refer to manual for proper sizing and construction details. Ductwall to be welded longitudinal seams.

D. Fittings shall be continuously welded, standing seam, or spot welded and sealed. Metal thickness and reinforcing shall be equivalent to the requirements of the largest span.

1. All elbows greater than 45" shall be radius type, R=1.5 times duct diameter.
2. Elbows less than 6" shall be of die stamped construction. Elbows 6" or greater shall be 5-gore construction.
3. Diverging and converging flow fittings shall be constructed with no excess material projecting from the body into the branch tap entrance. All such fittings shall be 45° "shoe" entrance, wye plus elbow, or 45° lateral branch. Special fittings such as heel tapped elbows and bullhead tees may be used only where shown on drawings. Adjustable elbows and straight saddle taps shall not be used. Low pressure adjustable elbows acceptable.

E. Where round ductwork 24" and smaller is indicated to be in areas exposed to view, utilize one of the following transverse joining methods:

1. Beaded sleeve connections with duct sealant applied to the sleeve joint prior to attachment.
2. Beaded sleeve connections with gasket integral to sleeve.
3. No sealant shall be visible on the outside of the duct.

F. Where round ductwork over 24" is indicated to be in areas exposed to view, utilize Van Stone flange joints with non-extruding gasket. No sealant shall be visible on the outside of the duct.

2.4 DISHWASHER EXHAUST DUCT

A. Material: Stainless steel.

B. Seams: Welded.

C. Drainage: Run duct vertical or pitch toward hood or dishwasher connection.

D. Fabricated Dishwasher hood:

1. Stainless steel with welded seams.
2. Provide 1" gutter on all sides with ¾" coupling. Route to nearest approved receptor.

2.5 GREASE LADEN DUCT

A. Material: 16-gauge carbon steel; or 18-gauge stainless steel.

B. Seams: Welded or brazed.

C. Materials in accordance with NFPA 96.

D. Refer to 23 33 00 for grease duct dampers.

2.6 GREASE LADEN DUCT (LISTED ZERO CLEARANCE GREASE DUCT)

A. Manufacturers:

1. Ampco
2. Metal Fab
3. Schebler
4. Selkirk

B. Description: The factory-built modular chimney shall be laboratory tested and listed in accordance with Underwriters Laboratories Standard UL 2221 classified for zero clearance to combustibles. Sections shall bear the UL listing mark (or cUL listing mark for Canada). Sections shall be sealed with banded flanges and joint sealant.

C. Design: Manufacturer to provide sizing calculations and complete system design conforming to NFPA 96 requirements including cleanout access doors. Spray application designs or designs using standard galvanized ductwork are not permitted.

D. Construction:

1. Provide minimum of 3" ceramic fiber insulation between the inner and outer shells.
2. Insulation is to be securely attached to the inner shell with steel straps and insulating pins welded to the inner shell. Stainless-steel centering clips shall be welded to the outer shell to maintain spacing and ensure concentricity of the shells.
3. Breeching and chimney sections, when installed according to manufacturer's instructions, shall comply with national safely standards and building codes.
4. Stacks terminating above a roof must terminate as required by code or NFPA 211.

E. Inner Shell:

1. Inner shell material shall be type 304 stainless steel.
2. All inner shell seams shall be fully penetration welded the entire length of the pipe section. Riveted, tack or spot-welded seams are not permitted.

F. Outer Jacket:

1. Outer shell material shall be aluminized steel. If exposed to weather type 304 or 316 stainless steel shall be provided.
2. All outer shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot-welded seams are not permitted.

G. Accessories:

1. Provided tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners. Accessories shall be fabricated from similar materials and designs as vent-pipe straight sections.
2. All accessories shall be listed and UL approved for same assembly.

H. Installation: Grease duct to be installed in accordance with manufacture's UL approved instructions and in accordance with state and local codes.

I. Warranty: Provide manufacturer's lifetime warranty for the entire duration the product is incorporated and used in its original installation.

2.7 CONTRACTOR FABRICATED CASINGS AND PLENUMS

A. Unless required otherwise by drawings, single wall casings and plenums may either be contractor or factory fabricated where shown on drawings. All double wall casings and plenums shall be factory fabricated.

B. Casings and plenums shall be constructed in accordance with the 2005 SMACNA "HVAC Duct Construction Standards," Third Edition and as specified below.

C. All casings and plenums on the suction side of any fan, including return air outside air, or mixing plenum shall be constructed to 2" negative pressure class.

D. Louver blank-off panels shall be constructed to 2" negative pressure class.

E. All casings and plenums for relief and exhaust air shall be 2" positive or negative pressure class.

F. All casings and plenums on the discharge side of supply fans shall be 4" positive pressure class.

G. Single wall plenums shall be of the standing seam type construction. Submit shop drawings indicating overall dimensions, support details, corner and edge details, penetration details, equipment installation details, and pressure class.

H. Seal all seams, edges, and corners with approved duct sealant.

I. Casing materials shall be the same as that for the connected duct systems.

J. Where automatic dampers may, completely shut off air flow and subject plenum of casing to fan close off pressure, install pressure relief panels, rated to open at 125%.

2.8 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Provide miscellaneous materials and products of the 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. Double wall turning vanes shall be Harper double wall turning vanes fabricated from the same material as the duct. Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert table, which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 lbs., when fastened per the manufacturer's instructions. Approved Systems: Ductmate PRO-Rail.

C. Single wall splitter and turning vanes shall be custom fabricated as specified below.

D. Ductwork Support Materials: Except as otherwise indicated, provide galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

E. **Type FDL** – Fiberglass Duct Liner:

1. Manufacturers:

    a. Certainteed
    b. Johns Manville
    c. Knauf
    d. Owens Corning

2. Model: Johns Manville Linacoustic RC with Permacoat (EPA registered antimicrobial coating), in accordance with UL 181, ASTM C1071, G21 and G22 with no observed growth.
3. Compliances:

    a. FSHH-1-545, Type I
    b. NFPA 90-A

4. Roughness: 0.0008 feet
5. Noise Reduction Coefficient: 0.85 or higher for 1-1/2" liner
6. Round Duct Liner: Spiracoustic Plus "snap-in" type with Permacote.

F. Duct Liner Adhesive:

1. Manufacturers:

    a. Childers CP-127 Chil-Quik
    b. CL Ward Duct Liner Adhesive
    c. Design Polymerics DP 2500
    d. Ductmate Industries, Inc. Gecko Glue
    e. Hercules Industries MTA500

2. Description: Water based.
3. UL Listings: UL 723/ASTM E84.

G. Duct Sealant:

1. Manufacturers:

    a. Childers CP-146 Chil-Flex
    b. CL Ward S Seal
    c. Design Polymerics 1010
    d. Ductmate PROseal
    e. Hercules Industries MTS200

2. Description: Non-hardening, water based, liquid or mastic elastic sealant with UV inhibitors for outdoor use
3. UL Listings: UL 181B-M and UL 723/ASTM E84.
4. Sealants shall contain no VOCs.

H. Duct Tape Sealing System:

1. Manufacturers:

   a. Design Polymerics
   b. Hardcast.
   c. Approved equal

2. Model:

   a. Tape: Hardcast DT
   b. Indoor Adhesive: Hardcast FTA-20
   c. Outdoor Adhesive: Hardcast RTA-50

I. Acoustical Duct Lagging:

1. Manufacturers:

   a. Acoustical Solutions
   b. Kinetics Noise Control
   c. Sound Seal

2. Model: Sound Seal B-10 LAG/QFA-3, foil face loaded vinyl or lead barrier sheet fully bonded to a minimum 1” thick fiberglass blanket, nominal density of 1.0psf, install so jacket edges overlap by minimum of 6”, minimum STC-27 tested by independent laboratory in accordance with ASTM E90 and E413, minimum insertion loss (IL) value at 500Hz shall be 23 and meets IMC flame/smoke ratings in accordance with ASTM E84.

J. Fiberglass ductboard is not accepted without prior written approval from the specifier.

K. Access doors shall be hinged or Ductmate Sandwich Type Access Doors manufactured by Ductmate Industries, Inc. Doors shall be of adequate size to allow easy access to hardware, which needs to be maintained.

L. Flexible Duct Connector:

1. Flexible duct connector shall be used where ductwork connects to fans of apparatus, or apparatus casing to fans.
2. Connectors will meet NFPA 90A and 90B specifications and provide an airtight and waterproof seal.

3. Indoor installations shall be Neoprene or vinyl coated fabrics.
4. Outdoor installations shall use Hypalon coated fabric.
5. Connector shall be Ductmate PROFlex or approved equal.

M. Roof-Mounted Duct Supports

1. Description: The Contractor shall design and detail the self-weight support of the roof-top HVAC ducts and their lateral stability to resist WIND and SEISMIC loads. The duct support design shall take into consideration the roof framing load carrying capacity for ME systems supported above and below the roof and distribute the load effect so as not to overload the roof framing. The system shall consist of vertical hot dipped galvanized or stainless-steel frame members or supports with welded 4”x4” base plate for permanent connection to the primary roof framing (not roof decking). The connection points of supports to the roof framing shall be provided with a “pitch pan” and shall be fabricated from the same material as the vertical support members. The “pitch pan” shall interface with roofing membrane, be filled with roofing asphalt, be flashed on all sides, and be provided with a waterproof seal. Mechanical Contractor shall coordinate support system with Roofing Contractor and receive his approval. Provide shop drawings of system for review.

2.9 FABRICATION

A. Construct rectangular ductwork to meet all functional criteria defined in Section VII, of the SMACNA “HVAC Duct Construction Standards Metal and Flexible” 2005 Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.

B. All “medium pressure” (systems with external pressures greater than 2” w.c.) duct systems shall be constructed for 4” W.C. positive and 1” W.C. negative static pressure and 3500 FPM velocity.

C. See air handler and fan schedules for external pressure requirements. All pressures above 2” E.S.P. shall be medium pressure.

D. All low-pressure ductwork is to be constructed for 2” W.C. positive and 1” negative static pressure and 2000 FPM.

E. All negative pressure ductwork shall be constructed for a minimum of 2” W.C. negative and 2” W.C. positive static pressure and 2000 FPM velocity.

F. All grease-laden negative pressure ductwork shall be constructed for a minimum of 4” W.C. negative static pressure and 3000 FPM velocity.

G. Make all changes in direction using 1.5 radius elbows where possible. Use splitter vanes or mitered rectangular elbows with turning vanes otherwise.

1. Use single thickness splitter vanes for all radius elbows less than 1.5 D = r.

a. D = diameter of duct or width of duct (in plane of change-in-direction).
b. r = radius of duct at duct center-line.
c. Use “Curve Ratios” of 0.45 or greater (as defined by figure 3-7 of the 1989 ASHRAE Fundamentals Handbook).

2. Use single thickness turning vanes with no trailing edges in accordance with SMACNA Standards.

a. All mitered, rectangular elbows in series.
b. All mitered, rectangular elbows less than 36” in width (in plane of change-of-direction).

3. Use double width, airfoil type turning vanes with no trailing edges for all rectangular elbows greater than 36” in width (in plane of change-of-direction).

a. Isolated elbows have a minimum of 3D straight duct upstream and downstream of the change-in-direction.

H. Fabricate transition elbows with turning vanes at correct angle so entering and leaving edges are parallel or tangent to air flow.

I. All branch duct take-offs shall use 45° laterals or 45° “pants-leg” type fittings.

PART 3 - EXECUTION

3.1 INSTALLATION OF DUCTWORK

A. Assemble and install ductwork in accordance with recognized industry practices, which will achieve air-tight and noiseless systems, capable of performing each indicated service.

B. Install each run with a minimum of joints.

C. Where ducts pass expansion joints or structural elements subject to movement provide flexible connections and supports to allow for movement without adverse effects.

D. Align ductwork accurately at connections, within 1/8” misalignment tolerance and with internal surfaces smooth.

E. Support ducts rigidly with suitable ties, braces, hangers and anchors of the type, which will hold ducts true-to-shape to prevent buckling. This Division is responsible for all duct supports.

F. Seal ducts in accordance with SMACNA requirements for pressure class indicated. Refer to duct leakage testing requirements for required seal class.

1. Indoor Ducts: Use liquid or mastic sealant, or tape system.
2. Outdoor Ducts: Use tape system.
3. Approved manufactured joining systems with gaskets may be used in lieu of transverse sealing.

G. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible.

H. Hold ducts close to walls, overhead construction, columns, and other structural and permanent-enclosure elements of the building.

1. Limit clearance to 0.5” where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.
2. Where possible, locate insulated ductwork for 1.0” clearance outside of insulation.

I. In finished spaces, conceal ductwork by locating in mechanical shafts, hollow wall construction or above suspended ceilings.

J. Where possible, avoid locating ducts on or near floor.

1. Where ducts must be located low, provide metal trestle to protect duct at places where duct will be climbed over.

K. Coordinate the layout with suspended ceiling and lighting layouts and similar finished work.

L. Install access doors where necessary for inspection and maintenance.

1. Provide additional 12” x 12” access door at each low leakage damper.
2. Arrange access doors so that:

    a. They open against the system air pressure wherever feasible.
    b. Their latches are operable from either side, except where the duct is too small to be entered.

M. Where ducts pass through non-fire-rated interior partitions below ceiling and exterior walls:

1. Conceal the space between the construction opening and the duct or duct-plus-insulation with sheet metal flanges of the same gauge as the duct.
2. Overlap the opening on all sides by at least 1-1½”.

N. Provide volume dampers at branch take-offs (except upstream of VAV boxes which should not have dampers).

O. Provide conical or tapered taps with balancing dampers on all round ductwork takeoffs (except upstream of VAV boxes, which should not have dampers).

P. Where space permits, round or oval ductwork of equivalent diameter may be substituted for unlined rectangular ductwork.

Q. Provide aluminum ductwork for the first 20 feet downstream of any aluminum grille. Slope duct towards grille at 1/8" /ft.

R. Do not modify ductwork in a manner that will increase external static pressure in the system without written approval from Architect/Engineer.

3.2 DUCT LINER INSTALLATION

A. Refer to Application Schedule, 23 07 00.

B. Ducts Exposed to Weather:

1. Dimensions indicate free area.
2. Seal ducts to three-inch static pressure standards, minimum.
3. Provide a protective aluminum jacket around all exposed surfaces.

C. Ductwork shall be insulated per Section 23 07 00. See Section 23 07 00 for additional insulation requirements on unlined and/or uninsulated ductwork.

1. Coordinate lined duct and insulated duct prior to bid.

D. Seal all exposed ends of liner with duct liner adhesive back a minimum of 2" from ends. Seal all joints in liner a minimum of 1" overlap. Seal all fasteners.

E. Completely remove any loose material from each section of lined ductwork as it is installed.

F. Interrupt duct liner a minimum of 18" upstream and 30 inches downstream of all electric resistance heaters in duct system. If ductwork is used for cooling, wrap that portion of duct which is not lined and extend insulation a minimum of 12" beyond lining in each direction.

3.3 GREASE EXHAUST DUCTS

A. Install in accordance with Local Building Code and NFPA 96. Connect to hoods in accordance with the manufacturer's listing.

B. Horizontal duct less than 75 feet in one run shall be pitched at ¼" per foot towards the hood or a drain point. Those portions over 75 feet shall be pitched at 1" per foot.

C. Enclose entire run of grease duct from hood to exterior wall or roof curb.

1. See Section 23 07 00 for blanket type fire rated enclosure.
2. See Division 07000 for shaft wall enclosure systems.

    a. Install duct so a minimum of 6” and a maximum of 12” is maintained between duct and enclosure.

D. Use no turning vanes, tie rods, dampers or other internal structures which will collect grease. All changes in direction shall be made with radius fittings.

E. Provide cleanouts per NFPA requirements and as follows:

1. Cleanouts shall be installed in the side or top of the duct, whichever is more accessible.
2. When installed on the side, the bottom of the opening shall be a minimum of 1-1½” above the bottom of the duct.
3. Ducts serving hoods with integral fire dampers shall have a clean out opening with in 18” of the collar.
4. Horizontal ducts shall either have one opening large enough for personnel entrance or at 12’ intervals and at every change of direction.
5. Vertical ducts shall either have one opening at the top large enough for personnel entrance and descent or a minimum 12” x 12” openings at every floor.
6. Openings shall have a flanged frame, extending 1” off the ductwall. Closure panels shall be attached to the flange by means of threaded studs welded to the flange, protruding through holes in the panel and fastened by means of wing nuts. Provide “Fiber Frax” or equivalent high temperature (1500°F) rope type gasket bonded to either the gasket or panel.
7. Provide access doors in the enclosure at all cleanouts.

    a. Use UL listed methods for blanket type fire rated enclosures. See Section 23 07 00.
    b. Use UL listed fire rated access doors in shaft wall enclosures. See Section 23 05 02.

8. Provide access doors at each change in direction.

F. All grease ducts parts exposed to weather shall be protected by one coat of corrosion and heat resistant primer and one coat of heat resistant paint. Alternatively, outdoor ductwork can be provided as Type 304 stainless steel.

3.4 DRYER EXHAUST DUCT

A. Assemble duct with no sheet metal screws, and no protrusions into the duct. All interior surfaces are to be smooth.

B. All elbows are to be radius type.

C. Provide 2 hour rated duct wrap or enclosure for all dryer exhaust ductwork from laundry room wall to exterior termination.

D. Fire dampers are not allowed.

3.5 DUCT LEAKAGE TESTING

A. Installed ductwork shall be tested prior to installation of access doors, take-offs, etc.

B. All leak testing shall be witnessed by the Engineer or representative of the Engineer. The Contractor shall give the Engineer 72 hours' notice prior to testing. Any testing not witnessed by the Engineer or his/her representative, shall be considered invalid and will be redone.

C. The testing shall be performed as follows:

1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
2. Use a certified orifice tube for measuring the leakage.
3. Define section of system to be tested and blank off.
4. Determine the percentage of the system being tested.
5. Using the percentage, determine the allowable leakage (cfm) for that section being tested.
6. Pressurize to operating pressure and repair any significant or audible leaks.
7. Repressurize and measure leakage.
8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in step 5.

D. All transverse joints and longitudinal seams shall conform to SMACNA's Class A sealing requirements as defined on page 1.17 of the 2005 SMACNA Manual, Third Edition.

E. Constant Volume Systems/Supply Ductwork
Allowable Leakage 1% of design cfm

F. Constant Volume Systems/Return Ductwork
Allowable Leakage 2% of design cfm

G. Variable Air Volume Systems/Supply Ductwork
Fan to VAV Boxes 1% of design cfm
VAV Boxes to Registers 2% of design cfm

H. Variable Air Volume Systems/Return Ductwork
Allowable Leakage 2% of design cfm

I. Exhaust Systems 1% of design cfm

J. Extent of Testing

1. Test all sheet metal located within shaft wall construction or concealed behind walls.
2. Test the first 25 percent of duct area of each individual fan system on the project. Testing shall begin at the supply fan or air handling unit discharge for supply air systems or at the exhaust fan or return fan intake for exhaust or return air systems. If all individual fan systems show leakage levels at or below those listed above, remaining ductwork will be permitted to be visually inspected.
3. At Engineer's discretion up to 5 additional tests at random system points may be required.
4. Submit duct testing reports for each individual fan system to Engineer for record.
5. Refer to Section 23 09 03 for additional requirements.

3.6 DUCTWORK STORAGE AND CLEANING

A. Cleaning:

1. Interior surfaces shall be free of dust and debris prior to initial startup. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes. Any cleaning of duct systems shall comply with recommendations of NAIMA and NADCA.
2. When internally cleaning duct work prior to installation or shipment to the jobsite, all duct ends and openings must be covered prior to transporting with a dual Polyethylene protective film. Film must be securely affixed to protect against dirt and debris and must be translucent to facilitate inspection of interior surfaces without removing film. Film must have a minimum elongation of 600%, contain no VOC and leave no residue on duct after removal.
3. Clean external surfaces of foreign substances that might cause corrosion, deterioration of the metal, or where ductwork is to be painted.

B. Protection:

1. Store duct a minimum of 4" above ground or floor to avoid damage from weather or spills.
2. Cover all stored ducts to protect from moisture or debris.
3. Cover all ends of installed ductwork at the end of each workday or when dust and debris producing construction (such as fire proofing, drywall, sanding, or core drilling) is occurring.

C. Ductwork contaminated or damaged above "shop" or "mill" conditions shall be cleaned, repaired or replaced to the Engineer's satisfaction.

1. Ductliner pre-installed in stored duct which has become wet may be installed if first allowed to completely dry out.

2. Ductliner in installed ductwork, which has become wet must be completely removed and replaced.
3. Torn ductliner may be replaced by coating with adhesive if damaged is minor and isolated. Extensively damaged liner shall be replaced back to a straight cut joint.

END OF SECTION 23 31 13

SECTION 23 33 00 - DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 INDUSTRY STANDARDS

A. Comply with SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) latest recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data on the following:

1. Flexible duct
2. Ceiling dampers
3. Fire dampers
4. Smoke dampers
5. Louvers
6. Louvered penthouses
7. Roof-mounted intakes
8. Roof-mounted reliefs
9. Gravity relief dampers
10. Sound attenuators

PART 2 - PRODUCTS

2.1 FLEXIBLE DUCT ACOUSTICAL

A. Manufacturers:

1. Flexmaster Type 1M.
2. ThermaFlex-MKE

B. Construction:

1. PE Liner film mechanically locked without adhesives.
2. Insulation: Minimum 1-½" thick fiberglass blanket with a polyethylene vapor barrier. Map 0.23 'c' factor, factory installed.
3. Helix: Corrosion resistant galvanized steel.

C. Pressure rating: 5” w.g. positive, 1” w.g. negative at maximum 180°F operating temperature.

D. Standards: NFPA90A UL-181, Class I, ASTM E-96 - Procedure A.

E. Insertion loss shall be at least:

	OCTAVE BAND (Hz)					
Duct Size	125	250	500	1000	2000	4000
8”	5.6	10.6	23.9	34.0	22.5	17.0
12”	6.6	27.8	22.8	29.0	18.7	10.9
	DB reduction for 6-foot length, straight route, 500 fpm.					

2.2 FLEXIBLE DUCT, HIGH PRESSURE

A. Manufacturers:

1. American/Elgen
2. Flexmaster Type 3
3. Genflex, IGE
4. Thermaflex, MKC

B. Construction:

1. Insulated: Reinforced inner liner, mechanically locked or bonded together by a corrosive resistant galvanized steel helix, Min. 1-½” thick fiberglass blanket with polyethylene vapor barrier. Max. 0.23 ‘c’ factor.
2. Uninsulated: Mechanically locked without adhesives with a corrosion resistant galvanized steel helix.
3. Aluminum: Mechanical lock without adhesives.

C. Pressure rating: 12” w.g. positive, 1” w.g. negative at 180^0F.

D. Standards: NFPA90A, UL-181 Class I, ASTM E96 - Procedure A.

2.3 LOUVERS

A. Louvers are specified in the Architectural Division. This division is responsible for coordinating all duct connections, damper sizes, etc. with the louvers specified. Where louvers are not specified under architectural divisions, use the following.

B. Manufacturers:

1. Air Balance
2. Airolite

3. Arrow United Industries
4. AWV
5. Construction Specialties
6. Greenheck
7. Louvers & Dampers, Inc.
8. Pottorff
9. Ruskin
10. Safe-Air Dowco
11. United Enertech
12. Wonder Metals

C. Screens: ½" mesh, .063" aluminum wire.

D. Blades: Of depth shown by schedule, drainable.

E. Rating Basis:

1. AMCA Standard 500, based on 15-minute test of 48" x 48" louver. Provide louvers with water penetration and pressure drop no greater than specified louver, and with free area no less than specified louver.

2.4 PREFABRICATED CURBS

A. General: Except where curbs are provided with equipment, provide prefabricated curbs for all roof-mounted equipment.

B. Manufacturers:

1. Pace
2. RPS
3. Thycurb

C. Model for grease-laden exhaust fans: ES-2.

1. Coordinate to fit vibration isolation rail.

D. Coordinate with roofing Contractor. Exterior insulation, cants, flashing and counter flashing shall be furnished and installed under roofing work, Division 7.

E. Model: As required.

2.5 SOUND ATTENUATORS

A. Manufacturers:

1. Aerosonics
2. IAC Acoustics
3. Kinetics
4. Pottorff
5. Ruskin
6. Semco
7. Vibro Acoustics

B. Acoustical Performance

1. All duct silencer performance data shall be derived from National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory tests in accordance with ASTM E477-99, Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers. Submit certification of acoustical and aerodynamic performance.

2.6 FIRE DAMPERS

A. Manufacturers:

1. Air Balance
2. Greenheck
3. Johnson Controls
4. Nailor
5. NCA
6. Pottorff
7. Prefco
8. Ruskin
9. Safe-Air Dowco
10. United Enertech

B. Rating: UL555 dynamic 1-½ hours, or 3 hours, UL555S Class II leakage rated. Match construction penetrated.

C. Size: Metal-to-metal for lined and unlined ducts.

D. For curtain type, use Type B “Top Hat” wherever possible.

E. Integral factory-mounted access door.

2.7 FIRE/SMOKE DAMPERS

A. Manufacturers:

1. Air Balance
2. Greenheck
3. Johnson Controls
4. Nailor
5. NCA
6. Pottorff
7. Prefco
8. Ruskin
9. Safe-Air Dowco
10. United Enertech

B. Fire Damper Rating: UL Standard 555 Dynamic, 1-½ hour or 3 hours.

C. Smoke Damper Rating: UL Standard 555S, Class II.

D. Damper Assembly:

1. Type: 120-Volt.
2. Listing: UL 555S, UL555.
3. Rating: Match wall rating.
4. Failure Position: Fail closed.
5. Heat Sensor: 165°F heat sensor.
6. Blade: Air foil.
7. Seals: Mechanically fastened, rated up to 450°F.
8. Integral factory-mounted access door.

2.8 SMOKE DAMPERS

A. Manufacturers:

1. Air Balance
2. Greenheck
3. Johnson Controls
4. Nailor
5. NCA
6. Pottorff
7. Prefco
8. Ruskin
9. Safe-Air Dowco
10. United Enertech

B. Smoke Damper Rating: UL Standard 555S, Class II.

C. Operator:

1. Type: 120-Volt.
2. Listing: UL Smoke Damper Operator Label.
3. Failure Position:

a. Smoke control system dampers: As shown on plans.
b. Others: Closed

D. Blade: Air foil.

E. Seals: Steel.

F. Integral factory-mounted access door.

2.9 GREASE DUCT DAMPERS

A. Manufacturers:

1. Halton
2. Provide submittal for prior approval.

B. Model: The Equalizer KBD

C. Rating: UL listed for Type I hood systems.

2.10 MISCELLANEOUS DUCTWORK ACCESSORIES

A. Duct Access Doors: Provide duct access doors with gaskets, door hinge, and with insulation where ductwork is indicated to be insulated.

1. Manufacturers:

a. Greenheck
b. Ductmate
c. Elmdor
d. Flexmaster
e. Milcor

B. Flexible Connectors:

1. Manufacturers:

a. Cain Thermolon
b. Carlisle Connector Plus w/Silicone Hi-T
c. Duro-Dyne Thermafab
d. Ductmate PROFlex with Silicone

2. Material: Glass fabric with silicone coating.
3. Rating: ASTM E84 or UL 723

a. ASTM E84

1) Flame Spread less than 25
2) Smoke Developed less than 50

2.11 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers:

1. Greenheck
2. Nailor
3. Pottorff
4. Ruskin
5. Safe-Air Dowco
6. United Enertech

B. Construction:

1. Frame: Extruded aluminum.
2. Blades: Formed aluminum with extruded vinyl edge seals.
3. Bearings: Synthetic
4. Downflow: Provide gravity type counter-balanced damper with zinc plated steel weights
5. Upflow or Horizontal Flow: Provide gravity type damper with or without zinc plated steel weights

C. Performance: 12 cfm per square foot at ½" W.G.

2.12 BALANCING DAMPERS

A. Construction:

1. Frame: 16-gauge galvanized steel.
2. Blades: 16-gauge galvanized steel with vinyl edge seals.

3. Bearings: Heavy duty nylon.
4. Performance:

    a. Maximum pressure drop in full open position (@3000 fpm): 0.55
    b. Maximum leakage: 32 cfm/sp at 4" W.C.

B. Type: Rectangular balancing dampers are to be opposed blade type with locking handle, unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESSORIES

A. Install fire, smoke and ceiling dampers in accordance with manufacturer's instructions and the latest version of the Fire, Smoke and Radiation Damper Guide for HVAC Systems, published by SMACNA.

B. Install access doors where necessary for inspection and maintenance.

1. Provide additional 12" x 12" access door at each low leakage damper.
2. Arrange access doors so that:

    a. They open against the system air pressure, wherever feasible.
    b. Their latches are operable from either side, except where the duct is too small to be entered.
    c. Install flexible connectors at all duct connections to rotating or reciprocating machinery or equipment.

3. Provide access doors at all fire damper locations.

C. Use HIGH PRESSURE flexible duct where shown upstream of VAV boxes.

D. Notify fire alarm provider of smoke damper control requirements and fire alarm interlocks.

E. Install flexible ductwork without tight bends and free of kinks.

1. Flexible ductwork shall not be less than 4', nor exceed 8' in length.
2. Flexible ductwork shall be installed with a "minimum length of straight duct" upstream of the diffuser neck inlet. "A minimum length" shall mean a length equal to three (3) duct diameters. "Straight duct" shall mean the center-line of the duct shall be aligned with a line perpendicular to the plane of the diffuser neck opening at the center point of the opening.
3. Conform to the detail on the drawings.

F. Install all dampers, including those furnished by Section 23 09 00 Contractor.

1. Caulk damper frames to ductwork.
2. Make sure dampers are free to operate properly.
3. Install parallel blade mixing dampers to two streams impinge on each other to facilitate mixing.

G. Provide balance dampers at branch take-off and where required to minimize balancing performed at diffuser face.

H. Provide all balance dampers as shown on plans and any additional dampers necessary to provide a balanced system meeting all sound requirements.

END OF SECTION 23 33 00

SECTION 23 34 00 - FANS

PART 1 - GENERAL

1.1 QUALITY CONTROL

A. Provide fans with AMCA performance certification and label.

A. Grease exhaust fan shall comply with NFPA 96 and be UL listed.

B. Fans serving dishwashers shall be UL listed and appropriate for moisture laden air application.

C. All fans 7.5 HP and below to be provided with an adjustable pulley to accommodate proper balancing.

D. All spun-aluminum fans to be provided with a belt tensioner and a two-section motor cover allowing access to motor and belts without the use of tools.

1.2 MOTOR HORSEPOWER

A. Do not increase or decrease motor horsepower from that specified without written approval from Architect/Engineer. See Section 23 05 01.

1.3 SUBMITTALS

A. Manufacturer’s Data: Submit manufacturer’s product data including:

1. Performance
2. Size
3. Type
4. Options provided
5. Fan curves
6. Indicate Compliance with Section 1.1 where applicable.

PART 2 - PRODUCTS

2.1 CABINET FAN

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City

B. Features:

1. Steel cabinet, acoustically insulated
2. Centrifugal wheel
3. Integral backdraft damper

C. Accessories:

1. Provide rheostatic speed controller for all direct drive fans. Mount under grille or on wall as specified in the drawings.

2.2 IN-LINE CENTRIFUGAL FAN

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City

B. Features:

1. Steel cabinet, baked enamel finish
2. Cast aluminum wheel, statically and dynamically balanced
3. Cast aluminum hub

4. Heavy duty pillow block bearings within fan housing with external grease fittings
5. Belt guard
6. Drive: See schedule

C. Accessories:

1. Access panel.

2.3 IN-LINE MIXED FLOW FAN

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City

B. Features:

1. Steel cabinet, baked enamel finish
2. Mixed flow wheel, statically and dynamically balanced
3. Hub keyed to shaft
4. Heavy duty pillow block bearings within fan housing with external grease fittings
5. Belt guard
6. Drive: See schedule

C. Accessories:

1. Access panel.

2.4 BELTED VENTILATING SETS (UTILITY FANS)

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower

7. PennBarry
8. Twin City
9. Design Basis: Twin City.
10. Other Acceptable Manufacturers:

    a. Ammerman
    b. Barry
    c. Cook
    d. Greenheck
    e. New York Blower
    f. Trane
    g. Twin City

B. Features:

1. Welded steel housing
2. Backward inclined fan wheel
3. Pillow block bearings, average life 200,000 hours
4. Adjustable V-belt drive

C. Accessories

1. For Outdoor Units: Motor weather cover.
2. For Indoor Units: Belt guard.

2.5 SIDEWALL PROPELLER FAN

A. Manufacturers:

1. Acme
2. Aerovent
3. Carnes
4. Cook
5. Greenheck
6. New York Blower
7. PennBarry
8. Twin City

B. Features:

1. Steel panel
2. Steel tube frame
3. Aluminum or welded steel wheel
4. Totally enclosed fan motor
5. Direct drive or belt drive as scheduled

PART 3 - EXECUTION

3.1 NOISE AND VIBRATION

A. Ensure that fans are properly supported on vibration isolators. Reference Section 23 05 48 for Vibration Isolation Requirements.

B. Ensure that flexible duct connections are properly made.

C. Check fan for improper balance.

1. Have fan re-balanced if necessary.

D. Check for proper rotation.

E. Check for unusual noise or vibration and correct as necessary.

3.2 ACCESS

A. Provide for proper access to all parts of fan needing inspection or service with access doors in fan or ductwork.

3.3 INSTALLATION

A. Install units level and plumb.

B. Provide necessary auxiliary supporting steel.

C. Mount motor and drives so belts run true.

D. Provide necessary lubrication.

E. Provide flexible duct connections on inlet and discharge.

3.4 CURBS

A. Provide necessary dimensions and details so roof opening can be provided at the proper time.

B. Coordinate delivery of curb with roofing contractor so project is not delayed.

C. Provide a weatherproof installation:

1. Seal all joints including, but not limited to:

a. Unit and curb.
b. Unit and ducts.

END OF SECTION 23 34 00

SECTION 23 34 33 – AIR CURTAINS

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 23 05 13 – Motors and Starters

B. Section 23 82 16 – Air Coils

C. Section 23 40 00 – Air Cleaning

1.2 MOTOR HORSEPOWER

A. Do not increase or decrease motor horsepower from that specified without written approval from Architect/Engineer. See Section 23 05 01.

1.3 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's product data including:

1. Performance
2. Options provided
3. Dimensions and weight
4. Electrical requirements
5. Installation requirements

PART 2 - PRODUCTS

2.1 AIR CURTAINS

A. Manufacturers:

1. Berner
2. Mars
3. King

B. Features:

1. Forward curved fan, double-width, double-inlet
2. Multi-speed fan motor
3. Min. 16 gauge steel housing
4. Inlet air grille
5. Discharge nozzle
6. Color to be selected by architect

C. Accessories:

1. Control panel
2. Filter
3. Door switch
4. Disconnect

D. Mounting:

1. Provide hardware for wall or suspended mount as required

E. Sound Criteria:

1. Submit sound power level

PART 3 - EXECUTION

3.1 NOISE AND VIBRATION

A. Check fan for improper balance. Re-balance fan if necessary.

B. Check for unusual noise or vibration and correct as necessary.

3.2 INSTALLATION

A. Install units level and plumb.

B. Provide necessary auxiliary supporting steel.

END OF SECTION 23 34 33

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Variable volume terminal units.

B. Variable volume regulators.

C. Integral heating coils.

D. Integral damper motor operators.

E. Integral controls.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Section 23 09 00 - Controls and Instrumentation: Thermostats and control components.

1.3 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. UL 181 - Factory-Made Air Ducts and Connectors.

C. ARI 880 - Air Conditioning and Refrigeration Institute Standard Rating Conditions for Air Terminals.

D. UL - Shutoff terminal must be UL listed as a Room Air Terminal.

E. ASTM A 527 (Steel Sheet, Zinc Coated Galvanized)

1.4 SUBMITTALS

A. Submit shop drawings and product data sheets indicating configuration, general assembly, and materials used in fabrication.

B. Submit product data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings which indicate air flow, static pressure, and radiated sound power levels (2^{nd} through 7^{th} octave bands) at design maximum operating

conditions. Also submit Radiated Sound NC values. Shall be calculated at design conditions with the following path attenuation credits:

CORRECTION TO OCTAVE BAND SOUND POWER VALUE						
	2	3	4	5	6	7
Env Adj	-3	-2	-1	-1-	-1	-1
Mineral Fiber Ceiling Tile	-9	-10	-12	-14	-15	-15
Space Effect Factor	-10	-11	-12	-13	-13	-14

This transfer function represents modeling assumptions based on ARI 885-90.

C. Submit manufacturer's installation instructions.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten years of experience.

1.6 WARRANTY

A. Provide one year manufacturer's parts warranty.

PART 2 - PRODUCTS

2.1 SINGLE DUCT VAV BOXES

A. Manufacturers:

1. Carrier
2. Enviro-Tec
3. Johnson Controls
4. Krueger
5. Metal Aire
6. Nailor
7. Price
8. Siemens
9. Titus
10. Trane

B. Sound Criteria:

1. Conform to ARI 880 performance test standard.
2. Discharge Sound:

    a. 0.2” SP: NC40
    b. 1.0” SP: NC53

3. Radiated Sound:

    a. 0.2” SP: NC27
    b. 1.0” SP: NC41

4. Sound levels may be attained using attenuators, but pressure drop of attenuator must be included as part of unit pressure drop.

    a. Units will discharge into lined or fiberglass ductwork, credit for which cannot be claimed in sound criteria.

C. Duct Connections:

1. Duct connections shown on drawing are minimum.
2. Units with larger connections may be used to meet pressure or sound requirements.
3. Flexible duct shall be same size as unit connection.

D. Construction:

1. Galvanized steel, ½” lining, conforming to UL181 and NFPA90A.
2. Maximum leakage not exceeding 1% design flow.

E. Heating Coils:

1. Refer to Section 23 82 16 coils.

F. Control:

1. Electronic, using velocity sensor, with compensation or correction for distorted flow at inlet.
2. Maximum and minimum volume controls shall be:

    a. Factory set (with allowance for altitude of project).
    b. Accurate within 10%.

3. Units shall be normally open with reversing relay for use with direct acting thermostat.
4. Provide electric motor.
5. Coordinate spring range with Automatic Temperature Control Section.
6. Coordinate controls on VAV units with control contractor.

2.2 SOUND PERFORMANCE

A. Terminal units shall not exceed the scheduled sound criteria.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION 23 36 00

SECTION 23 37 00 - AIR INLETS AND OUTLETS

PART 1 - GENERAL

1.1 CEILING CONSTRUCTION

A. Provide products compatible with ceiling construction.

1.2 SUBMITTALS

A. Submit catalog data including throw, sound, pressure drop and physical dimensions.

1.3 INDUSTRY STANDARDS

A. Provide products tested in accordance with ASHRAE 70-1991 150 Standard 5219, 150 Standard 3741.

PART 2 - PRODUCTS

2.1 GRILLES AND RECTANGULAR DIFFUSERS

A. Manufacturers:

1. Krueger
2. Metal Aire
3. Nailor
4. Price
5. Titus

B. Material: Steel or aluminum except:

1. Where noted otherwise.
2. Where required otherwise for fire rating.
3. Grilles and diffusers in locker rooms, showers and toilet rooms in locker rooms to be aluminum.

C. Finish: Baked white enamel except where noted.

D. Refer to the Drawings for required performance.

E. Match frame and border types to ceiling system.

2.2 SLOT DIFFUSERS WITH FACTORY-SUPPLIED PLENUMS

A. Manufacturers:

1. Krueger
2. Metal Aire
3. Nailor
4. Price
5. Titus

B. Material: Steel or aluminum except:

1. Where noted otherwise.
2. Required otherwise for fire rating.

C. Finish: Baked white enamel except where noted.

D. Inlet Size: Match duct size.

E. Match frame and border types to ceiling system.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to architectural reflected ceiling plan for exact locations and ceiling types.

B. Provide all support and framing devices necessary.

C. Exposed mounting screws:

1. Use tamper proof screws in countersunk holes.
2. Point screws to match frame.

D. Fire Rated Ceilings:

1. Provide insulation equivalent to ceiling construction above diffuser between ceiling opening and ceiling damper.

E. Install security type devices in accordance with manufacturer's directions.

END OF SECTION 23 37 00

SECTION 23 40 00 - AIR CLEANING

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data including:

1. Media:

    a. Description
    b. Efficiency
    c. Test method

2. Enclosure
3. Support requirements
4. Weight
5. Electrical data
6. Drawings showing dimensions

1.2 QUALITY CONTROL

A. All filters shall be listed as class II per UL Standard 900.

PART 2 - PRODUCTS

2.1 1" MERV 8 PANEL FILTERS

A. Manufacturers:

1. Air Guard Type DP/DP Max
2. American Air Filter PREpleat LPD
3. Camfil Aeropleat IV

B. Media and Performance:

1. Non-woven cotton/synthetic.
2. MERV 8 filter efficiency per ASHRAE Standard 52.2-2012.
3. Not less than 2.3 square feet of media area per square foot of filter face area.
4. Not more than 0.25" WG initial resistance at 500 FPM.
5. Capable of 1.0" WG final resistance.

C. Support

1. Wire grid media support to maintain radial pleats.
2. Beverage board frame and diagonal supports.

2.2 2" MERV 8 PANEL FILTERS

A. Maintenance:

1. Air Guard Type DP/DP Max
2. American Air Filter PrePleat 40 LPD
3. Camfil Farr 30/30

B. Media and Performance:

1. Non-woven cotton/synthetic
2. MERV 8 filter efficiency per ASHRAE Standard 52.2-2012.
3. Clean filter efficiency of 23% at one micron.
4. Not less than 2.5 square feet of media area per square foot of filter face area.
5. No more than 0.31" WG initial resistance at 500 FPM.
6. Capable of 1.0" WG final resistance.

C. Support

1. Welded wire grid to maintain radial pleats.
2. Beverage board frame and diagonal supports.

2.3 12" MERV 13 CARTRIDGE FILTERS

A. Manufacturers:

1. Air Guard VariPak
2. American Air Filter Varicel RF
3. Camfil Riga-Flo

B. Media and Performance:

1. Microfine glass media in a uniform high loft media blanket.
2. MERV 13 filter efficiency per ASHRAE Standard 52.2-2012.
3. Not more than 0.50" WG initial resistance at 500 FPM.
4. Capable of 1.5" WG final resistance.

C. Support

1. Rigid cartridge type.
2. Welded wire grid to maintain pleat shape.
3. Contour stabilizers to maintain pleat spacing.
4. Galvanized steel enclosure and diagonal supports.
5. Capable of withstanding 10” S.P. drop without noticeable distortion.

2.4 FILTER GAUGES

A. Dwyer Magnehelic Series 2000.

B. Provide mounting bracket, tubing, static pressure tips and vent valves.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate filter banks to allow for access and prevent interference or damage by other components such as dampers and humidifiers.

B. Provide vertical and horizontal stiffening bars, blank offs, angle flashing as necessary to install built up filter banks in plenum. Gasket or caulk between frame members, flashings, and blank offs.

C. Provide filter gauges to measure pressure drop of all filter banks with 2” MERV 8 or 12” MERV 13 filters.

D. Contractor shall provide a filter replacement matrix schedule for each unit indicating size and filter type.

E. Provide and install a clean set of filters in all equipment prior to turn over to owner and one spare filter for each unit. For units with multiple filters provide a spare filter for each type.

END OF SECTION 23 40 00

SECTION 23 62 13 - AIR-COOLED CONDENSING UNITS

PART 1 - GENERAL

1.1 STANDARDS

A. Comply with applicable portions of the following:

1. Safety:

    a. ANSI/ASHRAE 15.
    b. UL 465.

2. Ratings: ARI 210.
3. Energy Efficiency: ASHRAE 90.
4. Sound: ARI 270.

1.2 SUBMITTALS

A. Submit manufacturer’s data. Include the following:

1. Drawings showing:

    a. Over-all dimensions.
    b. Operating weights.
    c. Support requirements.
    d. Sizes and locations of connections.
    e. Accessories.

2. Performance.
3. Wiring diagrams.
4. Installation instructions.
5. Operating instructions.
6. Service instructions.
7. Parts lists.

B. LEED Submittal:

1. Product data for refrigerants.
2. Weights and type of refrigerants.

PART 2 - PRODUCTS

2.1 RATINGS

A. Based on sea level catalog ratings at 95º ambient.

B. Where ratings are not shown in schedule, refer to cooling unit schedule.

1. Allow two-degree suction line drop.

2.2 ELECTRICAL

A. Refer to electrical plans and/or specifications for electrical characteristics.

B. Provide equipment with ampacities not exceeding those of electrical circuits provided.

C. Provide unit(s) for single point electrical connections.

D. The electrical disconnect shall be provided under the electrical division.

2.3 CIRCUITS

A. If more than the specified number of refrigerant circuits is provided, coordinate evaporator circuits for equal number of circuits.

2.4 MANUFACTURERS

A. Manufacturers:

1. Bohn
2. Carrier
3. Daikin Applied
4. Dunham Bush
5. Lennox
6. Tempmaster
7. Trane
8. TSI
9. York

2.5 CONSTRUCTION

A. Casing: Welded, 18-gauge zinc-coated steel, with exterior phosphatized, primed with epoxy resin and finished with enamel.

1. Provide removable access panels.

B. Compressor: Hermetic or semi-hermetic with vibration isolators, crank case heater, suction pressure unloading.

C. Condenser Fans: Vertical discharge, direct drive, with permanently lubricated resiliently-mounted motors with built-in overload protection.

1. Provide fan guard.

D. Condenser Coil: Copper tube, aluminum fins with sub-cooling circuit.

1. Provide grille or louvers to protect coil from hail.

E. Controls: Factory-wired, including:

1. High and low pressurestats.
2. Compressor overload devices.
3. Short cycle timer.
4. 24-Volt transformer.

F. Capacity Control:

1. Provide head pressure control for operation at minimum load at minimum specified temperature.
2. Provide hot gas bypass for capacity between unloaded rating and minimum specified rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate condensing unit in general position indicated in relation to other work.

1. Position for sufficient clearance for normal service and maintenance, including clearance for cleaning and replacement of tubes, filters, motor, etc.

B. Charge with refrigerant in the quantity recommended by the manufacturer.

1. Bleedout non-condensable gases.
2. Test refrigerant system for leakage in manner recommended by manufacturer.

C. Install pressure relief system in compliance with governing regulations, to vent refrigerant in manner indicated.

D. Install refrigerant piping (Type ACR copper tube) in accordance with manufacturer's recommendations, and per the drawings.

1. Comply with the Clean Air Act.
2. Provide filter/dryer, site glass and service/isolation valves for each circuit.
3. Run piping plumb. Slope as required for proper oil return and to protect compressor.

    a. Provide oil trap at bottom of suction risers.

E. Provide for vibration and expansion of piping.

3.2 START-UP

A. Sustained Operation: Do not place unit in sustained operation prior to initial balancing of mechanical systems affected by unit operation.

B. Cooperate with other trades and installers of other work during testing, adjusting, balancing and start-up of mechanical systems.

C. Start up and first year parts and labor to be provided by equipment manufacturer.

END OF SECTION 23 62 13

SECTION 23 73 13 - ENERGY RECOVERY VENTILATORS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Indoor energy recovery air handling units.

1.2 RELATED WORK

A. Section 23 05 13 – Motors and Starters.

B. Section 23 05 30 – Electronic Speed Controllers.

C. Section 23 40 00 – Air Cleaning.

D. Section 23 82 16 – Coils.

1.3 REFERENCES

A. ANSI/AHRI Standard 1060 - Rating Air-To-Air Energy Recovery Ventilation Equipment

1.4 QUALITY ASSURANCE

A. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with ARI 410.

B. Air Handling Units: Product of manufacturer regularly engaged in production of components who issues complete catalog data on total product offering and whose products have been in satisfactory use in similar service for no less than 15 years.

1.5 SUBMITTALS

A. Shop drawings shall indicate assembly, unit dimensions, required clearances, construction details, and field connection details. Indicate accessories where required for complete system.

B. Product data shall indicate dimensions, weights, capacities, ratings, fan performance, motor electrical characteristics, and gauges and finishes of materials.

C. Provide fan curves with specified operating point clearly plotted.

D. Submit product data of filter media, filter performance data, filter assembly, and filter frames.

E. Submit manufacturer's installation instructions.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data.

B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.7 REGULATORY REQUIREMENTS

A. Agency Listings/Certifications:

1. Unit shall be manufactured to conform to UL 1812 and shall be listed by either UL/CUL or ETL. Units shall be provided with listing agency label affixed to the unit.
2. Unit shall comply with AHRI 1060.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site with factory- installed and/or factory provided lifting lugs. Items to be shipped per manufacturer's standard requirement.

B. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

C. Protect units from physical damage. Factory coil shipping covers shall be kept in place until installation.

D. Store and protect products under provisions of Section 23 05 02 Basic Mechanical Requirements.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.10 EXTRA STOCK

A. Provide one complete set of permanent filters.

1.11 WARRANTY

A. AHU manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of one year from unit start-up or 18 months from shipment, whichever occurs first. This shall warrant that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis of Design: Greenheck Minivent

B. Other Manufacturers:

1. Cook
2. Approved equal

2.2 GENERAL

A. Construction: Galvanized steel.

B. Fans: Forward curved blower.

C. Motor: Electronically commutated (EC).

1. Provide motor potentiometer for fan speed control.

D. Power: Single point power connection.

E. Access: Removable access panels.

F. Filters: 1” pleated type

G. Frost Control: Automatic frost control sequence within unit controller.

PART 3 - EXECUTION

3.1 GENERAL

A. Assemble and install in accordance with manufacturers written installation instructions and details on drawings.

B. Coordinate duct, piping and electrical work so as to provide access to unit for maintenance and filter replacement and coil removal with minimum disturbance of piping.

C. Prior to unit start-up all controls shall be installed and tested.

D. Prior to initial start-up and for system testing install air filters to protect the unit and ductwork from dirt and debris. After the system has been tested and prior to turning the system over to the Owner, replace the pre-filters with new, clean filters as specified.

E. Prior to turning the system over to the Owner, all damages incurred during shipping, storing and installing shall be repaired. These repairs shall be sufficient to bring the equipment back to the quality standards, equal to the original manufacturing standards. These repairs shall include but are not limited to repairing painted surfaces, dent removal, combing coil fins, repairing or replacing wet, sagging or torn insulation, etc.

F. Install units with adequate clearances to access valves, open access doors fully, for coil pull and NEC clearances in front of disconnect switches.

END OF SECTION 23 73 13

SECTION 23 82 16 - AIR COILS

PART 1 - GENERAL

1.1 SAFETY STANDARDS

A. Provide electric heating coil in compliance with the National Electric Code and listed by UL for zero clearance and so labeled.

1.2 CAPACITY RATINGS

A. Hydronic Coils: Certified per ARI 410.

1.3 SUBMITTALS

A. Submit manufacturer's product data including:

1. Performance data.
2. Accessories description
3. Operating weight.
4. Drawings showing:

    a. Dimensions.
    b. Sizes and locations of connections.

5. Support requirement.

1.4 FACE VELOCITY

Unless otherwise noted, face velocities shall not exceed the following:

A. Cooling Coils: 550 fpm.

B. Heating Coils: 600 fpm. (except electric coils)

PART 2 - PRODUCTS

2.1 HYDRONIC COILS

A. Manufacturers:

1. Aerofin
2. Airtherm
3. Carrier
4. Colmac
5. Daikin Applied
6. Dunham Bush
7. Heatcraft
8. Nationwide Coils
9. York

2.2 HEATING COILS (HOT WATER)

A. Construction:

1. Tubes: Copper.
2. Fins: Aluminum.
3. Casing: 16-gauge galvanized steel.
4. Max. service conditions:

    a. 200 psig.
    b. 220^0

5. Certified in accordance with ARI Standard 410.

2.3 COOLING COILS (CHILLED WATER)

A. Construction:

1. Tubes: Copper.
2. Fins: Aluminum.
3. Casing: 16-gauge galvanized steel.
4. Max.service conditions:

    a. 200 psig.
    b. 220^0

5. Certified in accordance with ARI Standard 410.

2.4 REFRIGERATION COILS

A. Designed to conform to ANSI-B9.1 Safety Code for mechanical refrigeration.

B. Tubes: Copper.

C. Fins: Aluminum.

D. Distributors: Equalizing Type.

E. Coils to be vertical split.

F. Accessories:

1. Distributor with hot gas bypass connection.

    a. Thermal expansion valve.
    b. Size per manufacturers requirements.
    c. Insulate sensing bulb.

2.5 ELECTRIC HEATING COILS

A. Manufacturers:

1. Berko
2. Carrier
3. Indeeco
4. QMark
5. Trane
6. Tutco

B. Description:

1. Type: Finned tubular, open coil.
2. Mounting: Casing suitable for duct mounting. As shown on the drawings.
3. Controls:

    a. Provide factory-mounted and wired control panel.
    b. Control Option: SCR
    c. Thermostat: Room

4. Standard Features:

    a. Thermal Cutoffs.
    b. Airflow Switch.
    c. Magnetic Contactors.

d. Control Transformer.
e. Fuses.

C. Optional Features:

1. Disconnect Switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install coils level and plumb.

B. Provide necessary auxiliary support.

C. Adjust air flow switch for safe operation.

D. Check and adjust all controls.

E. Pipe condensate drain from cooling coils as shown on the drawings or to nearest floor drain or mop sink.

F. Coordinate electrical requirements with Division 26 prior to ordering. Report any discrepancies to the Engineer for resolution.

G. For multiple coil sections, extend all connections insulated through unit casing or ductwork to connection points outside of casing or ductwork. Provide reverse return piping arrangement.

END OF SECTION 23 82 16

SECTION 23 82 19 - FAN COIL UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Factory constructed vertical or horizontal Fan Coil Units.

1.2 RELATED WORK

A. Section 23 05 13 – Motors and Starters
Section 23 05 30 – Electronic Speed Controllers
Section 23 09 00 – Automatic Temperature Controls
Section 23 40 00 – Air Cleaning
Section 23 82 16 – Coils

1.3 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.

B. SMACNA - HVAC Duct Construction Standards.

1.4 QUALITY ASSURANCE

A. Fan Coil Units: Product of manufacturer regularly engaged in production of components that issues complete catalog data on total product offering.

B. Fan Coil Units: Certify capacity, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI 430-89.

C. Air Coils: Certify capacities, pressure drops and selection procedures in accordance with ARI 410-87.

1.5 SUBMITTALS

A. Submit as-built drawings and product data under provisions of Division 1.

B. As-built drawings shall show unit configuration in direction of airflow, and shall indicate assembly and unit dimensions.

C. Product data shall indicate dimensions, weights, capacities, fan performance, motor electrical characteristics, and finishes of materials.

D. Submit product data of filter sizes and quantities, filter performance, and filter frames.

E. Submit manufacturer's installation instructions under provisions of Division 1.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 BLOWER COIL FAN COILS (400 TO 4,000 CFM)

A. Acceptable Manufacturers

1. Carrier
2. Daikin Applied
3. Enviro-Tec
4. First Company
5. International Environmental
6. Johnson Controls
7. Magic Aire
8. The Whalen Company
9. Titus
10. Trane Company

B. Construction

1. See drawings for unit configuration.
2. 18-gauge galvanized steel.
3. ABS or stainless-steel drain pan, positively sloped in every plane.
4. Provide secondary drain pan where indicated.
5. All parts exposed to moisture are to be galvanized.

6. Insulate unit throughout with 1-½ LB closed cell foil faced insulation.
7. Motor access panels on either side of unit.
8. Mixing box with ½" extended drive rod, and low leakage dampers with edge seals. Mixing box to allow 100% economizer operation.

C. Filters

1. See drawings for filter efficiency.
2. Filter rack, sized to provide maximum of 500 fpm across filter.

D. Fan

1. Fan to be forward curved centrifugal blower.
2. Provide adjustable v-belt drive.
3. Fan shaft to be supported by heavy duty permanently sealed ball bearings.
4. Fan and housing are corrosion resistant.

E. Motor

1. Provide integral overload protection.
2. Motor to be permanently lubricated.
3. Fan Motors shall be heavy duty, high efficiency, and open drip-proof or electronically commutated where specified.
4. Motor horsepower shall not be changed without written approval from the Engineer.

F. Coils

1. Coils are leak tested at 350 PSIG minimum air pressure, suitable for working pressures up to 250 PSIG with air vents
2. Coils shall be designed with aluminum plate fins and copper tubes.
3. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 440.
4. Provide factory installed extended drain and vent connections for water coils.

2.2 HORIZONTAL OR VERTICAL CASED FAN COIL UNITS (300 TO 1300 CFM)

A. Acceptable Manufacturers

1. Carrier
2. Daikin Applied
3. Enviro-Tec
4. First Company
5. International Environmental

6. Johnson Controls
7. Magic Aire
8. The Whalen Company
9. Titus
10. Trane Company

B. Construction

1. See drawings for unit configuration.
2. 18-gauge galvanized steel.
3. For exposed units, provide baked powder finish in standard color. Color selection by architect.
4. ABS or stainless-steel drain pan, positively sloped in every plane.
5. Thermoplastic secondary drain pan.
6. All parts exposed to moisture are to be galvanized.
7. Insulate unit throughout with closed cell insulation.
8. Refrigerator style leveling feet for vertical units.
9. Provide piping end pocket.

C. Fan

1. Aluminum, direct drive fan wheel and sheet metal housing.
2. Fan wheel to be forward curved, double width.
3. Fan and housing are corrosion resistant.

D. Motor

1. Provide electronically commutated fan motor and integral overload protection.
2. Motor to be permanently lubricated.
3. Motor shall be able to start at 78 percent of rated voltage and operate at 90 percent of rated voltage on all speed settings.

E. Coils

1. Coils are leak tested at 350 PSIG minimum air pressure, suitable for working pressures up to 250 PSIG with air vents
2. Coils shall be designed with aluminum plate fins and copper tubes.
3. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 440.
4. Provide factory installed extended drain and vent connections for water coils.

PART 3 - EXECUTION

3.1 GENERAL

A. Assemble and install in accordance with manufacturers written installation instructions and details on drawings.

B. Coordinate duct, piping and electrical work so as to provide access to unit for maintenance and filter replacement and coil removal with minimum disturbance of piping and no demolition of room construction or finishes.

C. Prior to unit start-up all controls shall be installed and tested.

D. Prior to initial start-up and for system testing install air filters to protect the unit and ductwork from dirt and debris. After the system has been tested and prior to turning the system over to the Owner, replace the pre-filters with new, clean filters as specified.

E. Prior to turning the system over to the Owner, all damages incurred during shipping, storing and installing shall be repaired. These repairs shall be sufficient to bring the equipment back to the quality standards, equal to the original manufacturing standards. These repairs shall include but are not limited to repairing painted surfaces, dent removal, combing coil fins, repairing or replacing wet, sagging or torn insulation, etc.

F. Pipe condensate full size to nearest floor drain. Provide trap 1” greater than fan static pressure.

G. Install units with adequate clearances as to:

1. Allow access to valves
2. Allow for coil pull, filter replacement and maintenance
3. Allow access doors to fully open
4. Provide required NEC clearances in front of disconnect and electrical components.

END OF SECTION 23 82 19

SECTION 23 82 39 - HEATING TERMINAL UNITS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data:

1. Performance data.
2. Drawings.
    a. Dimensions
    b. Support requirements
    c. Size and location of connections
3. Enclosure gauges.
4. Accessories.
5. Parts lists.
6. Additional Submittal Requirements for Fan Coil Units, Cabinet Heaters and Unit Heaters:
    a. Wiring diagrams.
    b. Installation, operating and maintenance instructions.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products as indicated by published product information, and as required for a complete installation.

2.2 HYDRONIC PROPELLER UNIT HEATERS

A. Manufacturers:

1. Daikin Applied
2. Modine
3. Sterling
4. Trane
5. Vulcan
6. Zehnder Rittling

B. Construction:

1. Coils:

a. Fins: Aluminum.
b. Tubes: Copper, expanded into fins.
c. Working Pressure: 250 psig.

2. Casing:

a. Material: 18-gauge steel.
b. Corners: Rounded, 1” minimum radius.
c. Finish: Phosphatized and painted inside and out with one coat of baked-on enamel.
d. Fan Orifice: Integral with casing.

3. Motors:

a. Type: Totally enclosed, shaded pole or split capacitor.
b. Insulation: Class B.
c. Mount: Resilient.
d. Bearings: Sleeve or permanently lubricated ball bearings.
e. Protection: Built-in thermal overload.

4. Guards

a. Provide wire guards over propeller fans.

2.3 HYDRONIC CABINET UNIT HEATERS

A. Manufacturers:

1. Daikin Applied
2. Modine
3. Sterling
4. Trane
5. Vulcan
6. Zehnder Rittling

B. Construction:

1. Coils:

a. Fins: Aluminum.
b. Tubes: Copper.
c. Working Pressure: 250 psig.

2. Casing:

    a. Material: 16-gauge steel.
    b. Corners: Rounded, 1” minimum radius.
    c. Finish: Phosphatized and painted inside and out with one coat of baked-on enamel.
    d. Color: Selected by Architect/Engineer from manufacturer’s standard colors.
    e. Heating Element Supports: Adjustable.
    f. Gaskets: Between front panel and enclosure.

3. Grilles: Fabricated steel bar grille.

    a. Directional Louvers: Under grille.

4. Fans:

    a. Arrangement: Blow-through
    b. Type: Multi-wheel, DWDI, FC, aluminum.
    c. Balance: Factory balance, static and dynamic.
    d. Drive: Direct.

5. Motors:

    a. Type: Shaded pole, permanently lubricated.
    b. Insulation: Class B.
    c. Speeds: Three.
    d. Protection: Built-in thermal overload.

6. Filters: Disposable, ¾” or 1” thick.
7. Filters: Permanent.

    a. Type: Permanent.
    b. Material: Metal.
    c. Thickness: 1”

2.4 HYDRONIC FINNED TUBE RADIATION

A. Manufacturers:

1. Modine
2. Slant Fin
3. Smith’s Environmental Products
4. Sterling
5. Trane
6. Vulcan
7. Zehnder Rittling

B. Provide with high pressure rating allowing for 125 PSI operating pressure.

C. Heating Element: Provide heating elements consisting of copper tubes, mechanically expanded into aluminum fins.

1. If tubing size is changed from that specified, adjust rating to allow for change in water velocity.

D. Enclosure:

1. Material: 14-gauge steel.
2. Element Supports: Adjustable.

a. Provide additional brackets where supply and/or return pipes are located in enclosure.

3. Finish:

a. Primer: Zinc.
b. Top Coat: Enamel.
c. Color: Selected by Architect from manufacturer's standards.

4. Gasket:

a. Location: Between back panel and wall.
b. Material: Sponge rubber.

5. Accessories: Provide manufacturer's standard accessories of steel, same gauge as enclosure, as required, including, but not limited to:

a. Inside corners.
b. Outside corners.
c. End caps.
d. Access sections.
e. Extensions.
f. Knob operated dampers, where shown on drawing.

2.5 ELECTRIC PROPELLER UNIT HEATERS

A. Manufacturers:

1. Berko
2. Indeeco
3. Markel
4. Modine
5. QMark

6. Raywall
7. Trane

B. Construction:

1. Casing:

   a. Material: Steel.
   b. Finish: Baked-on enamel.
   c. Heating Element Supports: Adjustable.
   d. Gaskets: Between front panel and enclosure.

2. Louver: Adjustable.
3. Heating Element: Finned steel sheaths providing extended surface.
4. CSA listed, ETL listed, or UL listed
5. Provide manufacturer's written certification that unit is suitable for use at altitude of the project.

2.6 ELECTRIC PROPELLER CEILING HEATERS

A. Manufacturers:

1. Berko
2. Indeeco
3. Markel
4. QMark
5. Raywall

B. Construction:

1. Casing:

   a. Material: Steel.
   b. Finish: Powder coat.

2. Mounting: Surface mount or recessed mount as scheduled.
3. Heating Element: Finned steel sheaths.
4. CSA listed, ETL listed, or UL listed
5. Provide manufacturer's written certification that unit is suitable for use at altitude of the project.

2.7 ELECTRIC WALL HEATERS

A. Manufacturers:

1. Berko
2. Indeeco
3. Markel
4. QMark
5. Raywall

B. Construction:

1. Casing:

   a. Material: Steel.
   b. Finish: Powder coat.

2. Mounting: Surface mount or recessed mount as scheduled.
3. Heating Element: Finned steel sheaths.
4. CSA listed, ETL listed, or UL listed
5. Provide manufacturer's written certification that unit is suitable for use at altitude of the project.

PART 3 - EXECUTION

3.1 GENERAL

A. Locate units so clearance is provided for:

1. Service and maintenance.
2. Enclosure removal.

B. Level or pitch elements as required:

1. Install shims if necessary.

C. Touch-up finish after final adjustment.

D. Replace damaged enclosures.

E. Straighten bent fins.

F. Replace damaged elements.

END OF SECTION 23 82 39

SECTION 23 90 00 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:

1. Copies of all warranties
2. Operation & Maintenance Manuals
3. Required tests
4. Test and balance reports
5. Record drawings
6. Permit requirements
7. Valve tag list

B. The contractor shall compile a closeout manual which shall include:

1. A list of all required tests and a place for signoff of date completed.
2. A list of all submittals with dates of acceptance by the engineer.
3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
4. Test procedures to be used for life safety systems.
5. Project close out check list.

C. The final closeout manual shall include the following:

1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
3. Copies of all warranties.
4. Test and Balance report.

D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

1.2 SUBMITTALS

A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:

1. A list of all required tests.
2. Preliminary schedule showing major milestones for completion of the mechanical/plumbing systems.

B. Within 30 days of substantial completion submit the completed closeout manual as described in Part 1.

C. Within 2 weeks of substantial completion submit a completed "Project Closeout Check List", and the Final Closeout Manual.

D. Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary – Mechanical, Plumbing and Fire Protection

- ☐ All required submittals have been cleaned, submitted and either been approved or modified in accordance with the Engineer's "make corrections noted" comments. Our records indicate the following submittals are still outstanding:
- ☐ Clean filters installed in all units. (Install just prior to building turnover)
- ☐ Attic stock provided as required in the following sections:
  - ☐ 22 11 23 Pump Shaft Seals
  - ☐ 23 05 01 Auxiliary Starter Contacts
  - ☐ 23 05 30 VFD Fuses
  - ☐ 23 40 00 Spare Filters
- ☐ All equipment has been started up and is functioning within manufacturers' recommendations without any undue noise or vibration. (Submit a list of equipment with startup dates. Provide list no later than 120 days prior to project completion date).
- ☐ All vibration isolation has been installed and is operating properly.
- ☐ Duct access doors have been installed at fire and fire/smoke dampers and are properly fire-stopped and fire and fire/smoke dampers have been visually inspected to confirm that they are open.
- ☐ Access doors have been installed as required for concealed equipment, water hammer arrestors, valves, controls, actuators, etc.
- ☐ Chemical treatment system installed per specification and functioning properly.
- ☐ All equipment has been installed with the manufacturers recommended service clearances and is fully accessible for required maintenance.
- ☐ All equipment and piping are labeled per specifications.

- ☐ All hydronic, gas and plumbing piping cleaned, flushed and tested per specifications. Submit testing reports for record. Submit letter stating domestic water disinfection (chlorination) has been completed per the specifications.
- ☐ All action items are complete as listed in the action items reports. Submit a list of action items with sign off by Architect or Engineer for record. Punch list to be completed prior to turn over of building.
- ☐ Temperature control system complete and tested per specifications.
- ☐ Test and balance complete and report submitted and accepted by Engineer.
- ☐ Fire sprinkler system and pump tested per specifications.
- ☐ Operation and maintenance manuals submitted with table of contents and required documentation for extended warranties.
- ☐ Factory Testing documented and submitted for record.
- ☐ Record drawings submitted per specifications.
- ☐ Temperature Control record documents provided per specifications.

PART 2 - EXECUTION

2.1 EQUIPMENT STARTUP AND TESTING

A. Prior to completion and punchlist by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

2.2 LIFE SAFETY SYSTEMS

A. All life safety systems shall be fully and successfully tested by the contractor before being witnessed by the engineer or building official

B. The contractor shall provide a detailed test procedure, with instrumentation to be used, for approval by the engineer and building official prior to any testing.

C. Once tested by the contractor and fully operational, the systems shall be demonstrated to the engineer. Once accepted by the engineer the system shall be demonstrated to the building and fire officials.

2.3 COORDINATION WITH OTHERS

A. The Division 21 through 23 contractor shall coordinate his requirements with the General Contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of the Division 21 through 23 systems.

2.4 PUNCH LISTS

A. The contractor shall submit in writing that the project is ready for final review by the engineer.

B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.

C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.

D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION 23 90 00

SECTION 26 05 00 - ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements.

B. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. Architect shall decide which is most stringent.

C. Provisions of Divisions 21, 22, 23, 27 and 28 shall also apply to the work of this section as if fully repeated here.

D. Provision indicate Section 23 05 01/26 05 01 “Mechanical and Electrical Coordination” shall also apply to the work of this section as if fully repeated here.

1.2 REGULATORY REQUIREMENTS

A. All materials shall conform to the current applicable industry standards. Workmanship and neat appearance shall be as important as electrical and mechanical operation. Defective or damaged materials shall be replaced or repaired prior to final acceptance in a manner meeting approval of the Architect and at no additional cost to the Owner.

B. The latest editions of the following standards are minimum requirements.

1. Underwriters’ Laboratories, Inc. (UL)
2. National Electrical Manufacturer’s Assoc. (NEMA)
3. American National Standards Institute (ANSI)
4. Institute of Electrical and Electronic Engineers (IEEE)
5. International Electrical Testing Association (NETA)
6. Insulated Cable Engineer’s Association (ICEA)

C. All work and materials shall comply with latest rules, codes and regulations including, but not limited to the following:

1. OSHA.
2. National Fire Codes of National Fire Protection Assoc. (NFPA)
3. National Electrical Safety Code (NESC, ANSI C2)
4. National Electrical Code 2020 Edition with city, county and state Amendments.
5. International Building Code 2018 Edition with city, county and state Amendments.
6. 2010 ADAAG Americans with Disabilities Accessibility Guidelines.
7. All applicable Federal, state and local laws, code amendments and regulations.

D. Code compliance is mandatory. Nothing in these drawings and specifications permits work not conforming to these codes.

E. No work shall be concealed until after inspection and approval by proper authorities. If work is concealed without inspection and approval, Contractor shall be responsible for all work required to open and restore the concealed area including all required modifications.

F. Contradictions: Where Codes are contradictory, follow the most stringent. Architect/Engineer shall determine which is most stringent.

1.3 CONTRACT DOCUMENTS

A. Drawings indicate general arrangement of circuits and locations of outlets, conduit, and other work. Information shown on drawings is as accurate as planning can determine, but not guaranteed and field verification of all dimensions, locations, levels, etc., to suit field conditions is directed. Review all architectural, structural and mechanical drawings, and adjust all work to conform to all conditions shown therein. Architectural drawings shall take precedence over all other drawings. Discrepancies between different drawings or between drawings and specifications or regulations and codes governing installation shall be brought to attention of the Architect.

B. Where the Drawings and Specifications do not comply with the minimum requirements of the Codes, either notify the Architect/Engineer in writing during the Bidding Period of the revisions required to meet Code requirements, or provide an installation which complies with the Code requirements. After entering into contract, Contractor will be held to complete all work necessary to meet these requirements without additional expense to the Owner.

C. Follow Drawings and Specifications where they are superior to Code requirements. The more stringent of plans and drawing shall apply.

1.4 COORDINATION DRAWINGS

A. Prepare coordination drawings in accordance with Division 1 “Submittals” to a scale of 1/4” = 1’-0” or larger; detailing major elements, components, and systems of electrical equipment (i.e., all transformer vaults, switchgear rooms, generator rooms, electrical rooms and technology rooms) and materials in relationship with other systems, installations, and building components. Where equipment is located outdoors, prepare shop drawings indicating electrical equipment locations and exterior elements in the equipment areas. Indicate locations where space is limited for installation and access and where sequencing and coordination of

installations are important to the efficient flow of the work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of major raceway systems, and materials. Include the following:

    a. Exterior wall and foundation penetrations.
    b. Fire-rated wall and floor penetrations.
    c. Support details.
    d. Sizes and location of required concrete pads and bases.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installation.
4. Underground conduit and duct bank routing.

1.5 RECORD DRAWINGS

A. Refer to Division 1 for additional requirements.

B. Maintain a blue-line set of Electrical Contract Drawings in clean, undamaged condition, for mark-up of installations which vary from the Contract Drawings. These drawings shall be a separate set of drawings, not used for construction purposes, and shall be kept up to date as the job progresses. This set shall be made available for inspection by the Engineer or Architect at all times. Upon completion of the contract a set of computerized “as builts” capable of interfacing with AutoCAD software, shall be delivered to the Architect.

C. Prepare record documents in accordance with the requirements in Division 1 Section “Project Closeout.” In addition to the requirements specified in Division 1, indicate installed conditions for:

    1. Major raceway systems, size and location, for both exterior and interior and locations of handholes and conduit stub-up locations.
    2. Panelboard circuit directories reflecting all field changes.
    3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
    4. Results of all testing performed as specified in the specification.
    5. Certification of inspection from Authorities Having Jurisdiction.

D. Record the locations and invert elevations of underground installations.

1.6 OPERATING AND MAINTENANCE MANUALS

A. Refer to Division 1 for additional requirements.

B. Submission:

1. Submit an electronic copy of Operating and Maintenance Manuals prior to scheduling systems demonstration for the Owner.

C. Requirement Contents:

1. Manuals shall have either a combined file with bookmarks for each section or individual file for each section. If individual files, each digital file shall include section number and title in the file name.
2. Submittal for each section shall identify all equipment and materials installed on the project.
3. Manual to include contact information for a local supplier that can provide the specific piece of equipment.
4. Provide certificates for such items of equipment which have warranties in excess of one year.
5. Provide test results for each specification section identified herein.

1.7 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.

B. Protection of Equipment:

1. All electrical equipment to be used in the construction shall be properly stored and protected against the elements. All equipment shall be stored under cover, and shall not be stored at the construction site on the ground, in mud, water, rain, sleet, or dust. Large diameter cables may be stored on reels outside; however, all cable ends shall be waterproofed and the reels covered with weatherproof materials. Such weatherproof materials shall be heavy-duty, securely fastened, and made impervious to the elements.
2. Conventional electrical construction materials such as building wire, outlet and junction boxes, wiring devices, conduit, lighting fixtures, fittings, etc., shall be stored in construction buildings, covered trailers, or portable covered warehouses. Any equipment subject to damage or corrosion from excessive moisture shall be stored in dry, heated areas. Any equipment containing plastic or material subject to damage caused by excessive heat or sunlight shall be stored to prevent such damage. This includes plastic ducts and lenses.
3. Equipment damaged as a result of the above conditions shall be properly repaired at the contractor’s expense or shall be replaced at the contractor’s expense, if in the opinion of

the Engineer, the equipment has been damaged to such an extent that it cannot operate properly after repairs are made.

4. All electrical enclosures exposed to construction damaged such as paint spots, spackling or plaster spatter, grout splashes, waterproofing compound, tar spots or runs, and pipe covering compound splashes, shall be completely covered and protected against damage.
5. In the event leakage into the building of any foreign material or fluid occurs or may occur, the contractor shall take all steps as described above to protect any and all equipment.
6. After connections to electrical equipment are complete and the equipment is ready for operation, all construction debris shall be removed from all enclosures. Such debris includes dust, dirt, wire clippings, tape, and insulation removed in order to make the connection.

1.8 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement will apply continuously and not be limited to normal working hours. See also General Conditions.

B. No act, service, drawings review or construction review by the Architect or Engineer, is intended to include review of the adequacy of the Contractor's safety measures in, on, or near the construction site.

1.9 WARRANTIES

A. The warranty period is generally one year after Date of Acceptance.

1. During this period, provide labor and materials as required to repair or replace defects in the electrical systems at no cost to the Owner. Provide certificate with O & M manual submittal which guarantees same day service response to the Owner's call for such warranty service.
2. Provide certificates for such items of equipment which have warranties in excess of one year. Insert copies of O & M manual. Such equipment shall include:

    a. Emergency lighting invertor
    b. Transformers
    c. Electrical panelboard
    d. Lighting fixtures
    e. Lighting Control
    f. Fire alarm system

3. Provide extended manufacturers warranties to cover one full year from Date of Acceptance if standard manufacturers' warranty ends any time prior to that date.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. All equipment and materials installed shall be new, unless otherwise specified.

B. All major equipment components shall have manufacturers' name, address, model number and serial number permanently attached in a conspicuous location.

C. All equipment shall be UL listed and bear the UL label.

D. Specifications list approved products for the project, if not listed follow substitution request process.

E. All areas directly exposed to outside air shall be considered exterior. Contractor's electrical installation, means and methods and materials used shall be appropriate for outdoor installations in these areas.

2.2 GENERAL SUBMITTAL REQUIREMENTS

A. Coordination and Sequencing:

1. After receipt of notice to proceed, the Contractor shall submit to the Architect a typed list of submittals and the scheduled date of submission. List shall include submittal number, section number and scheduled date of submission. Submittals shall be grouped and submitted in no more than ten complete packages.
2. The contractor shall not submit any shop drawings or product data that does not comply with the contract documents. Prior to submitting shop drawings, review submittal for compliance with Contract Documents and place a stamp or other confirmation thereon which states that submittals have been reviewed. Submittals without such verification will be returned disapproved without review.
3. Submittal is for information and record, unless otherwise indicated, and is not a change order request.

B. Preparation of Submittals:

1. Refer to Division 1 requirements.
2. The Contractor shall submit for approval by the Architect data of materials and equipment to be incorporated in the work. Submittals shall be supported by descriptive material, catalogs, cuts, diagrams, performance curves, and charts published by the manufacturer to show conformance to specification and drawing requirements; model numbers alone will not be acceptable. Provide complete electrical characteristics for all equipment. Submit product submittals on items as outlined in sections hereinafter.

3. Product submittals shall be made by specification section. All items of a section, requiring submission, shall be submitted together in one individual electronic file.
4. If two or more sections require inter-coordination (e.g., emergency generator and transfer switch; short circuit study, coordination study, electrical room layouts and electrical switchboards, fire alarm and fire command center layout), they shall be submitted at the same time. If electrical gear is submitted without electrical room layouts, short circuit study, coordination study, the submittal will be returned without review.
5. Each section shall be submitted as an individual file with section number and section name in the file name of the submittal.
6. Submittals of an entire product catalog will be rejected without review. Products to be used on the project must be indicated on cut sheets.
7. Provide cover letter in electronic file identifying project name, Contractor, Subcontractor, submittal name, date of submission, specification section, and information to distinguish it from other submittals.
8. Submittals not presented in individual electronic files or neat and legible fashion will returned “Without Action.”
9. Submittals shall show Contractor’s executed review and approval marking. Submittals which are received from sources other than through Contractor’s office will be returned “Without Action.”
10. Provide space for Architect’s “Action” marking.

C. Substitutions

1. Refer to the General Conditions, which govern “Substitution” of specified equipment or materials.
2. Indicate any portions of work which deviate from the Contract Documents.

    a. Explain the reasons for the deviations.
    b. Show how such deviations coordinate with interfacing portions of other work.

3. Where substitution of materials alters space requirements indicated on the drawings, submit shop drawings indicating proposed layout of space, all equipment to be installed therein and clearances between equipment (i.e., electrical rooms). All clearances required by the National Electrical Code and applicable state and local regulations must be maintained.

D. Review Process

1. The Architect reserves the right to require a sample of any equipment to be submitted for approval and to retain its possession.
2. Refer to the individual sections for identified equipment and material for which submittals are required. In addition, provide shop drawings and product data on the following equipment:

    Electrical Power Conductors and Cables
    Grounding and Bonding

Hangers and Supports
Raceway and Boxes
Identification
Network Lighting Control
Low-Voltage Distribution Transformers
Switchboards
Panelboards
Wiring Devices
Fuses
Surge Protection Device
Lighting Fixtures

Do not submit on equipment or materials not requested in the specifications.

3. Review of shop drawings and product data by the Architect/Engineer, including any review annotations or stamp notations, does not relieve the contractor from the required compliance with the contract documents.
4. The shop drawing and product data review stamp notation requirements are defined as follows:

    a. "NO EXCEPTION TAKEN:" The reviewer did not observe any items which were not in compliance with the contract documents. All dimensions, details, and coordination with other trades are the responsibility of the contractor.
    b. "MAKE CORRECTIONS NOTED:" The reviewer indicated items observed that were not in compliance with the contract documents. The contractor shall not resubmit, but shall make corrections and provide corrected documents with the "Record Drawings."
    c. "REJECTED, REVISE AND RESUBMIT:" The reviewer indicated items observed which were not in compliance with the contract documents. The contractor shall resubmit showing corrections of all noted items. Delays for resubmittal do not relieve the contractor from meeting project schedules.
    d. "REJECTED:" The submission does not comply with the contract requirements. The entire submittal must be corrected and submitted for review. Delays for resubmittal do not relieve the contractor from meeting project schedules.

5. If shop drawings are submitted and returned as "NO EXCEPTION TAKEN" or "MAKE CORRECTIONS NOTED" and meet contract requirements, the contractor shall not resubmit any other shop drawings for these items.
6. If resubmittals are necessary, they shall be made as specified above for submittals. Resubmittals shall highlight all revisions made and cover shall include the phrase "RESUBMITTAL NO. _____."
7. Resubmittal requirements do not entitle the Contractor to additional time and are not a cause for delay of the project.

PART 3 - EXECUTION

3.1 CONDITIONS AT SITE

A. Visit to site is required of all bidders prior to submission of bid. All bidders will be held to have familiarized themselves with all discernible conditions, and no extra payment will be allowed for work required because of these conditions, whether specifically mentioned or not.

B. Lines of other services and/or equipment that are damaged as a result of this work shall promptly be repaired at no expense to the Owner.

3.2 LICENSES, FEES AND PERMITS

A. Arrange for required inspections and pay all license, permit and inspection fees. Furnish a certificate of final inspections and approvals from local authority having jurisdiction over electrical installation.

3.3 WORKMANSHIP AND CONTRACTOR'S QUALIFICATIONS

A. Only professional quality workmanship will be accepted. Haphazard or poor installation practice will be cause for rejection of work.

B. Provide foreman in charge of this work at all times. Foremen for this work shall have had experience in installing not less than 5 such electrical systems of equal or greater complexity.

C. Where specifications call for an installation to be made in accordance with manufacturers' recommendations, a copy of such recommendations shall at all times be kept in job superintendent's office.

3.4 RELATION WITH OTHER TRADES

A. Contractor shall coordinate work of this Division with other trades to avoid conflict and to provide rough-ins and other connections for equipment furnished under other divisions that require electrical connections. Inform other trades of required clearances of accesses for or around electrical equipment to maintain serviceability and code compliance.

B. Verify equipment dimensions and rough-in requirements for Divisions 2 through 28 with provisions specified under this Section of work, and report discrepancies to the Architect in ample time to prevent delays or unwarranted changes of work.

3.5 TESTING

A. Provide all labor, materials, and equipment necessary to make required tests. Tests shall be complete and results approved before final inspection is begun.

3.6 PROGRESS OF WORK

A. Order progress of electrical work so as to conform to progress of work of other trades, and complete entire installation as soon as condition of building will permit. Assume any cost resulting from defective or ill-timed work performed under this Division.

3.7 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 1 Section “Cutting and Patching.” In addition to the requirement specified in Division 1, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:

    a. Uncover work to provide for installation of ill-timed work.
    b. Remove and replace defective work.
    c. Remove and replace work not conforming to requirements of the Contract documents.
    d. Remove samples of installed work as specified for testing.
    e. Install equipment and materials in newly installed structures.
    f. Upon written instructions from the architect, uncover and restore work to provide for Architect observation of concealed work.

3.8 SLEEVES

A. Place sleeve in forms of walls, floor slabs and partitions for passage of all conduits, pipes, and ducts installed under Divisions 26, 27 and 28. Sleeves shall be set in place a sufficient time ahead of concrete work so as not to delay that work. Install sleeves and raceways through exterior walls so as to provide a waterproof installation. All floor penetrations shall be made watertight. Conduits passing through walls shall be installed to preserve integrity of the wall rating (i.e., fire rating, sound rating, air, etc.). All penetration made through existing concrete slabs or walls shall be x-rayed and approved by Structural Engineer prior to cutting.

3.9 EXCAVATION, TRENCHING, AND BACKFILLING

A. Perform all excavation to install conduit and duct banks indicated on the drawings or specified herein. During excavation, pile material for backfilling back from the banks of the trench to avoid overloading and to prevent slides and cave-ins. Remove and dispose of all excavated

materials not to be used for backfill. Grade to prevent surface water from flowing into trenches and excavation. Remove any water accumulating therein by pumping. Do all excavation by open cut. No tunneling shall be done unless indicated on the drawings or unless written permission is received from the Architect.

B. Grade the bottom of trenches to provide uniform bearing and support for conduits or duct bank on undisturbed soil at every point along its entire length. Tamp over depths with loose, granular, moist earth. Remove unstable soil that is not capable of supporting equipment or installation and replace with specified material for a minimum of 12” below invert of equipment or installation.

C. Backfill the trenches with excavated materials approved for backfilling, consisting of earth, loam, sandy clay, sand and gravel or soft shale. These materials should be free from large clods of earth and stones, deposited in 6” layers and rammed until the installation has cover of not less than the adjacent ground but not greater than 2” above existing ground. Backfilling shall be carried on simultaneously on both sides of the trench so that injurious pressures do not occur. Compaction of the filled trench shall be at least equal to that of the surrounding undisturbed material. Do not settle backfill with water. Reopen any trenches not meeting compaction requirements or where settlement occurs, refill, compact, and restore surface to grade and compaction indicated on the drawings, mounded over and smoothed off.

D. In addition, all excavation and backfilling shall comply with Division 2. The most stringent requirement shall apply.

3.10 CLEANUP

A. Remove all materials, scrap, etc., relative to electrical installations and leave premises in a clean, orderly condition. Any costs to the Owner for cleanup of site will be charged to the Contractor. At completion, all equipment, raceways, etc., shall be thoroughly cleaned and all residue removed from the inside and outside surfaces. Defaced finish shall be refinished.

3.11 TEMPORARY POWER

A. Provide temporary power as requested by the general contractor and in accordance with OSHA and local code requirements. Lighting and power outlets shall be provided throughout the project. Check with construction manager or general contractor prior to bid for special lighting and power outlets and provide as needed.

3.12 MINOR CHANGES

A. The Owner reserves the right to make minor changes in the locations of outlets and equipment up to the time of electrical rough-in without any cost to the Owner.

3.13 ELEVATOR COORDINATION

A. Provide control wiring as required by elevator vendor.

1. 2# 12-1”C from auxiliary contact (closed before switch returns to normal power) on transfer switch serving elevators to each elevator machine room which is served via that transfer switch. Terminate as and where required by the elevator vendor.

B. Provide 1” conduit from elevator controller to fire alarm control panel for elevator communication system, as required by elevator vendor.

3.14 ELECTRICAL SYSTEMS OPERATIONAL TESTS, CERTIFICATION, AND DESIGN AUTHORITY ASSISTANCE

A. Testing

1. Refer to the individual specification sections for test requirements.
2. Prior to the final inspection, the systems or equipment shall be tested and reported as herein specified. One electronic copy of the tests shall be submitted to the Architect/Engineer for approval.
3. All electrical systems shall be tested for compliance with the specifications.

B. Manufacturers’ Certifications

1. The electrical systems specified herein shall be reviewed for compliance with these specifications, installation in accordance with the manufacturers’ recommendations and system operation by a representative of the manufacturer. The manufacturer shall submit certification that the system has been installed in accordance with the manufacturers’ recommendations and is operating as specified in the contract documents.

C. Design Authority Assistance

1. The Contractor shall provide personnel to assist the Architect/Engineer or their representative during all construction review visits. The Contractor shall provide all necessary tools and equipment to demonstrate the system operation and provide access to equipment, including screwdrivers, wrenches, ladders, flashlights, circuit testing devices, meters, keys, etc.
2. Remove equipment covers (i.e., switchgears, switchboards, panelboard trims, panelboards, motor controls, device plates, and junction box covers) as directed for inspection of internal wiring. Accessible ceiling shall be removed as directed for inspection of equipment installed above ceilings. Reinstall all covers or ceilings after inspection.
3. Energize and de-energize circuits and equipment as directed. Demonstrate operation of equipment as directed by Architect/Engineer.

4. The Contractor shall provide authorized representatives of the manufacturers to demonstrate to the Architect/Engineer compliance with the specifications of their respective system during or prior to the final inspection at a time designated by the Architect. Refer to the appropriate specification section for additional testing requirements. Representatives of the emergency generator/automatic transfer switch and fire alarm systems are required for demonstrations.

3.15 COMMISSIONING

A. After startup and testing of each system has been completed, the Owner shall have an independent firm conduct detailed observations of the equipment and systems to confirm compliance with the Contract Documents.

B. The Division 26 Contractor shall include, as part of the work of his contract, costs to cover manpower, equipment, tools, ladders, instruments, etc., necessary to expedite the system performance observations.

C. The independent firm shall develop systems, equipment checkout procedures and data forms for recording compliance of the systems to the Contract Documents, performance, and construction observation lists, and will assist in developing schedules for checkout and Owner acceptance, at a future date during the construction phase.

END OF SECTION 26 05 00

SECTION 23 05 01/26 05 01 - MECHANICAL AND ELECTRICAL COORDINATION

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. The Divisions 21 through and 26 through 28 contractor(s) shall comply with the provisions of this section. The Divisions 21 through 23 contractor(s) shall verify electrical service provided by the electrical contractor before ordering any mechanical equipment requiring electrical connections. Provide submittals of all mechanical equipment to Division 26 through 28 contractor(s).

B. The final responsibility for properly coordinating the electrical work of this section shall belong to the Divisions 21 through 23 system contractor performing the work, which requires the electrical power.

1. Each Divisions 21 through 23 contractor shall be responsible for providing power wiring for certain devices as described in the specifications and on the drawings. This work shall be provided by a licensed electrician in accordance with all of the applicable provisions of the Division 26 through 28 specifications, NEC and local codes.

1.2 WORK INCLUDED

A. Carefully coordinate the interface between Divisions 21 through 23 (Mechanical) and Divisions 26 through 28 (Electrical), and Division 23 09 00 (Building Management and Automatic Temperature Control Systems) before submitting any equipment for review or commencing installation

1.3 DEFINITIONS

A. Automatic: Pertaining to a function, operation, process or device that, under specified conditions, functions without intervention by human operator.

B. Disconnect Switch: A mechanical switching device used for changing the connections in a circuit, or for isolating a circuit or equipment from a power source.

C. Motor Control Center: A floor-mounted assembly of one or more enclosed vertical sections having a common horizontal power bus and primarily containing motor starting units.

D. Control Circuit/Power: The circuit which carries the electrical signals of a control apparatus or system directing the performance of the controller but does not carry the main power circuit.

E. Manual Operation: Operation by hand without the use of any other power.

F. MC: Mechanical Contractor = Divisions 21 through 23 Contractor who furnishes motor.

G. TC: Temperature Controls = Division 23 09 00 Contractor who furnishes control.

H. EC: Electrical Contractor = Divisions 26 through 28 Contractor.

I. FA: Fire Alarm Contractor = Division 28 Contractor who furnishes Fire Alarm System.

J. IPC: Ice Plant Contractor = Contractor who furnishes the Ice Plant System.

K. EP: Electric to Pneumatic Converter.

L. PE: Pneumatic to Electric Converter.

1.4 RESPONSIBILITY SCHEDULE

A. Responsibility: Unless otherwise indicated, all motors and controls for Divisions 21 through 23 equipment shall be furnished, set in place and wired in accordance with the following schedule:

ITEM -	**Furnished Under**	**Set In Place Under**	**Power Wiring Under**	**Control Wiring Under**
MC: Mechanical Contractor TC: Temperature Contractor EC: Electrical Contractor FA: Fire Alarm Contractor				
AHU Interior Marine Lights	MC	MC	EC	MC
Equipment Motors	MC	MC	EC	--
Automatically or Manually Controlled Starters/Contactors: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
In Motor Control Centers (Note 4)	EC	EC	EC	TC
Motor Speed Controllers: (Note 4) -Separate -Factory Mounted and Wired	 MC MC	 EC MC	 EC EC	 TC TC
Disconnect Switches (Note 1)	EC	EC	EC	--
Thermal Overload Switches (Note 1)	EC	EC	EC	--
Switches (Manual or Automatic other than disconnect) (Note 2)	MC or TC	MC or TC	EC or TC	TC or MC
Control Relays (Note 2)	MC or TC	MC or TC	--	TC
Control Transformers	MC or TC	MC or TC	EC or TC	TC
Push Button Stations, Pilot Lights	MC	EC	EC	EC

ITEM -	**Furnished Under**	**Set In Place Under**	**Power Wiring Under**	**Control Wiring Under**
MC: Mechanical Contractor TC: Temperature Contractor EC: Electrical Contractor FA: Fire Alarm Contractor				
Thermostat and Controls: Integral with Equipment or Directly Attached to Ducts, Pipes, etc. (Note 2)	MC or TC	EC or TC	EC or TC	TC
Equipment in Temperature Control Panels	TC	TC	TC	TC
Standalone Control Panels (BAS) (Note 6)	TC	TC	TC	TC
Valve Motors, Damper Motors, Solenoid Valves, etc.	TC	TC	TC	TC
EP Valves or Switches, P.E. Switches, etc.	TC	TC	--	TC
Fire Alarm System (Note 3)	FA	FA	EC	FA
Fire Sprinkler Alarm (Note 3)	MC	MC	EC	FA
Duct System Smoke Detectors (Note 5)	FA	MC	--	TC/FA
Relays for Fan Control via duct detectors (Note 5)	MC	MC	EC	TC
Room Smoke Detectors Including Relays for Fan Control (Note 3)	FA	FA	--	FA
Smoke Management Controls (Note 6)	FA	FA	EC	FA
CO Sensors	TC	TC	TC	TC
Control Air Compressor	TC	TC	TC	TC
Refrigerated Air Dryer	TC	TC	TC	TC
Equipment Interlocks	TC	TC	--	TC
Fire/Smoke and Smoke Dampers (Note 6)	MC	MC	EC	FA
Smoke Control Dampers (for smoke management system)	MC	MC	EC	FA/TC
Positive Indication Devices (i.e., current sensors, end switches, airflow sensors)	TC	TC	--	FA/TC
Heat Trace Systems (Note 7)	MC	MC	MC	MC

Notes:

1. If furnished as part of factory wired equipment furnished and set-in place by MC, wiring and connections by EC.
2. If float switches, line thermostats, P.E. switches, time switches, or other controls carry the FULL LOAD CURRENT to any motor, they shall be furnished by MC, but they shall be set in place and connected by EC, except that where such items are an integral part of the mechanical equipment, or directly attached to ducts, piping, or other mechanical equipment, they shall be furnished and set-in place by MC and connected by EC. If they

do not carry the FULL LOAD CURRENT to any motor, they shall be furnished, set in place and wired by TC contractor.

3. Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28.
4. Electrical contractor is responsible for wiring from starter to motor, unless factory wired.
5. Temperature control contractor shall provide conduit and wire from auxiliary contact in motor starter to the detector so that the unit shuts down in all operating modes. Fire Alarm Contractor to wire from detector to fire alarm panel.
6. Each division shall be fully responsible for any control panels as called for on the drawings or specifications.

    a. Division 26 shall provide all power and control wiring to fire/smoke or smoke dampers. Division 23 and 26/28 shall provide parallel control wiring (with 28 fire alarm having priority signal) to dampers and equipment utilized in both normal and smoke control modes. Refer to Smoke Control and Fire Alarm Drawings and the Fire Alarm Matrix.
    b. Fire alarm system shall override automated building control system during smoke exhaust mode.
    c. TC wiring to fire/smoke or smoke dampers required only when damper also serves HVAC system.

7. Mechanical contractor shall be responsible for fully functional heat trace system. Mechanical contractor shall engage licensed electrician to install heat trace system. Where applicable, mechanical contractor shall engage temperature controls contractor to install control wiring to Division 23 09 00 system.

B. Power Wiring by Divisions 21 through 23: The electrical power for certain equipment provided under Divisions 21 through 23 has not been specifically indicated on the electrical drawings and must be provided by and field coordinated by the Divisions 21 through 23 trade requiring such power.

Sufficient power for this purpose shall be furnished as “spare” dedicated circuit capacity in Division 26’s panelboards. All wiring, conduit and electrical devices downstream of the panelboards are the responsibility of the Divisions 21 through 23 trade requiring the power.

1. Such equipment is hereby defined as:

    a. Electrical heat trace. Required heat trace locations, capacities and specification are shown on the plumbing and mechanical drawings (Division 22 and 23 work).
    b. Fire protection air compressors, dry-pipe control panels and valves. Required connections are included in the Division 21 work and will be shown by that contractor’s engineered system design drawings.

        1) Pre-action system initiation signals (such as smoke detectors or general alarm conditions in a pre-action zone) shall be provided under Division 28 fire alarm work.

2) Division 21 shall provide pre-action control panel and interconnection between nearest suitable fire alarm panel and location of pre-action valve(s).
3) Division 28 shall provide interconnection between fire command center alarm panel (provided under Division 28) and remote communication fire alarm panel (provided under Division 28).

c. Infrared plumbing fixtures. Fixtures requiring power are shown on the plumbing drawings and schedules. Provide junction box and or receptacle as required by manufacturer.
d. Temperature control panels, control air compressors and line voltage power for 24v control transformers. Required connections are included in Division 23 09 00 and will be shown by that contractor's control submittal drawings.
e. Condensate pumps. Provide power from associated unit or from nearby panelboard.

1.5 GENERAL REQUIREMENTS

A. Connections:

1. Connections to all controls directly attached to ducts, piping and mechanical equipment shall be made with flexible connections.

B. Starters:

1. Provide magnetic starters for all three phase motors and equipment complete with:

a. Control transformers.
b. 120V holding coils.
c. Integral hand-off-auto switch.
d. Auxiliary contacts required for system operation plus one (1) spare.
e. Refer to Section 23 05 13 Motors, Starters and Drives.

C. Remote Switches and Pushbutton Stations:

1. Provide remote switches and/or pushbutton stations required for manually operated equipment (if no automatic controls have been provided) complete with pilot lights of an approved type lighted by current from load side of starter.

D. Special Requirements:

1. Motors, starters and other electrical equipment installed in moist areas or areas of special conditions, such as explosion proof, shall be designed and approved for installation in such areas with appropriate enclosure.

E. Identification:

1. Provide identification of purpose for each switch and/or pushbutton station furnished. Identification may be either engraved plastic sign permanently mounted to wall below switch or stamping on switch cover proper. All such identification signs and/or switch covers in finished areas shall match other hardware in the immediate area.

F. Control Voltage:

1. Maximum allowable control voltage 120V. Fully protect control circuit conductors in accordance with National Electrical Code.

G. DDC Control Interface:

1. Fully coordinate the requirements of each division with regard to supplying a complete DDC Control System prior to submitting bid.
2. All control power shall be furnished via dedicated line voltage circuits.
3. Dedicated control circuits from electrical panelboards to DDC control panels and from electrical panelboards to dedicated DDC J-boxes (for distributed control components such as VAV boxes), and control transformer line voltage connections shall be provided under Division 23 09 00 where required and as shown on the drawings.

    a. Exceptions: The following Divisions 21 through 23 equipment has been provided with electrical power feeders downstream of the panelboards by Division 26:

        1) Division 28, Fire Alarm System Panels.
        2) Division 23 09 00 Building Automation System (BAS):

            a) Each air handling unit (AHU) has been provided with a dedicated combination control and unit lighting circuit(s) to its air handling room.
            b) Certain BAS panels requiring emergency power.

        3) See the drawings for additional exceptions.

4. Low-voltage wiring from J-boxes to distributed control components, all low-voltage connections, all control panels and all control transformers (not part of unitary equipment) shall be provided under Division 23 09 00.
5. Any additional power requirements shall be the responsibility of the Division 23 09 00 Contractor requiring same and provided at no additional cost to the owner.

1.6 CEILING AND CHASE CAVITY PRECEDENCE

A. Coordinate ceiling cavity space carefully with all trades. In the event of conflict, install mechanical and electric systems within the cavity space allocation in the following order of

precedence. A system with higher precedence may direct that systems of lower precedence be relocated from space, which is required for expedient routing of the precedent system.

1. Plumbing waste, cooling coil drain piping, and roof drain mains and leaders.
2. Hydronic main piping (12" and larger).
3. Plumbing vent piping.
4. Supply, return and exhaust ductwork.
5. Electrical conduit greater than 4" diameter.
6. Hydronic branch and mains (greater than 2", but less than 12").
7. Domestic water piping.
8. Fire sprinkler mains and leaders.
9. Hydronic branch piping (2" and less).
10. Domestic hot and cold-water branches.
11. Electrical conduit branch feeders.
12. Fire sprinkler branch piping and sprinkler runouts.

B. Light fixtures have precedence in a zone, which is the same height above the ceiling as the depth of the fixture (plus 2").

C. Examine the contract documents of all trades (e.g., all Divisions 21 through 23 and 26 through 28 drawings, the architectural floor plans, reflected ceiling plans, elevations and sections, structural plans and sections, etc.).

D. Coordinate necessary equipment, ductwork and piping locations so that the final installation is compatible with the materials and equipment of the other trades.

E. Prepare shop drawings for installation of all new work before installation to verify coordination of work between trades.

F. Provide access doors for all equipment, valves, clean-outs, actuators and controls which require access for adjustment or servicing and which are located in otherwise inaccessible locations.

1. For equipment located in "accessible locations" such as lay-in ceilings: Locate equipment to provide adequate service clearance for normal maintenance without removing architectural, mechanical, electrical or structural elements such as the ceiling support system, electrical fixtures, etc. "Normal maintenance" includes, but is not limited to: filter changing; greasing of bearings; using p/t ports for pressure or temperature measurements; and replacement of ballasts, fuses, etc.

PART 2 - PRODUCTS

2.1 MOTOR HORSEPOWER

A. In general, all motors ¾ HP and above shall be three phase, all motors ½ HP or less shall be single phase.

B. Voltage and phase of motors as scheduled on the electrical drawings shall take precedence in the case of a conflict between the mechanical and electrical drawings or general condition 2.1. A., above.

C. Work under Divisions 21 through 23 includes coordinating the electrical requirements of all mechanical equipment with the requirements of the work under Divisions 26 through 28, before ordering the equipment.

1. If motor horsepowers are changed under the work of Divisions 21 through 23 without a change in duty of the motor's driven device, coordination of additional electrical work (if any) and additional payment for that work (if any) shall be provided under the section of Divisions 21 through 23 initiating the change. Increases or decreases in motor horsepower from that specified shall not be made without written approval from the Architect/Engineer.

PART 3 - EXECUTION - (NOT USED)

END OF SECTION 23 05 01/26 05 01

SECTION 26 05 02 - BASIC MATERIAL AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements.

1.2 DESCRIPTION OF WORK

A. Work included in this section consists of conduits, wires and other miscellaneous materials not specifically mentioned in other sections of Division 26, 27 and 28 but necessary or required for equipment or system operation or function, and the labor to install them.

1.3 SUBMITTALS

A. Materials list with manufacturer, style, series or model identified.

B. Manufacturer’s descriptive literature and/or sample if requested by the Architect/Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Refer to Section 26 05 03.

2.2 CONDUIT RACEWAYS

A. Refer to Section 26 05 33.

2.3 ELECTRICAL POWER CONDUCTORS AND CABLES

A. Refer to Section 26 05 19.

2.4 WIRING DEVICES

A. Refer to Section 26 27 26.

2.5 OUTLET BOXES, JUNCTION AND PULL BOXES

A. Outlet Boxes: Hot-dipped galvanized or sherardized of required size, 4" square minimum, for flush-mounted devices and lighting fixtures. Cast-type FD with gasketed covers for surface-mounted devices.

B. Junction and Pull Boxes: Use outlet boxes as junction boxes wherever possible. Larger junction and pull boxes shall be fabricated from code-gauge sheet steel, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless-steel nuts, bolts, screws, and washers. Pull and junction boxes installed in finished spaces must be flush-mounted cabinets provided with trim, hinged door and flush latch and lock to match flush-mounted panelboard trim. Provide galvanized code-gauge steel where required for outdoor exposure.

C. All exterior boxes shall be in use gasketed, weatherproof type with cast metallic covers.

D. Refer to Section 26 05 33 for additional requirements.

2.6 WIRE CONNECTORS

A. For wires that are #8 AWG and smaller: Insulated pressure type with live spring, rated 105°C, 600-Volt, for building wiring and 1000-Volt in signs or fixtures.

B. For wires that are #6 AWG and larger: Compression type with 3M #33 or equal tape insulation.

2.7 CONDUIT HANGERS

A. Refer to Section 26 05 29 for additional requirements.

2.8 FUSES

A. Refer to Section 26 28 16.

2.9 ACCESS PANELS

A. Electrical Contractor to provide access panels for electrical equipment which are required for accessibility by code.

2.10 CONDUIT SLEEVES

A. Sleeves for Conduit Penetration: Hilti, Inc., model CP 6820-P; or 3M Corp. MCID or PCID. Refer to Division 7 "Firestopping" for additional requirements.

B. Exterior Wall Penetration Seals: Provide seals at all foundation of exterior wall locations. Link Seal or approved manufacturer.

2.11 CONDUIT SLEEVES

A. Sleeves for Conduit Penetration: Hilti, Inc., model CP 6820-P; or 3M Corp. MCID or PCID. Refer to Division 7 "Firestopping" for additional requirements.

B. Exterior Wall Penetration Seals: Provide seals at all foundation of exterior wall locations. Link Seal or approved manufacturer.

1. New Construction – Cast in place shall be Century Line (HDPE) or Steel Wall Sleeve
2. Exiting Construction – Core Drilled

C. Seal Product:

	Seal Element	Intended Application
C	EPDM (Black)	Direct ground burial, occasional or periodic water contact.
L	EPDM (Blue)	Use with fragile pipe and tubing. Direct ground burial, occasional or periodic water contact.
O	Nitrile	Oil, fuel and solvent resistant.
T	Silicone	Extreme temperatures rated (-55˚C - +204˚C).
S-316	EPDM (Black)	Chemical processing & wastewater treatment. High level of water resistance, inorganic acids and alkalis, and most organic chemicals.
LS-316	EPDM (Blue)	Use with fragile pipe and tubing. Chemical processing & wastewater treatment. High level of water resistance, inorganic acids and alkalis, and most organic chemicals.
OS-316	Nitrile	Oil resistant rubber with stainless steel hardware.

2.12 INTERNAL CONDUIT SEALANT

A. Conduit sealant shall be used in all conduits penetrating the building envelope or moisture barrier to prevent rodents and moisture. Sealant shall be able to be removed without damaging the conductors.

1. Conduits 2" or greater – Polywater FST or approved equal.
2. Conduits <2" – Poly Water FST Mini or approved equal.

2.13 EQUIPMENT MOUNTING AND SUPPORT HARDWARE

A. Steel channels, bolts and washers, used for mounting or support of electrical equipment shall be galvanized typed. Where installed in corrosive atmosphere, stainless-steel type hardware shall be used.

B. Refer to Section 26 05 29 for additional requirements.

PART 3 - EXECUTION

3.1 GENERAL

A. Provide complete raceway systems for all conductors including control wiring and low-voltage wiring unless otherwise noted.

B. Electrical system layouts indicated on drawings are generally diagrammatic, but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of raceways and locations of outlets by structure and equipment served. Take all dimensions from architectural drawings.

C. All home runs to panelboards are indicated as starting from the outlet nearest to the panel and continuing in the general direction of that panel. Continue such circuits to panel as though routes were completely indicated.

D. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of the Architect, and conform to all structural requirements when cutting or boring structure.

E. Furnish and install all necessary hardware, hangers, blocking, brackets, bracing, runners, etc., required for equipment specified under this Section.

3.2 RACEWAYS

A. Refer to Section 26 05 33.

3.3 OUTLETS

A. Exact location of outlets and equipment shall be governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Verify final location of all outlets, panels, equipment, etc., with the Architect/Engineer.

B. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4" octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8" no-bolt fixture studs. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located on one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide tile box or a 4" square box with tile ring in masonry walls which will not be plastered or furred, or where "dry-wall" type materials are applied. Through the wall type boxes are not permitted. Install minimum 12" lateral separation for back to back boxes.

C. Surface-mounted devices are to be mounted in cast type boxes with gasketed covers: (Crouse-Hinds FS/FD or equal).

D. Dimensions unless shown on drawings are given below and are from finished floor to center line of outlets unless noted otherwise. Adjust heights of outlets in masonry walls to correspond with consistent brick or block course. Outlets in block walls shall be installed in core of block.

Wall Switches	4' - 0" (to top of box)
Convenience outlets	1' - 4" (to bottom of box) – gyp or 8" block 1' – 6" (to bottom of box) – 6" block
Hallways	1' - 6" (to bottom of box)
Above counter wall outlet	0' - 8" (above counter to top of box, maximum 44" AFF, field verify height of backsplash)
Panelboards wall mounted	6' - 6" (to top of back box)
Wall phone outlet	4' - 0" (to top of box)
Tele/Data outlets	1' - 6" (to bottom of outlet)
Fire alarm horns, speakers	ceiling or wall
Fire alarm pull stations	4' - 0" (to top of device)
Fire alarm strobes	6' - 8" or 6" below ceiling (whichever is lower)
Television outlets	Refer to A/V or architectural drawing.

Confirm final location and heights of all outlets, wall switches, and television outlets with architectural drawings and furniture plans prior to installation.

E. Outlets except over counters, benches, special equipment, baseboards, fin tube radiators, etc., or at wainscoting, shall be at a height to prevent interference to service equipment, or as noted on drawings.

F. Refer to Section 26 05 33 for additional requirements.

3.4 JUNCTION PULL BOXES

A. Construct junction or pull boxes not over 150 cubic inches in size shall be standard outlet boxes, and those over 150 cubic inches shall be constructed the same as “Cabinets,” with screw covers of same gauge metal. Removal covers must be accessible at all times.

B. Provide a standard access panel having a hinged metal door neatly fitted into a flush metal trim, where a junction box or equipment is located above non-accessible ceilings or behind finished walls. Coordinate location and type with the Architect.

END OF SECTION 26 05 02

SECTION 26 05 03 - MANUFACTURERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. The following lists of manufacturers are for the specifications as identified.

B. All submittals and documentation shall be in accordance with the project General Requirements, Division 1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work are listed herein. All manufacturers not listed shall be pre-approved prior to bid in order to be considered. Refer to Division 1 for pre-approval format.

TITLE	SPECIFICATION SECTION	MANUFACTURER
Electrical Power Conductors and Cables	26 05 19	Aetna Insulated Wire Cerro Wire CME Wire and Cable Encore Wire Southwire Co.
Grounding and Bonding	26 05 26	ABB (Blackburn/Color-Keyed) nVent (Erico/Cadweld) Ideal Industries Hubbell (Burndy) VFC/Lyncole
Hangers and Supports		
- Slotted Metal Angle and U-channel Systems	26 05 29	ABB (Thomas and Betts Corp) Eaton (B-Line Systems) Atkore (Unistrut Diversified Products)
- Conduit Sealing Bushings	26 05 29	ABB (Thomas and Betts Corp.) Emerson (OZ/Gedney) Hubbell (RACO)

TITLE	SPECIFICATION SECTION	MANUFACTURER
Raceways		
- Conduit and Tubing	26 05 33	ABB (T&B - OCAL) Atkore (Allied Tube & Conduit) Carlon, Inc. JM Eagle Rob Roy Industries Wheatland
- Conduit Bodies	26 05 33	ABB (Thomas and Betts Corp.) Emerson (Appleton Electric) Eaton (Crouse-Hinds) Hubbell (Killark Electric)
Wireway and Enclosures	26 05 33	Eaton (Cooper B-Line) nVent (Hoffman) Hammond Mfg.
Surface Raceways	26 05 33	Hubbell Legrand (Wiremold)
Electrical Boxes and Fittings		
Raintight outlet boxes	26 05 33	ABB (T&B – Red Dot) Emerson (Appleton Electric) Eaton (Crouse – Hinds) Hubbell (RACO)
Bushings, knockout closures and locknuts	26 05 33	ABB (T&B – Steel City) Emerson (Appleton Electric) Eaton (Crouse – Hinds) Hubbell (RACO)
Lighting Control System	26 09 43	n-light Lutron Crestron
Identification	26 05 53	Ideal Industries, Inc. Panduit Corp. Seton Identification Product. Brady, Co.

TITLE	SPECIFICATION SECTION	MANUFACTURER
Low-Voltage Distribution Transformers	26 22 13	Eaton ABB (GE) Siemens Schneider Electric (Square D)
Switchboards Panelboards	26 24 13 26 24 16	Eaton ABB (GE) Siemens Schneider Electric (Square D)
Wiring Devices		
- Receptacles and Switches	26 27 26	Eaton (Cooper) Hubbell, Inc. Leviton Legrand (Pass & Seymour)
- Dimmers	26 27 26	Lutron Phillips
- Occupancy Sensors	26 27 26	Lutron Legrand (Wattstopper) Hubbell Sensorswitch
Connections	26 28 16	ABB (Thomas and Betts Corp.) Emerson (Appleton Electric) Hubbel (Burndy Corp.) Ideal Industries, Inc.
Fuses (See Note)	26 28 16	Eaton (Bussman) Mersen (Ferraz Shawmut) Littelfuse
Surge Protection Device	26 43 13	Refer to Section
Addressable Fire Alarm System	28 46 00	Edwards System Technology JCI (Simplex Grinnell) Notifier Siemens
NOTE: Contractor shall submit fuse coordination for the entire electrical distribution if alternate manufacturer is used.		

PART 3 - EXECUTION - NOT USED.

END OF SECTION 26 05 03

SECTION 26 05 04 - FOOD SERVICE EQUIPMENT WIRING

PART 1 - GENERAL

1.1 DESCRIPTION

A. General: Provide food service equipment wiring, complete, as shown and specified per Contract Documents.

B. Related Sections: The following Sections apply to Work under this Section.

1. Division 26 Section “Electrical Requirements” and “Basic Material and Methods”.

1.2 GENERAL

A. Obtain and verify electrical requirements and location of food service equipment prior to installation of related electrical Work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Refer to Section 26 05 26 “Basic Material and Methods”

PART 3 - EXECUTION

3.1 FOOD SERVICE EQUIPMENT WIRING

A. All final connections to equipment by Electrical Contractor.

B. All electrical lines shall be extended from rough-in to connection point or points on the fixture by the Electrical Contractor furnishing all labor and materials.

C. Where electrical lines are shown out of floor on drawings, Electrical Contractor shall stub up 6" above finished floor and connect, after equipment has been set in place and leveled by Kitchen Equipment Contractor (KEC).

D. All rough-ins shall be concealed in walls or columns wherever possible.

E. All fabricated equipment shall be completely wired internally, and all electrical outlets and receptacles mounted on or in fabricated equipment shall be furnished and installed by KEC who shall run all lines to suitable terminal boxes or subpanels; starters or disconnect switches by Electrical Contractor. Final connection shall be made by the Electrical Contractor. Where equipment wiring terminates in a junction box, switch, or terminal box, the Electrical Contractor shall make all connections between the branch circuit and equipment wiring. Where terminal is a receptacle, connect branch circuit to receptacle. Where terminal is a sub-panel, connect branch circuit to the mains of the sub-panel. All receptacles shall be furnished by Electrical Contractor, except those which are built into an item of equipment.

F. Pre NEC 210.08(B), all single phase breakers within any food service space or portable cart rated 50 amps or less shall be GFCI type. All three phase breakers within any food service space rated 100 amps or less shall be GFCI type.

G. All plug-in equipment receptacles shall be polarized. The Electrical Contractor shall provide the appropriate grounding type receptacles for all wall- and floor-mounted outlets to be used for plug-in equipment as noted on the drawings, with characteristics as noted. All plug-in equipment shall have the appropriate cord and plug set furnished and installed by the KEC. The KEC and Electrical Contractor shall coordinate their work so that the receptacles provided will match the specific plugs installed as part of the plug-in equipment, and any changes in cords and plugs or receptacles required in the field will be done at no cost to the Owner.

H. The Electrical Contractor shall interwire equipment components where required, such as, ventilator control panels to ventilators, fans and detergent systems, and disposer control panels to disposer motors and solenoids.

I. Electric switches with thermal overload protection will be mounted on the dishwashing machine by KEC or dishmachine manufacturer. Machine may be shipped to the job site in one or more sections. After machine is assembled by the KEC, the Electrical Contractor shall interconnect machine sections and provide final connections.

J. The KEC shall supply, one each motor-driven appliance or electrical heating unit, a suitable control switch or starter of the proper type in accordance with Underwriter's Laboratory requirements wherever such switch or starter is not furnished integrally with the equipment by its manufacturer. All other line switches; safety cut-outs; disconnect switches; control panels; fuse boxes; other controls, fittings, and connections, when not an integral part of the unit, will be furnished and installed by the Electrical Contractor.

K. All conduit, junction boxes, and other fittings for equipment which is freestanding, or open tubular construction, exposed to public view, shall be stainless steel or chrome plated. Assemblies in non-public areas shall be epoxy-painted aluminum.

L. The Electrical Contractor shall supply power and interconnecting services and all final connections to walk-in refrigeration and freezer compressor/condensers and evaporators, solenoid valves and switches required for a complete operating system. Furnish and install a disconnect switch for each compressor. Walk-in refrigerator lights shall be furnished by the

KEC and installed and fully connected by the Electrical Contractor. Exposed conduit inside the walk-in compartment is unacceptable.

M. The Electrical Contractor shall furnish and install control wiring between refrigeration temperature alarm systems and remote monitoring panel.

N. "Sealtite" type flexible conduit shall be used for all flexible conduit installations, depending on code requirements. Junction boxes for equipment requiring flexible conduit should be mounted right on conduit at elevations which will limit the total length of the flexible conduit to 24" overall.

O. Sleeve collars shall extend 2" above top of the finished floor. Openings between collar and conduit shall be sealed watertight.

P. Electrical Contractor shall connect electrical supply from rough-in location to the disposer control panel and then to the disposer motor and solenoids. Control panel contains overload and under-voltage protection and fused disconnect switch.

Q. The KEC shall provide microswitches as part of the fire suppression system, which, when wired to, will allow for the interruption of power to all electrically operated equipment and closed gas solenoid as required in case of fire. Power source for the fire suppression system shall be interwired to an external battery system by the Electrical Contractor so that the fire system will remain energized in the event of a power failure. The Electrical Contractor shall provide adequate contactors, shunt-trips, or other equipment to interrupt power as required by code and inter-wire with system as supplied by KEC. (If Utility Distribution System is specified, shut-offs will be provided by KEC as part of the system and the Electrical Contractor will need to interwire from the microswitch at the fire suppression system tanks to the terminal block in the system.)

R. Electrical Contractor shall interwire ventilator exhaust and washdown system per directions of KEC and manufacturer. Ventilator exhaust system shall be interfaced with fire suppression system, such that when activated the ventilator exhaust shall become or remain operational. The ventilator control system shall be interwired to an emergency generator or external battery system so that the ventilator system is constantly energized in the event of a power failure.

END OF SECTION 26 05 04

SECTION 26 05 05 - ELECTRICAL DEMOLITION AND RELOCATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. This Section supplements Division 1, General Requirements. Where contradictions occur between this Section and Division 1, the more stringent of the two shall apply. The Architect shall decide which is more stringent.

B. Requirements of the following Divisions and Sections apply to this Section:

1. Division 26 Section 26 05 00 “Electrical Requirements.”
2. Division 9 Section “Painting” for related requirements.

C. Refer to other Division 26 Sections for additional specific electrical demolition or relocation associated with specific items.

1.2 SUMMARY

A. This Section includes basic requirements for demolition and relocation of electrical materials, equipment, and installations. The Contractor shall be responsible for visiting the site prior to bid to determine the actual conditions, which might affect the bid or contract price. No allowance will be made subsequently resulting from the neglect to visit the site and make such determinations.

B. Generally, electrical items that are to be replaced with other equipment in the same location are work covered by this section. Also covered by this section are electrical items that are to be removed in their entirety or that are to be relocated to another place.

1.3 UTILITY SERVICES

A. Maintain existing utility services. Where necessary to cut existing conduits, wires, cables, etc. of utility services or fire protection systems, they shall be cut and capped at suitable places or where directed by the Owner’s representative.

B. Electrical service in demolition area shall be reduced to a minimum and identified to eliminate uncertainty about which circuits are energized.

C. The Contractor shall notify the Owner’s representative in writing of any planned utility interruptions including interruptions of power to communications and fire protection systems at least 48 hours in advance or as otherwise specified. The request shall state the reason, date,

beginning time, and expected duration of such interruptions. No interruptions shall be made without the Owner's written concurrence and such interruptions shall be coordinated with the Owner to cause the least inconvenience to the Owner's operations. Service interruptions which cannot wait for written approval may be granted with verbal approval from the Owner's representative. After verbal approval is granted, written confirmation shall be issued by the Contractor as soon as practical.

1.4 PROTECTIVE MEASURES

A. Provide the following protective measures:

1. Wherever existing roofing surfaces are penetrated by electrical conduit, they shall be protected against water infiltration. Water leaks shall be repaired immediately upon discovery when they occur.
2. Temporary protection against damage for all portions of existing structures and grounds where work is to be done, materials handled, and equipment moved or relocated.
3. Contractor shall patch and fill openings in floors, walls and ceilings for removed equipment or piping with the same material, fire and structural integrity that would have existed prior to the penetration including concrete, block, gyp wallboard, exterior walls, roof membranes, etc. except for steel and wood beams which shall have the openings capped with similar material.

B. The Contractor shall be responsible for contacting utilities or locating services and obtaining locations of all underground services in the general area of demolition work.

PART 2 - PRODUCTS

2.1 EQUIPMENT AND MATERIALS

A. The Contractor shall provide all equipment and materials necessary for the removal or relocation of electrical equipment.

B. Materials used in restoration or repairing work related to demolition and relocation shall conform in type, quality, and function to that of the original existing construction or as otherwise indicated.

2.2 DISPOSAL AND RETENTION

A. Materials and equipment resulting from work and removed from the building or structures, or parts thereof, shall become the property of the Contractor and shall be removed from the site by the Contractor except as follow:

1. Light fixtures, lamps, and ballasts.
2. Fire, heat, and smoke detection devices.
3. Telephones and telephone equipment other than outlet devices.
4. Fire alarm notification devices and pull stations.
5. Paging speakers, clocks, and intercom call stations.

B. Items removed or noted to be retained by the Owner but which are declined to be retained by the Owner shall be removed from the site by the Contractor.

C. Combustible waste material and rubbish shall not be stored or allowed to accumulate within a building or its vicinity, but shall be kept in a suitable trash container for subsequent removal or shall be removed from the premises as rapidly as practical.

D. All hazard waste shall be properly disposed of by a licensed hazard waste disposal facility. Items shall include but not limited to fluorescent lamps, diesel fuel, radiator coolant, etc.

PART 3 - EXECUTION

A. Remove or relocate all items indicated on the drawings or as otherwise indicated.

B. Where the drawings indicate that equipment is to be replaced or where other equipment requires the relocation of existing equipment, the existing equipment shall be removed or relocated as though it was specifically noted to be removed or relocated.

C. Wherever electrical materials have been removed from surfaces of the building or structure, those surfaces shall be patched and repaired.

D. Remove, cut, alter, replace, patch, and repair existing work as necessary to install new work. Unless otherwise indicated or specified, do not cut, alter, or remove any structural members, ducts, piping, or service lines without approval of the Owner’s representative.

E. Existing work or equipment to be altered or extended and found to be defective shall be reported to the Owner’s representative before it is disturbed or any further work is performed on it.

F. Where electrical equipment is indicated to be removed or relocated, the work shall include the complete disconnection from its source, dismantling as necessary, and removal or installation of all conduit, wires, cables, etc. Unless noted otherwise, wires shall be removed from conduits

back to the last utilization device or to the panelboard. No wiring shall be removed that prevents operation of other equipment not scheduled or indicated to be removed.

G. Perform and schedule all demolition work with other trades and work of the contract as necessary for the efficient progress and flow of the work.

END OF SECTION 26 05 05

SECTION 26 05 10 - TESTING

PART 1 - GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Acceptance and startup testing requirements for electrical power distribution equipment and systems. Contractor shall retain and pay for the services of a recognized independent testing firm for purpose of performing inspections and tests as herein specified.

1. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
2. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.
3. The tests and inspections shall determine suitability for startup and energization.
4. The following equipment shall be tested and calibrated:

   Grounding and Bonding – Section 26 05 26
   Low-Voltage Distribution Transformers – Section 26 22 13
   Panelboards – Section 26 24 16
   Distribution Switchboards – Section 26 24 16
   Electrical Power Conductors and Cables – Section 20 05 19

1.2 SUBMITTALS

A. Provide submittal per Contract General Conditions, Division 1, and Section 26 05 00.

B. Qualification of testing firm.

C. Submit one electronic copy of certified test reports to Engineer for approval.

D. One electronic copy of blank forms for checklists, test reports, and other related forms for Engineer's review and approval.

1.3 GENERAL REQUIREMENTS

A. The Contractor shall perform routine insulation resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to any acceptance testing.

B. The Contractor shall test all lighting, low-voltage relays and circuits to ensure proper operating conditions prior to acceptance testing.

C. The Contractor shall perform visual and mechanical inspections, verifying that the equipment nameplate information meets the intent of the drawings and specifications.

D. The Contractor shall be responsible for all final settings and adjustments on protective devices and tap changes, submitting settings to the Architect/Engineer for review.

E. Provide a complete short-circuit study, equipment interrupting/withstand evaluation, and a protective device coordination study for the electrical distribution system described herein. This study shall be submitted with electrical equipment submission and electrical room layouts.

F. The Contractor shall engage the services of a recognized corporate and financially independent testing firm for the purpose of performing inspections and tests as herein specified.

G. The firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.

H. It is the purpose of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design specifications.

I. The tests and inspections shall determine suitability for energization. Equipment shall not be energized until accepted by the testing firm.

1.4 QUALIFICATIONS OF TESTING FIRM

A. The testing firm shall be a recognized corporate and financially independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, Part 1907, or be a Full Member company of the InterNational Electrical Testing Association (NETA).

D. The lead, on-site, technical person shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing.

E. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing and engineering services. All studies, tests, and reports shall be sealed by a registered electrical professional engineer with a current Colorado stamp.

F. The testing firm shall submit proof of the above qualifications with bid documents, when requested.

G. The terms used herewith, such as test agency, test contractor, testing laboratory, or contractor test company, shall be construed to mean the testing firm.

1.5 APPLICABLE CODES, STANDARDS, AND REFERENCES

A. All inspections and tests shall be in accordance with the following codes and standards except as provided otherwise herein:

1. National Electrical Manufacturer's Association - NEMA
2. American Society for Testing and Materials - ASTM
3. Institute of Electrical and Electronic Engineers - IEEE
4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-2009
5. American National Standards Institute - ANSI C2: National Electrical Safety Code
6. State and City of Steamboat Spring, CO Codes and Ordinances
7. Insulated Cable Engineers Association - ICEA
8. Association of Edison Illuminating Companies - AEIC
9. Occupational Safety and Health Administration - OSHA
10. National Fire Protection Association - NFPA

    a. ANSI/NFPA 70: National Electrical Code
    b. ANSI/NFPA 70B: Electrical Equipment Maintenance
    c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
    d. ANSI/NFPA 780: Lightning Protection Code
    e. ANSI/NFPA 101: Life Safety Code

B. All inspections and tests shall utilize the following references:

1. Project design specifications.
2. Project design drawings.
3. Short-circuit and coordination study.
4. Manufacturer's instruction manuals applicable to each particular apparatus.
5. Project list of equipment to be inspected and tested as stated above.

PART 2 - SHORT-CIRCUIT, COORDINATION, AND ARC FLASH STUDIES

2.1 SHORT-CIRCUIT STUDY

The electrical equipment manufacturer shall perform a short-circuit analysis of the specified electrical power distribution system. This analysis shall include:

A. Calculation of the maximum RMS symmetrical three-phase short-circuit current available at significant locations in the electrical system. The results shall represent the highest short-circuit currents to which the equipment might be subjected under the reported system conditions. The short-circuit currents shall be calculated with the aid of a digital computer. Appropriate motor short-circuit contribution shall be included in the calculation.

B. The study shall include all portions of the electrical distribution system from the normal and alternate sources of power throughout the low-voltage distribution system. Normal system operating method, alternate operation, and operations which could result in maximum fault conditions shall be thoroughly covered in the study.

C. The study shall be calculated from the utility meter to the unit substation to the lowest overcurrent device or equipment on the electrical distribution system. The utility conductors shall not be used for calculations.

D. An evaluation of the adequacy of the short-circuit ratings of the electrical equipment supplied by that manufacturer.

E. Provide one electronic copy of the short-circuit analysis for the engineer’s approval.

F. A computer printout of input data, a computer printout of calculated results and an explanation of how to interpret the printouts.

G. A one-line diagram identifying all bus locations and the maximum available short-circuit current at each bus.

H. A bus-to-bus listing of the maximum available short-circuit current expressed in RMS symmetrical amperes and the X/R ratio of the fault current.

I. A table of equipment short-circuit ratings versus calculated short-circuit current values.

J. An analysis of the results in which any inadequacies shall be called to the attention of the Engineer and recommendations made for improvements. These recommendations shall be incorporated by the electrical equipment manufacturer to the electrical equipment at no cost to the Owner, where approved by the Engineer.

2.2 ARC FLASH HAZARD ANALYSIS

A. Provide with the coordination and short circuit studies an Arc Flash study and device by device listing of PPE requirements and ratings as required by the NEC and NFPA 70E. All equipment shall have appropriate labeling installed in the field by the electrical contractor as determined by the study.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchgear, switchboards, panelboards, busway, etc.) where work could be performed on energized parts.

PART 3 - INSPECTION AND TEST PROCEDURES

3.1 PROCEDURE

A. Testing firm to provide and comply with the following:

1. Acceptance test procedures for each individual equipment listed in Part 1 of this section for Engineer review and approval prior to any test and after thorough evaluation of the system. Testing shall conform to the latest version of InterNational Electrical Testing Association (NETA) specifications and standards for electrical power distribution equipment and systems and manufacturer's instructions.
2. Refer to each individual specification section for testing requirements and comply.
3. Inspect installed equipment, record results and report any discrepancy and deficiency with contract documents and governing codes prior to testing. All results shall be submitted to the Engineer for approval.

3.2 SYSTEM FUNCTION TESTS

A. General:

1. Perform system function tests upon completion of equipment component tests as define in this specification. It is the purpose of system function tests to prove the proper interaction of all sensing, processing, and action devices.
2. Implementation:

    a. Develop test parameters for the purpose of evaluating performance of all integral components and their functioning as a complete unit within design requirements.
    b. Test all interlock devices, and trip settings on breakers.
    c. Record the operation of alarms and indicating devices.

3.3 DEFICIENCIES

A. All deficiencies reported by testing firm to be corrected by Contractor and Acceptance Test to be re-done accordingly.

END OF SECTION 26 05 10

SECTION 26 05 19 - ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirement of the following Division 26 Sections apply to this section:

1. Electrical Requirements

1.2 SUMMARY

A. This Section includes wires, cables, and connectors for power, lighting, signal, control and related systems rated 600-Volts and less.

B. Related Sections: The following Sections contain requirements that relate to this section:

1. Division 31 Section “Earthwork” for trenching and backfilling.
2. Division 26 Section “Electrical Boxes and Fittings” for connectors for terminating cables in boxes and other electrical enclosures.
3. Division 26 Section “Raceways and Boxes” for MC cable, raceway and boxes.

1.3 SUBMITTALS

A. Product Data for electrical wires, cables and connectors.

B. Submit pulling tension calculations for all underground feeders.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following code:

B. NFPA 70 “National Electrical Code.”

1. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.

C. UL Compliance: Provide components, which are listed and labeled by UL under the following standards.

1.	UL Standard 44	Rubber Insulated Wires and Cables
2.	UL Standard 83	Thermoplastic-Insulated Wires and Cables
3.	UL Standard 486A	Wire Connectors and Soldering Lugs for Use with Copper Conductors
4.	UL Standard 854	Service Entrance Cable
5.	UL Standard 2196	Testing for Fire Resistive Cables
6.	UL Standard 1424	Cables for Power-Limited Fire-Alarm Circuits

D. NEMA/ICEA Compliance: Provide components which comply with the following standards:

1. WC-5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
2. WC-7: Cross Linked Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

E. IEEE Compliance: Provide components, which comply with the following standard.

1. Standard 82: Test procedures for Impulse Voltage Tests on Insulated Conductors.

PART 2 - PRODUCTS

2.1 WIRES AND CABLES (600-VOLT COPPER CONDUCTORS)

A. General: Provide suitable wire and cable for the temperature, conditions and location where installed. All wires and cables shall be new and delivered to the site in unbroken packages and reels.

B. All wires and cables shall be of the same manufacturer throughout the entire project.

C. Conductors: Provide solid conductors for power and lighting circuits #10 AWG and smaller. Provide stranded conductors for #8 AWG and larger.

D. Conductor Material: All wires and cables shall be copper, single conductor rated at 600-Volts, which conform to or exceed ICEA specifications and the following:

1. In sizes 1/0 AWG to 4/0: Cross-linked polyethylene insulation type XHHW-2 (90°C) or THWN-2.
2. In sizes 250 KCMIL and larger: Type XHHW-2 (90°C) or THWN.

3. In sizes 1 AWG and smaller: All conductors shall have heat/moisture resistant thermoplastic insulation type THWN-2 (90°C) except as follows:

    a. Where conduit temperature will exceed 100°F, use type THHN (90°C).
    b. In 120-Volt incandescent fixtures, type SF-2 or SFF-2 (150 - 200°C).
    c. In wireway of fluorescent lighting fixtures type THHN (90°C).

E. Rated Conductor Material: Where required by these specifications and code, provide 2-hour rated cable conforming to the following requirements:

1. Cabling must meet current UL requirements for fire alarm resistance.
2. Cabling must meet current NEC 700 and 760 requirements.

F. Grounding conductors: Shall be of the same type as its associated phase conductors.

G. All conductors shall be labeled with wire size, insulation rating, etc. using an engraved process, computer scan on labels are not permitted.

H. Color Coding for phase identification in accordance with Table 1 in Part 3 herein.

I. Connectors for Conductors:

1. Provide UL-listed factory-fabricated, solderless metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.
2. For wires that are #8 AWG and smaller: Insulated pressure type with live spring, rated 105°C, 600-Volt, for building wiring and 1000-Volt in signs or fixtures.
3. For wires that are #6 AWG and larger: Compression type with 3M #33 or equal tape insulation.

J. Splices and Taps:

1. No. 10 AWG and smaller - Connectors for solid conductors shall be solderless, screw-on, spring pressure cable type, 600-Volt, 105°C with integral insulation and UL approved for aluminum and copper conductors. Connectors for stranded conductors shall be crimp-on type with integral insulating cover.
2. No. 8 AWG and larger - Hydraulically applied crimping sleeve or tap connector sized for the conductors. Insulate the hydraulically applied connector with 90-degree, 600-Volt insulating cover provided by the connector manufacturer. Insulator materials and installation shall be approved for the specific application, location, voltage, and temperature and shall not have an insulation value less than the conductors being joined.

2.2 ALUMINUM WIRES AND CABLES (ALTERNATE DESIGN, IF VE IS ACCEPTED)

A. Where indicated on drawings as AL: aluminum alloy, compact stranded, Type XHHW-2 or THHN/THWN, 90°C meeting requirements of UL#44 and Federal Spec A-A-59544 with XLPE insulation and AA-8000 series alloy only may be used in lieu of copper conductors.

B. Terminations shall be compression bolted lug with appropriate joint compounds and Belleville spring washers.

C. Installation and terminations shall be in strict accordance with manufacturer's recommendations and as identified in specifications.

D. Uses not allowed:
1. If not specifically shown on drawings with AL identifier.
2. For service-entrance conductors where Utility Company standards prohibit aluminum conductors
3. For any feeders or branch circuits to mechanical and vibrating equipment.
4. For any applications 100Amps and below.
5. Where terminations that are unable to utilize compression, bolted lug fittings.
6. For use as emergency and standby system feeders or branch circuits.

E. All grounding conductors shall be copper.

F. Refer to feeder table on drawings for conductor and conduit sizes to correspond with over current protection device size.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Use the following wiring methods as indicated:

1. Install all wire in raceway. Power and control wiring shall be installed in separate raceways.

3.2 INSTALLATION OF WIRES AND CABLES

A. General: Install electrical cables, wires, and connectors in compliance with NEC.

B. Coordinate cable and wire installation with other Work.

C. Do not install more conductors in a raceway than indicated on the drawings. A maximum of three ungrounded conductors are to be installed in any one conduit on a 3-phase, 4-wire system, unless specifically noted otherwise on the drawings. When more than three ungrounded conductors are installed in a raceway, the conductor size shall be increase per code for derating.

No two ungrounded conductors of the same phase are to be installed in the same conduit, unless specifically noted otherwise on the drawings.

1. Where multi-wire circuits are permitted by these specifications, all grounded and ungrounded conductors shall be grouped by wire markers, cable ties or similar means with the panelboard or wireway at least one location.

D. Provide dedicated neutral conductor for all single phase circuits. Shared neutral conductor is not acceptable on single phase circuits.

E. Minimum wire size shall be a No.12 AWG except for control or signal circuits, which may be No. 14 AWG.

F. Unless otherwise indicated on drawings, all wiring for branch circuits shall be a minimum No. 12 AWG in ¾" conduit, protected by 20 amperes circuit breakers. If distance from panel to first outlet is 75 feet or greater for 120-Volt circuits, and 125 feet or greater for 277-Volt circuits, No. 10 AWG shall be installed throughout the circuit, unless noted otherwise on the drawings.

G. Size of current carrying conductors, unless noted otherwise on drawings, shall be determined from Table 310.15(B)(16) of the latest National Electric Code for the load served.

H. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary.

I. Use pulling means including fish tape, cable, rope, and basket weave wire/cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable.

J. Size of conduits, unless specifically shown, shall be determined from Appendix C of the latest National Electrical Code.

K. Keep conductor splices to a minimum. All splices shall be made within junction boxes, wiring troughs and other enclosures as permitted by the National Electrical Code.

1. Splices shall not be permitted within 25 feet of any panel or electrical room.
2. Do not splice conductors in panelboards, safety switches, switchboards, motor control centers or motor control enclosures.
3. Splices in conductors installed below grade will not be permitted, unless approved in writing by the Architect and Engineer.

L. Install splice and tap connectors, which possess equivalent or better mechanical strength and insulation rather than conductors being spliced.

M. Use splice and tap connectors which are compatible with conductor material.

N. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than No. 10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

O. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturers' published torque tightening values. Where manufacturers' torque requirements are not indicated, tighten connectors and terminals to comply with tightening torque values specified in UL 486A and UL 486B. After tightening the connection/terminal, mark the bolt surface and that of the product or workpiece. Then loosen the bolt. Re-tighten it until the markings re-align. The torque needed to return the bolt to its original position is the torque value of the bolt.

3.3 FIELD QUALITY CONTROL

A. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled.

B. Prior to energizing, test wires and cables for electrical continuity and for short circuits.

C. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

D. Prior to completion of project, an infrared scan of switchgear and panelboard feeder equipment connection shall be performed when all loads are energized.

E. TABLE I: Color Coding for Phase Identification:

1. Color code secondary service, feeder, and branch circuit conductors with factory applied color as follows:

208V/120-Volts	Phase	480V/277-Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

3.4 FEEDER TESTING

A. Products

1. Material: Contractor shall provide all necessary testing equipment and devices required to perform the test described in this section.

B. Execution

1. Visual and Mechanical Inspection

   a. Inspect cables for physical damage and proper connection in accordance with one-line diagrams.
   b. Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench.
   c. Check cable color coding with specification section 26 05 53 and National Electrical Code standards.

2. Electrical Tests

   a. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 1000-Volts D.C. for 1 minute.
   b. Perform continuity test to insure proper cable connection.

3. Test Values

   a. Evaluate results by comparison with cables of same length and type. Investigate any insulation-resistance values less than 50 megohms.
   b. Submit results to Engineer for approval in accordance with Section 26 05 10.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Materials and Methods sections apply to work of this section.

C. Requirements of this section apply to electrical grounding and bonding work specified elsewhere in these specifications.

1.2 SUMMARY

A. Extent of electrical grounding and bonding work is indicated by drawings and schedules and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.

B. Type of electrical grounding and bonding work specified in this section includes the following:

1. Solidly grounded.

C. Applications of electrical grounding and bonding work in this section includes the following:

1. Underground metal piping.
2. Underground metal water piping.
3. Underground metal structures.
4. Electrical power systems.
5. Grounding electrodes.
6. Separately derived systems.
7. Raceways.
8. Service equipment.
9. Enclosures.
10. Equipment.
11. Lighting Standards.
12. Signs.

D. Refer to other Division 26 sections for wires/cables, electrical raceways, boxes and fittings, and wiring devices which are required in conjunction with electrical grounding and bonding work; not work of this section.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's data on grounding and bonding products and associated accessories.

B. Wiring Diagrams: Submit wiring diagrams for electrical grounding and bonding work which indicates layout of ground rods, location of system grounding electrode connections, routing of grounding electrode conductors, also include diagrams for circuits and equipment grounding connections.

C. Submit ground riser diagram for entire project. Show bus bars with transformer ground electrode conductors, etc.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience on projects with electrical grounding work similar to that required for project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.
2. ANSI Compliance: C119.4 Electrical Connectors,
3. UL Compliance: Comply with applicable requirements of UL Standards No.'s 467, Electrical Grounding and Bonding Equipment", and 869 "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Standard 486A-486B, "Wire Connectors and soldering Lugs for Use with Copper Conductors." UL Standard 486C "Splicing Wire Connectors" UL1059 "Terminal Blocks. Provide grounding and bonding products which are UL-listed and labeled for their intended usage.
4. IEEE Compliance: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.
5. NFPA Compliance: NFPA 70 National Electrical Code, NFPA 780" Standard for the Installation of Lightning Protection Systems"

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials and Components:

1. Provide electrical grounding and bonding system; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is installer's option. Where materials or components are not indicated provide products which comply with NEC, UL, and IEEE requirements and with established industry standards for those applications indicated.

2.2 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductors, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductors.
6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Rectangular bars of annealed copper 1/4 by 3 by 12 inches (6 by 76 by 300 mm) in cross section, unless otherwise indicated; with insulators.

2.3 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Mechanical Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts. Of type recommended by ABB (Blackburn/Color-Keyed) Installation Products, (Burndy) Hubbell Inc or equal.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Irreversible Compression Connectors: Use for connections to structural steel and for underground connections except those at test well. Install connection to ground rods. Comply with manufacturer's written recommendations and training. Must be factory filled with an oxide inhibitor and installed with manufacturers recommend dies. The die index must match the listed index for the connector. Use of a 14 Ton or larger hydraulic compression tool to provide correct circumferential pressure for compression connectors and index die numbers are properly indented. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code method to make visible indication that the connector has been adequately compressed on the ground conductor, ground rod or ground plate. Irreversible compression connectors may be used below grade, above grade and concrete incased applications. Of types recommended by ABB (Blackburn) Installation Products, Burndy (Hubbell Inc). or approved equal.

D. Welded Connectors: Exothermic-welding kits of types recommended by ABB (Furseweld) Installation Products, Burndy (Thermoweld) Hubbell Inc. Erico – nVent (Cadweld) (or approved equal) manufacturer for materials being joined and installation conditions. Exothermically welded connections are required on all grounding electrode conductors other than water pipes, all connections to building steel (connections to structural member), all grounding conductors run under the earth, connection to ground rods and in any case where grounding conductors are subject to a hostile environment.

1. The exothermic welding system furnished under these specifications shall meet the applicable requirements of IEEE80, Chapter 9, Section of conductors and joints.
2. Molds shall be made from graphite or other material that is so designed to provide an average life of not less than 50 exothermic welds under normal conditions. Molds shall bear permanent marking, indicating the name of the manufacturer, the mold model, the type and size of welding mixture compatible with the welding process, and the size of the conductor. Instructions detailing general safety information, and welding procedures shall be provided with each mold.
3. Starting material, if used, shall consist of aluminum and copper/copper oxide and iron oxides. It shall not contain phosphorous or any caustic, toxic or explosive substance. Weld metal used for grounding connections shall contain copper oxide, aluminum. Where welding is done in enclosed structures, the Erico Exolon smokeless system shall be used.

E. Exothermic connections are to be performed by manufacturer's trained personnel with a qualification and/or training certificate on file with the contractor.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No.10 AWG and smaller, and stranded conductors for No.8 AWG and larger, unless otherwise indicated.

B. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 1 inch (25 mm), minimum, from wall 6 inches (150 mm) above finished floor, unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.

C. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

D. Comply with IEEE C2 grounding requirements

1. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No.3/0 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits. The conduit shall not be acceptable as an equipment ground.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.

C. Protection:

1. All grounding electrode conductors smaller than #6 AWG shall be routed in conduit – EMT or Rigid/IMC if exposed to damage or weather.
2. All grounding electrode conductors #6 AWG and larger shall be routed in conduit – EMT or Rigid/IMC if exposed to weather.

D. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

E. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.3 EXAMINATION

A. Examine areas and conditions under which electrical grounding and bonding connections are to be made and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.4 INSTALLATION OF ELECTRICAL GROUNDING AND BONDING SYSTEMS

A. General: Install electrical grounding and bonding systems in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.

B. Coordinate with other electrical work as necessary to interface installation of electrical grounding and bonding system work with other work.

C. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

D. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96A when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment
3. Use exothermic-welded connectors or irreversible compression connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, each unit substation, or each main electrical room grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

I. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer’s published torque tightening values for connectors and bolts. Where manufacturer’s torquing requirements are not indicated, tighten connections to comply

with tightening torque values specified in UL 486A to assure permanent and effective grounding.

J. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

K. Install all connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.5 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this section:

1. "Electrical Requirements."

1.2 SUMMARY

A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

B. Related Sections: The following Sections contain requirements that related to this Section:

1. Division 3 Section "Mild Steel Concrete Reinforcement" for inserts, anchors, and sleeves to be installed in concrete for use with supporting devices.
2. Division 5 Section "Metal Fabrications" for requirements for miscellaneous metal items involved in supports and fastenings.
3. Division 7 Section "Firestopping" for requirements for firestopping at sleeves through walls and floors that are fire barriers.
4. Refer to Division 26 Sections for additional specific support requirements that may be applicable to specific items.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data for each type of product specified.

1. Hanger and support schedule showing manufacturer's figure number, size, spacing, features, and application for each required type of hanger, support, sleeve, seal, and fastener to be used.

C. Shop drawings indicating details of fabricated products and materials.

D. Engineered Design consisting of details and engineering analysis for supports for the following items:

1. Conduit (racked)
2. Ceiling-mounted boxes, transformers.
3. Conduit - Ceiling mounted, concrete encased.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code.”

B. Electrical components shall be listed and labeled by UL, ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

C. Installation shall comply with local authorities seismic requirements.

PART 2 - PRODUCTS

2.1 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized and where installed in corrosive atmosphere, stainless-steel type channel and hardware shall be used.

2.2 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.

B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads. Aircraft cable and other non-rigid supports shall not be permitted for use as supporting material for conduit.

C. Fasteners: Types, materials, and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type.
2. Toggle Bolts: All steel springhead type.

D. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.

E. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for nonarmored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.

F. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, at a minimum of 8 inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

2.3 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer’s recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs., provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.

4. Support parallel runs of horizontal raceways together on trapeze-type hangers. All supporting rods shall be rigid. Aircraft cable and other similar non-rigid cable shall not be used to support horizontal conduit.
5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 1/2 inch and smaller raceways serving lighting and receptacle branch circuits above suspended ceilings only. For hanger rods with spring steel fasteners, use ¼-inch diameter or larger threaded steel. Use spring fasteners that are specifically designed for supporting single conduits or tubing.
6. Space supports for raceway in accordance with NEC.
7. Support exposed and concealed raceway within 1 foot of an unsupported box and access fittings. In horizontal runs, supports at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples of threadless box connectors.
8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

D. Vertical Conductor Supports: Install simultaneously with installation of conductors (i.e., strain reliefs).

1. Support shall be at each individual conductor.

E. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

F. In open overhead spaces, cast boxes threaded to raceways need not be supported separately except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to the raceways on opposite sides of the box and support the raceway with an approved type of fastener not more than 24 inches from the box.

G. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and wall for raceways and cable installations. For sleeves through fire-rated wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables in accordance with “Fire Stopping” requirement of Division 7.

H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable

trays, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions or light steel construction, use sheet metal screws.
2. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

J. TESTS: Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:

1. Expansion anchors.
2. Toggle bolts.

K. Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Engineer's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. Requirements of the following Division 26 Sections apply to this Section:

1. "Electrical Requirements."
2. "Basic Material and Methods"

1.2 SUMMARY

A. Drawings are diagrammatic. All bends, boxes, fittings, couplings are not necessarily shown. Supply as necessary to comply with the National Electric Code.

B. Provide complete raceway systems for all conductors including control wiring and low-voltage wiring unless otherwise noted.

C. This Section includes raceways for electrical wiring. Types of raceways, boxes and fittings in this section include the following:

1. Electrical metallic tubing (EMT).
2. Flexible metal conduit.
3. Intermediate metal conduit (IMC).
4. Liquid-tight flexible conduit.
5. Rigid metallic conduit (RMC).
6. Metal clad cable (MC).
7. Surface raceways.
8. Rigid non-metallic conduit.
9. Electrical non-metallic tubing (ENT)
10. Wireway.
11. Outlet boxes.
12. Junction boxes.
13. Pull boxes.
14. Bushings.
15. Locknuts.
16. Knockout closures.

D. Related Sections: The following section contains requirements that relate to this section:

1. Division 26 Section “Raceway and Boxes” for conduit connectors, fittings, and couplings.
2. Division 7 Section “Firestopping” for conduit penetrations through rated walls and slabs.

E. Section only applies for electrical systems to be installed within raceways. This excludes beverage piping and pneumatic systems pulled within raceways.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of contract and Division 1 Specification Section.

B. Product Data for the following products:

1. Raceways and fittings.
2. Wireways and fittings.
3. Boxes and fittings.

C. Installation Instructions: Manufacturer’s written installation instructions for wireway, surface raceway, and nonmetallic raceway products.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code.”

B. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.

C. UL Compliance and Labeling: Comply with applicable requirements of UL standards pertaining to electrical raceway systems. Provide raceway products and components listed and labeled by UL.

D. Manufacturers: Firms regularly engaged in manufacture of electrical boxes and fittings, of types, sizes, and capacities required, whose products have been in satisfactory use in similar service for not less than five years.

E. Installer’s Qualifications: Firms with at least five years of successful installation experience on projects utilizing electrical boxes and fittings similar to those required for this project.

F. NEC Compliance: Comply with NEC as applicable to construction and installation of electrical wiring boxes and fittings.

G. UL Compliance: Comply with applicable requirements of UL 50, UL 514-Series, and UL 886 pertaining to electrical boxes and fittings. Provide electrical boxes and fittings which are UL-listed and labeled.

H. NEMA Compliance: Comply with applicable requirements of NEMA Standards/Pub No.'s OS1, OS2 and PUB 250 pertaining to outlet and device boxes, covers and box supports.

I. Federal Specification Compliance: Comply with applicable requirements of FS W-C 586, "Electrical Cast Metal Conduit Outlet Boxes, Bodies, and Entrance Caps."

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: ANSI C80.1

B. PVC Coated Rigid Galvanized Steel Conduit: ANSI C80.1, UL6 & NEMA RN-1 2018

C. Intermediate Steel Conduit: UL 1242.

D. Electrical Metallic Tubing and Fittings: ANSI C80.3.

E. Flexible Metal Conduit: UL 1, zinc-coated steel.

F. Liquid-tight Flexible Metal Conduit and Fittings: UL 360.

2.2 METAL CLAD CABLE, TYPE MC

A. The multi-conductor metal clad cable shall comply with UL 1569 "Metal Clad, Type MC," UL 83 "Thermoplastic Insulated Wires and Cables" Federal Specification J-C-30B "Wire and Cable," Local and National Electrical Codes.

B. The metal clad cable shall be THHN insulation, copper conductors in sizes #12 through #8 AWG only for continuous operation at a maximum conductor temperature of 90 degree C dry.

C. These cables shall bear appropriate Underwriters Laboratories labels for metal clad cable and be suitable for use as branch circuits in both exposed and concealed work in accordance with applicable sections of the National Electrical Code.

D. An insulated grounding conductor sized in accordance with Table 5.3 Underwriter's Standard UL 1569 shall be cabled with the circuit conductors and shall be identified in compliance with Section 29 of UL 1569. The grounding conductor shall not be smaller than size indicated in NEC Article Table 250.122.

E. A galvanized steel or aluminum armor shall be applied over the inner cable assembly with a positive interlock in compliance with Section 10 of UL 1569. MC cable with a PVC jacket shall not be permitted to be installed in slabs.

2.3 CONDUIT BODIES AND FITTINGS

A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching gasketed covers secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways.

C. EMT Conduit Bodies 1 Inch and Smaller: Use bodies with steel set screw connectors and couplings for interior applications and steel compression gland connectors and couplings for exterior applications.

D. EMT Conduit Bodies 1 Inch and Larger: Use bodies with steel set screw connectors and couplings for interior applications and steel compression gland connectors and couplings for exterior applications.

E. Nonmetallic Conduit and Tubing: Use nonmetallic conduit bodies conforming to UL514B.

F. PVC Coated RGS Conduit Bodies: Conduit bodies shall have a nominal 40mils of PVC and 2mils of interior urethane and shall be NEMA 4X listed with encapsulated stainless-steel screws.

G. Liquid-Tight Flexible Conduit Fittings: With threaded grounding cone, steel, nylon or equal plastic compression ring, and a gland for tightening. Either steel or malleable iron only with insulated throats and male thread and locknut or male bushing with or without O-ring seal. Each connector shall provide a low resistance ground connection between the flexible conduit and the outlet box, conduit or other equipment to which it is connected.

H. Bushings: Insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system, for rigid steel conduit, IMC and EMT, larger than 3/4” size.

I. Expansion Fittings: Each conduit that is buried in or secured to the building’s construction on opposite sides of a building expansion joint and each long run of exposed conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings for rigid steel conduit shall be hot-dipped galvanized malleable iron with factory installed packing and a grounding ring and internal bonding jumper. Expansion fittings for rigid non-metallic conduit shall be of the short type in runs 25’ or less, and the long type in runs 26’ to 80’. The long type shall be a two-piece barrel and piston joint, providing 6” of the total movement range in 3/4” through 6” conduit sizes. The short type shall be a one piece, coupling with O-ring, providing 2” of total movement range in 3/4” to 2” conduit sizes.

J. Seal Off Fittings: Refer to section 26 05 02 for additional requirements.

K. Sleeves for Conduit Penetration: Refer to section 26 05 02 for additional requirements.

2.4 WIREWAYS

A. General: Electrical wireways shall be of types, sizes, and number of channels as indicated. Fittings and accessories including but not limited to couplings, offsets, elbows, expansion joints, adapters, hold-down straps, and end caps shall match and mate with wireway as required for complete system. Where features are not indicated, select to fulfill wiring requirements and comply with applicable provisions of NEC.

B. Wireway covers shall be hinged type.

2.5 SURFACE RACEWAYS

A. General: Sizes and channels as indicated on drawings. Provide fittings that match and mate with raceway. Provide internal barriers for areas with power and communications sections.

B. Surface Metal Raceway: Construct of two-piece galvanized steel with snap-on covers, with 9/32-inch mounting screw knockouts in base approximately 8 inches o.c. Finish with manufacturer's standard prime coating suitable for painting. Provide raceways of types suitable for each application required. Sizes 1-3/4" H x 4-3/4" W.

C. Accessories:

1. Couplings for joining raceway sections.
2. Wire clips for conductors.
3. Blank end fittings.
4. Circuit breaker housings for single pole breakers.
5. Device brackets for single or two gang devices.
6. Combination receptacle and tele/data outlet covers.
7. Outlet boxes with hubs for conduit connectors.

2.6 FABRICATED MATERIALS - BOXES

A. Outlet Boxes: Provide galvanized flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes (minimum 4-inch square, 1 ½-inch deep), including box depths as required, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes

with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

1. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.

B. Device Boxes: Provide galvanized coated flat rolled sheet-steel non-gangable device boxes, of shapes, cubic inch capacities, and sizes (minimum 4-inch square, 1 ½-inches deep), including box depths as indicated, suitable for installation at respective locations. Construct device boxes for flush mounting with mounting holes, and with conduit-size knockout openings in bottom and ends, and with threaded screw holes in end plates for fastening devices. Provide conduit connectors and corrosion-resistant screws for equipment type grounding.

1. Device Box Accessories: Provide device box accessories as required for each installation, including mounting brackets, device box extensions, switch box supports, plaster ears, and plaster ears, and plasterboard expandable grip fasteners, which are compatible with device boxes being utilized to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer's code-compliance option.

C. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with spring-hinged watertight caps suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners.

D. Junction and Pull Boxes: Provide code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless-steel nuts, bolts, screws, and washers. Pull boxes installed in finished spaces must be flush-mounted cabinets provided with trim, hinged door and flush latch and lock to match flush-mounted panelboard trim. Provide galvanized code-gauge steel where required for outdoor exposure.

E. Exterior junction or pull boxes, flush with grade:

1. All exterior pull box locations shall be submitted and approved by landscape architect prior to installation.
2. Junction or pull box to be mounted flush with grade shall be polymer composite raintight with screw cover lids. Box dimensions shall be 30"W x 48"L x 36"D. Covers shall be polymer composite suitable for pedestrian traffic secured to box with stainless-steel screws. Box to be furnished with continuous neoprene gasket to seal cover. Conduit entry shall be on side of box with bell ends.

F. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Outdoors: Use the following wiring methods:

1. Exposed: Intermediate metal conduit, rigid steel conduit, raintight box.
2. Concealed: Intermediate metal conduit, rigid steel conduit.
3. Underground, Single Run: Rigid non-metallic conduit. PVC coated GRC 90° elbows.
4. Underground, Grouped: Rigid non-metallic conduit. PVC coated GRC 90° elbows.
5. Connection to Vibrating Equipment including transformers, pneumatic or electrical solenoid, and motor-operated equipment: Liquid-tight flexible metal conduit.

B. Indoors: Use the following wiring methods:

1. Exposed (below 10 ft. to floor): Intermediate metal conduit, rigid steel conduit.
2. Exposed (above 10ft. or in electrical room): Electrical metallic tubing.
3. Concealed: Electrical metallic tubing.
4. Concealed: Metal clad cable will be allowed as final branch wiring of receptacles (maximum total length of 25’ from homerun J-box or hard piped J-box to first outlet on circuit). MC is not allowed for homeruns to panels, connections to mechanical equipment. Maximum conductor size is in MC cable #8 AWG. MC is acceptable for final light fixture connection, maximum 6’ length.
5. Connection to Vibrating Equipment including transformers, pneumatic or electrical solenoid, and motor-operated equipment: Flexible metal conduit.
6. Connection to Vibrating Equipment in Moist/Humid or Corrosive Atmosphere including pneumatic or electric solenoid, and motor-operated equipment: Liquid-tight flexible metal conduit.
7. Within concrete slabs: Rigid non-metallic conduit. PVC coated MC cable and ENT is not allowed. Homeruns shall be in conduit. Maximum sizes and locations as approved by the Structural Engineer.
8. Raceway mounted to underside of metal-corrugated sheet roof decking shall be Rigid Metal Conduit or intermediate Metal Conduit.
9. Exposed Wet Locations: Intermediate metal conduit, rigid steel conduit, raintight box.

    a. Provide conduit bodies or exterior boxes with a minimum of 1/8” drain. Drain shall be located to allow exterior raceway system to drain.

10. Corrosive Environment, including areas where pool equipment is installed or areas where chemicals are stored: Rigid Metal Conduit, intermediate Metal Conduit, PVC fiberglass.

3.2 INSTALLATION OF RACEWAYS

A. General: Install electrical raceways in accordance with manufacturers' written installation instructions, applicable requirements of NEC, and as follows.

B. Electrical system layouts indicated on drawings are generally diagrammatic, but shall be followed as closely as actual construction and work of other trades will permit. Govern exact routing of raceways and locations of outlets by structure and equipment served. Take all dimensions from architectural drawings.

C. All home runs to panelboards are indicated as starting from the outlet nearest to the panel and continuing in the general direction of that panel. Continue such circuits to panel as though routes were completely indicated.

D. Avoid cutting and boring holes through structure or structural members wherever possible. Obtain prior approval of the Architect, and conform to all structural requirements when cutting or boring structure.

E. Furnish and install all necessary hardware, hangers, blocking, brackets, bracing, runners, etc., required for equipment specified under this Section.

F. Minimum size conduit shall be 3/4" for power circuits and 1" for telecommunications devices.

G. Conceal conduit and EMT, unless indicated otherwise, within finished wall, ceilings, and floors. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.

H. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.

I. Complete installation of electrical raceways before starting installation of conductors within raceways.

J. Provide supports for raceways as specified elsewhere in Division 26 and in accordance with NEC and local authorities' seismic requirements.

K. Prevent foreign matter from entering raceways by using temporary closure protection.

L. PVC coated rigid galvanized steel conduit systems: Provide onsite installation training course by company representative. The representative shall conduct onsite training course to qualify for the installation certificate. After the onsite training installation, the representative shall then register the installer in his data base and provide certification for installation.

M. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab. All elbow penetration through the slab shall be

PVC coated rigid metallic conduit Ells. Where elbows end below the slab, extend PVC coated rigid conduit a minimum of 6 inches above the finished slab.

N. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

O. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.

P. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.

Q. Raceways embedded in slabs shall only be permitted with the strict written approval of the Structural Engineer and Architect. For bidding purpose, conduit shall not be permitted in slab.

R. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. All exposed conduit runs shall be approved by the Architect prior to installing.

S. All exposed conduits in public areas shall be painted to match surrounding walls. Verify exact color with the Architect. Coordinate painting of all exposed conduits with Construction Manager / General Contractor.

T. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways are of the same size. In other cases, provide field bends for parallel raceways. All exposed conduit routing shall be approved by the Architect prior to installing.

U. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Use expansion fittings at building expansion joints.

V. Tighten set screws of threadless fittings with suitable tool.

W. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside of the box. All conduit connections to junction boxes shall have insulated bushings.

X. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

Y. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave no less than 12 inches of slack at each end of the pull wire.

Z. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Fitting should come complete with O-ring gasket. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

1. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces, air-conditioned spaces and walk-in coolers.
2. Where required by the NEC.

AA. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit may be used 6 inches above the floor. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs flush with floor.

BB. Flexible connection: Use length (maximum of 6 ft.) of flexible conduit for recessed and semi-recessed lighting fixtures, for equipment subject to vibration, noise transmission, or movement; and for all motors. Use liquid-tight flexible conduit in wet locations. Install separate equipment grounding conductor across flexible connections.

CC. Install nonferrous conduit or tubing for circuits operating above 60 Hz.

DD. PVC externally coated rigid steel conduit: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit.

EE. All underground conduits shall be installed a minimum of 48 inches below finish grade for medium-voltage feeders and 30 inches for 480-Volt feeders. All other conduits shall be installed in accordance with the NEC and coordinated depth with other trades.

FF. Grounding: Install a separate green equipment grounding conductor in all raceways from the panelboard/junction box supplying the raceway to the receptacle or equipment ground terminals. Conduits will not be permitted as a ground conductor.

GG. Clearances: All electrical raceways shall be routed to maintain appropriate clearances from low-voltage raceways per NEC, ANSI/EIA/TIA, and BICSI requirements. Provided below are minimum requirements of key components that shall be maintained. For any instances where

field conditions do not allow for the minimum clearances, the Contractor shall notify the Architect and Engineer so that an acceptable solution can be coordinated.

1. 120V Power Conduits: 6 inches (150mm)
2. 208V and Higher Power: 24 inches (600mm)
3. Lighting System: 12 inches (300mm)
4. Transformers: 48 inches (1200mm)
5. Motors and Fans: 48 inches (1200mm)
6. Other Interfering Sources to be field verified and coordinated by Contractor with Architect and Engineer.

HH. Support: All electrical raceways shall be independently supported. Support from suspended ceiling elements is not permitted.

3.3 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

B. Dimensions unless shown on drawings are given below and are from finished floor to center line of outlets unless noted otherwise. Adjust heights of outlets in masonry walls to correspond with consistent brick or block course. Outlets in block walls shall be installed in core of block.

Wall Switches	4' - 0" (to top of box)
Convenience outlets	1' - 4" (to bottom of box) – gyp or 8" block
	1' – 6" (to bottom of box) – 6" block
Panelboards wall mounted	6' - 6" (to top of back box)
Wall phone outlet	4' - 0" (to top of box)
Fire alarm horns, speakers	ceiling or wall
Fire alarm pull stations	4' - 0" (to top of device)
Fire alarm strobes	6' - 8" or 6" below ceiling (whichever is lower)

Confirm final location and heights of all outlets, wall switches, and television outlets with architectural drawings and furniture plans prior to installation.

C. Exact location of outlets and equipment shall be governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to room layout and will not interfere with other work or equipment. Verify final location of all outlets, panels, equipment, etc., with the Architect/Engineer.

D. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

E. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4" octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8" no-bolt fixture studs. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Outlet boxes in finished ceilings or walls shall be fitted with appropriate covers, set to come flush with the finished surface. Where more than one switch or device is located on one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted.

F. Provide tile box or a 4" square box with tile ring in masonry walls which will not be plastered or furred, or where "dry-wall" type materials are applied. Through the wall type boxes are not permitted. Install minimum 12" lateral separation for back to back boxes.

G. Provide outlets in rain tight box with metallic "in use" covers for interior and exterior locations exposed to weather or moisture.

H. Provide rain tight box for all interior, exterior and non-conditioned locations exposed to weather or moisture. This includes boxes located under overhangs not directly exposed to moisture.

I. Surface-mounted devices are to be mounted in cast type boxes with gasketed covers: (Crouse-Hinds FS/FD or equal).

J. Provide knockout closures to cap unused knockout holes where blanks have been removed.

K. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

L. Electrical Contractor to provide access panels for electrical boxes which are code required to have accessibility.

M. Installing boxes back-to-back in walls shall not be permitted. Provide no less than 12 inches (150 mm) of separation.

N. Position recessed outlet boxes accurately to allow for surface finish thickness.

O. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surfaces.

P. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embedded electrical boxes in concrete or masonry.

Q. Provide electrical connections for installed boxes.

R. Exterior junction or pull boxes shall be mounted flush with grade, unless noted otherwise or indicated to be above ground on the drawings. Boxes shall be surrounded on all sides with

6 inches minimum of concrete. Top of concrete shall flush with grade. Seal all conduit entries into box with duct seal to prevent entrance of moisture, after conductors are installed.

S. Tap and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates and moisture seals the connection. Kit shall consist of the appropriate size and type mold, encapsulating resin and end sealing tape.

T. Subsequent to installation of boxes, protect boxes from construction debris and damage.

U. Provide a standard access panel having a hinged metal door neatly fitted into a flush metal trim, where a junction box or equipment is located above non-accessible ceilings or behind finished walls. Coordinate location and type with the Architect.

V. Outlets except over counters, benches, special equipment, baseboards, fin tube radiators, etc., or at wainscoting, shall be at a height to prevent interference to service equipment, or as noted on drawings.

3.4 GROUNDING

A. Upon completion of installation work, properly ground electrical boxes and demonstrate compliance with requirements.

3.5 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris. Swab all raceways that were not sealed or subject to water infiltration during construction.

END OF SECTION 26 05 33

SECTION 26 05 48 - VIBRATION AND SEISMIC CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Furnish and install vibration control devices, materials, and related items. Perform all work as shown on the drawings and as specified herein to provide complete vibration isolation systems in proper working order.

1.2 MATERIAL AND EQUIPMENT

A. All vibration isolation mounts shall be supplied by one of the approved manufacturers stated in the PRODUCTS Section of this specification. Substitutions of equal equipment beyond the alternatives listed will be permitted only with the written permission of the Architect. Accompany each request for acceptance of substitute equipment with manufacturer's certified data proving the equivalence of the proposed substitute in quality and performance. The Architect shall be the final judge of the validity of the data submitted.

B. Unless otherwise specified, supply only new equipment, parts, and materials.

1.3 SUBMITTALS

A. Refer to related sections elsewhere for procedural instructions for submittals.

B. The shop drawing submittal for isolated electrical equipment shall include submittal information for the isolation mounts. Information supplied shall be as follows:

1. A complete description of products to be supplied including product data, dimensions, specifications, and installation instructions.
2. Detailed selection data for each vibration isolator supporting equipment, including:

    a. The equipment identification mark.
    b. The isolator type.
    c. The actual load.

3. Routt County is currently identified as a Seismic Category C. Provide seismic bracing/support for applicable building(s) with an importance factor above 1.0 as defined by the IBC. Detailed selection data for seismic restraints for buildings including:

    a. Submit manufacturer's data for all manufactured restraints.
    b. All submittals shall be stamped and certified by a Structural Engineer registered in the State of Colorado with a minimum of 5 years experience in the design of seismic restraints.
    c. Submit shop drawings for all fabricated restraints.
    d. Show restraint type and location on the installation shop drawings. Drawings to include:

        1) All seismic brace locations.
        2) All seismic restraint connections to structure and vertical support anchorage at seismic locations and all other vertical support anchorage connections. Including but not limited to Quantity, Size, and Embedment.
        3) Brace reaction at all connection points to the structure for Structural Engineer of Record use in checking suitability of the building structure.
        4) Type and size of brace member.
        5) Suspended utility maximum lbs. per linear foot or maximum conduit size at all seismic locations.
        6) Minimum all thread rod size at all seismic locations.
        7) Size all horizontal support members taking into account, but not limited to, deflection and load.
        8) Registered Colorado Engineer stamp and signature.

    e. Submit calculations for all seismic restraint systems that are not preapproved.
    f. Job site conditions not covered by the manufacturer's seismic bracing guidelines shall be engineered by the manufacturer.

C. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job. All costs associated with submission of samples shall be borne by the Contractor.

1.4 QUALITY ASSURANCE

A. Coordinate the size, location, and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

B. Provide vibration isolators of the appropriate sizes and proper loading to meet the specified requirements.

C. Supply and install any incidental materials needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim for additional payment.

D. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

E. Should any electrical equipment cause excessive noise or vibration, the Contractor shall be responsible for remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

F. Upon completion of the work, the Architect or Architect's representative shall inspect the installation and shall inform the installing contractor of any further work that must be completed. Make all adjustments as directed by the Architect that result from the final inspection. This work shall be done before vibration isolation systems are accepted.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION MOUNT TYPES

A. Type DNP (Double Neoprene Pad):

1. Neoprene pad isolators shall be formed by two layers of ¼" to 5/16" thick ribbed or waffled neoprene, separated by a stainless-steel or aluminum plate. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.
2. Type DNP isolators shall be formed from one of the following products or approved equal:

Type NR	Amber/Booth
Type Korpad	Korfund Dynamics
Type WSW	Mason Industries
Type NPS	Kinetics Noise Control
Series Shear Flex	Vibration Mountings & Control

B. Type HN (Hanger Neoprene):

1. Vibration isolation hangers shall consist of a neoprene-in-shear or glass fiber element contained in a steel housing. A neoprene neck bushing (or other element) shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30° arc before contacting the hanger housing.
2. Type HN isolators shall be one of the following products or approved equal:

Type BRDA	Amber/Booth
Type H	Korfund Dynamics
Type HD	Mason Industries

Type RH or FH	Kinetics Noise Control
Type RHD or RFD	Vibration Mountings & Control

2.2 FLEXIBLE ELECTRICAL CONNECTIONS

A. Type A:

1. Flexible Electrical Connection Type A shall be a prefabricated unit incorporating a flexible and watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wireway, and end hubs with tapered electrical threads to fit standard threaded rigid metal conduit.
2. Flexible Electrical Connection Type A shall be Crouse-Hinds (Syracuse, NY) "XD Expansion/Deflection Coupling," Spring City Electrical Mfg. Co. (Spring City, PA) "Type DF Expansion and Deflection Fitting," or approved equal.

B. Type B:

1. Flexible Electrical Connection Type B shall be field fabricated using a minimum 2 (two) foot length of flexible conduit or cable.

C. Type C:

1. Flexible Electrical Connection Type C shall be field fabricated using a minimum 4 (four) foot length of flexible conduit or cable.

PART 3 - EXECUTION

3.1 APPLICATION

A. Transformers, Unit Substations, and Uninterruptible Power Supplies (UPS):

1. Transformers, Unit Substations, and UPS devices within the building construction shall follow the following table:

Transformers	Base Type	Isolator Type	Static Defl (in.)	Mason Industries Type
Suspended – 45 to 350 kVA	Trapeze	Spring	1	30N
Suspended – Less than 45 kVA		Neoprene	0.05	W

2. Electrical connections to isolated transformers and UPS devices shall be made using flexible electrical connections Type A or Type B.

B. Mechanical Equipment:

1. Electrical connections to vibration isolated mechanical equipment shall be made using flexible electrical connections Type A or Type C.

3.2 INSTALLATION

A. General:

1. In all cases, isolated electrical equipment shall be positioned so that it is free standing and does not come in rigid contact with the building structure or other systems.

B. Isolation Mounts:

1. All mounts shall be aligned squarely above or below mounting points for the supported equipment.
2. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plate shall rest entirely on the pad.
3. Hanger rods for vibration isolated supports shall be connected to structural beams or joists, not to the floor slab between beams and joists. Provide suitable intermediate support members as necessary.
4. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360° about the rod axis without contacting any object.

C. Flexible Electrical Connections:

1. Type C connections shall be installed in a grossly slack “U” shape or a 360 loop.
2. Rigid conduit on the isolated-equipment side of the flexible connection, and the flexible connection itself, shall not be tied to the building construction or other rigid structures.

3.3 SEISMIC REQUIREMENTS

A. Brace all electrical systems and items of equipment to withstand lateral and vertical forces that result from earthquakes. Refer to Part 1 of this section.

B. Provide slack cable restraints and bracing for conduit and cable trays as follows:

1. Conduit 2-1/2” in Diameter and Larger: Shall be braced per IBC.
2. Conduit Smaller than 2-1/2” in Diameter: Comply with IBC requirements, including flexible connections between component and the conduit.
3. Cable Trays with Weights Greater than 10 lbs/ft: Shall be braced per IBC.

C. All electrical equipment and systems shall be provided with restraints and anchors adequate to withstand the applicable force factors per the International Building Code.

D. Anchors and Equipment:

1. Calculations: Calculations shall be certified by a Structural Engineer registered in the State of Colorado with experience in the design of seismic restraints.

E. For conduits crossing seismic separations, provide approved fittings that permit horizontal expansion and vertical and angular deflection. Selection of fitting to be based on the dimension of the separation and conduit size.

3.4 SEISMIC REQUIREMENTS FOR LIGHTING FIXTURES

A. Pendant Light Fixtures: Provide approved seismic fixture suspension allowing for 45° swing in all directions without impacting adjacent obstruction or structure. For stem-mounted fixtures, provide approved seismic ball aligners at fixture and outlet box, and 9-gauge steel wire in each stem and with the circuit conductors, continuous from the fixture housing, through the outlet box, and attach directly to the structure above. Do not use ceiling construction to directly support the fixture. Within the fixture housing, provide a mechanically crimped cable loop and secure to the housing with a closed eyebolt nut and lockwasher. At the structure above, provide a cable loop and closed eye threaded lag screws and steel wedge drilled anchors. Level and adjust fixtures and remove cable slack before attaching to the fixture housing.

1. Where pendant fixtures are indicated to be cable supported, provide 3/32” (minimum) stainless-steel aircraft cables, cable to rod swivel adapters, 1/4–20 rod extensions above the ceiling to the structure. Brace the rod seismically with a rod fitting and (3) 12-gauge steel wires extended from the rod to the structure at 1200 angles.
2. If a 45º swing cannot be achieved, brace fixtures to prevent contact with the adjacent obstruction or structure. All fixture suspension assemblies to be State of Colorado approved.
3. Submit a sample of the seismic ball aligner and details of the cable attachments and assemblies with the fixture shop drawing submittal.

B. Fixtures Installed In or On a Suspended Acoustical Ceiling System:

1. As a minimum, all lighting fixtures shall be positively attached to the suspended ceiling system. The attachment device shall have a capacity of 100% of the lighting fixture weight acting in all directions.
2. In addition to the ceiling system support methods required by code, because the ceiling system is supporting light fixtures, provide (2) 12-gauge steel hanger wires from diagonal corners of the fixture housing to the structure above for fixtures weighing less than 56 pounds.
3. Lighting fixtures weighing 56 pounds or more shall be supported directly from the structure above by approved hangers. Do not use the ceiling suspension system to directly support the fixture.
4. Pendant hung lighting fixtures shall be supported directly from the structure above with 9-gauge steel wire, or an approved equivalent. Do not use the ceiling suspension system to directly support the fixture.

5. Attach surface-mounted fixtures to main runners with a minimum of two approved clamping devices, 14-gauge minimum, and support each clamp from the ceiling structure with 10-gauge wire.

END OF SECTION 26 05 48

SECTION 26 05 53 - IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this Section:

1. "Electrical Requirements."

1.2 SUMMARY

A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:

1. Buried electrical line warnings.
2. Identification labeling for raceways, cables, and conductors.
3. Operational instruction signs.
4. Warning and caution signs.
5. Equipment labels and signs.

B. Related Sections: The following Sections contain requirements that relate to this Section.

1. Division 9 Section "Painting" for related identification requirements.
2. Division 26 Section "Electrical Power Conductors Cables" for requirements for color coding of conductors for phase identification.

C. Refer to other Division 26 Sections for additional specific electrical identification associated with specific items.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Schedule of identification nomenclature to be used for identification signs and labels.

D. Samples of engraved, plastic laminate to be used on switchgear, switchboards, disconnect switches and panelboards.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

B. ANSI Compliance: Comply with requirements of ANSI Standard A13.1, "Scheme for the identification of Piping Systems," with regard to type and size of lettering for raceway and cable labels.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION PRODUCTS

A. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape not less than 3 mil thick by 1 inch to 2 inches in width.

B. Underground Line Marking Tape: Permanent, bright-colored, continuous-printed, plastic tape with magnetic tracer strip not less than 6-inches wide by 4-mil thick. Printed legend indicative of general type of underground line below.

C. Wire/Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wrap around, cable/conductor markers with preprinted numbers and letters.

D. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for sign up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in black letters on white face for normal power and white letters on red face for emergency and standby power. Plastic laminate shall be punched for mechanical fasteners. Refer to details on drawings for exact information requirements.

E. Baked-Enamel Warning and Caution Signs for Interior Use: Preprinted aluminum signs, punched for fasteners, with colors, legend, and size appropriate to the location.

F. Exterior Metal-Backed Butyrate Warning and Caution Signs: Weather-resistant, non-fading, preprinted cellulose acetate butyrate signs with 20-gage, galvanized steel backing, with colors, legend, and size appropriate to the location. Provide ¼-inch grommets in corners for mounting.

G. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless-steel screws or number 10/32 stainless-steel machine screws with nuts and flat and lock washers.

H. Cable Ties: Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a temperature range from minus 50°F to 350°F. Provide ties in specified colors when used for color coding.

I. Electronic Labels: Self-adhesive, 3/16-inch-industrial label, black on clear for normal circuits and red on clear for emergency/standby circuits. Acceptable manufacturers include the following:

1. Brother
2. Kroy

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

3.2 IDENTIFICATION

A. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Also, label box covers with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels at concealed boxes.

B. Underground Electrical Line Identification: During trench backfilling, for underground power, signal, and communications lines, install continuous underground plastic line marker, located directly above line at 6 to 8 inches below finished grade. Where multiple lines installed in a common trench or concrete envelope do not exceed an overall width of 16 inches; install a single line marker.

C. Install line marker for underground wiring, both direct-buried and in raceway.

D. Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be painted with colors

indicated below. Make each color band 2 inches-wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Apply the following colors:

1. Fire Alarm Systems: Red.
2. Fire Suppression Supervisory and Control System: Red and Yellow.
3. Mechanical and Electrical Supervisory System: Green and Blue.
4. Telephone System: Green and Yellow
5. Tag or label conductors as follows:

    a. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and intent.
    b. Multiple Circuits: Where multiple branch circuits or control wiring or communications/signal conductors are present in the same box or enclosure label each conductor or cable. Provide label on each box indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
    c. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facilities' electrical installations.

E. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

F. Conductor Color Coding: Provide color coding for secondary service, feeder, and branch circuit conductors throughout the project secondary electrical system as follows:

208/120-Volts	Phase	480/277-Volts
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray
Green	Ground	Green

G. Use conductors with color factory-applied the entire length of the conductors except as follows:

1. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG:

    a. Apply colored, pressure-sensitive plastic tap in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply

the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.

b. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

2. All grounded conductors No. 6 AWG and smaller shall be a factory applied color across the entire length of conductors.

H. Power Circuit Identification:

1. Securely fasten wrap-around marker bands to cables, feeders, and power circuits in pull boxes, junction boxes, and switchgear rooms.

I. Apply warning, caution, and instruction signs and stencils as follows:

1. Install warning, caution, or instruction signs where required by NEC where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items.
2. Emergency Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
3. Arc Flash Labels: All electrical equipment shall be marked with a label consisting of the following information:

    a. Nominal voltage.
    b. Available fault current at the equipment.
    c. Clearing time.
    d. Arc flash hazard boundary.
    e. Flash hazard at 18”.
    f. PPE (Personnel protective equipment) level.
    g. Distance of limited approach.
    h. Distance of restricted approach.
    i. Distance of prohibited approach.
    j. Date label is applied or calculations were performed.

J. Install equipment/system circuit/device identification as follows:

1. Apply equipment identification labels of engraved plastic-laminate on each major unit for electrical equipment. This includes communication/signal/alarm system, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated,

provide single line of text, with 3/8-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), black lettering in white field for normal power and red lettering on white field for emergency and standby power. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment:

a. Panelboards, electrical cabinets, and enclosures.

1) Labels shall include at a minimum: voltage, phase, ampacity, AIC rating, available fault current (and when it was calculated) and where the equipment is fed from. **Refer to detail on drawings for additional information.**

b. Access doors and panels for concealed electrical items.
c. Electrical switchgear and switchboards.

1) Labels shall include at a minimum: voltage, phase, ampacity, AIC rating, available fault current and where the equipment is fed from. **Refer to detail on drawings for additional information.**

d. Motor starters, motor control centers.
e. Pushbutton stations.
f. Power transfer equipment.
g. Contactors.
h. Remote-controlled switches.
i. Dimmers.
j. Control devices.
k. Transformers.

1) Include on label, location of primary overcurrent protection device.

l. Power generating units.
m. Telephone switching equipment.
n. Fire alarm master station or control panel.
o. Lighting control panel.
p. Static uninterruptable power supply

2. Apply electronic label on the outside of all receptacle and switch plates in all back of house spaces. Label shall be on the inside of the cover plate where exposed to the public. The labels shall identify circuit and panelboard.
3. All emergency circuits shall be permanently marked as emergency as indicated below:

a. Junction Boxes – with permanently fastened labels.
b. Raceways – with permanently fastened labels at intervals of not more than 25ft.

K. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power

distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification (including room numbers) of items controlled by each individual breaker.

L. Fire Pump Service Identification: A placard shall be externally installed on the Fire Pump primary disconnecting means stating, “Fire Pump Disconnecting Mean.” The lettering shall be at least one inch in height. In addition, a placard shall be placed adjacent to the Fire Pump controller stating the location of this disconnecting means and the location of the key (if the disconnecting means is locked).

M. Electrical Service Room Distribution Placard: In each of the main electrical rooms, provide a single line riser diagram placard of the entire electrical distribution fed from that room. The placard shall also identify where other services are located per NEC 230.2(e). The riser diagram shall be framed under glass and mounted on the wall in the electrical room. The print shall be of diffusion transfer process to eliminate fading.

END OF SECTION 26 05 53

SECTION 26 09 43 - LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections apply to work of this section.

B. Requirements of the following Division 26 Sections apply to this section:

1. Basic Materials and Methods
2. Lighting Fixtures

C. Refer to lighting control drawings for operational intent of the following:

1. Lighting control matrix on drawings for operational intent and device requirement.
2. Typical control diagrams and details.
3. Equipment layout and quantity.

1.2 SUMMARY

A. Provide a complete and coordinated network lighting control system with distributed nodes as well as stand-alone room control system.

B. The drawings and specifications indicate control intent for building areas. Where control intent is indicated either on drawings or specifications for a building area, the contractor shall provide that control feature to the entire area, as applicable.

C. The exact quantity of product required (sensors, photocells, power packs, dimmer switches, relay panels, etc.) to meet the control intent, shall be determined by the manufacturer based upon the specific performance of the product. Where a revised quantity of product is required, the contractor shall furnish and install in coordination with the engineer and architect.

D. Types of lighting control equipment specified in this section includes but is not limited to the following:

1. Programmable relay panels
2. Touch screen control stations
3. I/O Modules
4. Power packs
5. Occupancy Sensors
6. Photo Sensors

7. Wall Controllers
8. Relay Control Panels
9. Distributed Room Controllers
10. UL924 Rated Devices
11. System Communications Wiring
12. Lighting Control Software
13. A customized software which calendar based (365 days) to provide building wide automatic/remote and manual lighting control for interior and exterior light fixtures.
14. Custom graphic control of plaza and ice rink lighting.

E. Refer to other Division 26 sections for wires/cables, raceways, electrical boxes and fittings, and wiring devices which are required in conjunction with lighting control equipment to perform work of this section.

F. The following outlines the areas of work to be controlled by this section.

1. General Lighting System Control

a. Interior Lighting: All corridors, restrooms, offices, storage rooms, laundry rooms, kitchens, etc.
b. Exterior Lighting: All pedestrian light poles, façade lighting, parking lot lighting, etc.
c. Dimming: All lobbies, conference rooms, dining areas, etc. shall be fully coordinated with the luminaire driver type for compatibility.
d. Advertising, graphic panels and wayfinding signage.
e. Local controls: Where denoted on drawings, local switching, dimming, and occupancy sensors shall be furnished and installed as shown on the drawings, as required by local energy codes, and operate independently of the lighting control system.
f. Daylight controls: all photocell control shall be seen as inputs to the lighting control system.

1.3 SUBMITTALS

Submittal documentation shall be furnished by the manufacturer for approval by the Engineer and must be approved in writing prior to shipment of any equipment from the manufacturer. Separate shop drawings shall be issued for different buildings covered in this scope. Each shall consist of:

A. Product Data: The manufacturer shall submit in a bill of material form an itemized list of all materials being supplied to meet the specifications.

B. Shop Drawings: Manufacturer shall submit plan drawings of all equipment/components, one-line diagram, relay/dimmer panel schedules, override dimmer/switch station schedules, and plan drawings with all device locations, including photocells, occupancy sensors, switch packs,

I/O modules, override dimmer/switch locations, and panel locations. Sensor coverage and quantity shall be provided as part of shop drawings.

C. Riser Diagram: Manufacturer shall submit a line diagram of the system configurations in sufficient detail to show the relative placement of all equipment and interconnection with equipment supplied by other manufacturers.

D. Wiring Diagrams: Manufacturer shall submit typical wiring diagrams for all components. Detailed interconnection diagrams are required only if proper interwiring of components is not clearly indicated on typical wiring diagrams.

E. Plan Drawings: Manufacturer shall submit hard copy color plan drawings showing the type and location of system components including photocells, occupancy sensors, switch packs, I/O Modules, etc. Sensor coverage and quantity shall be verified prior to the preparation of these drawings.

F. Product Overview: Manufacturer shall submit data sheets on all components of the system. These shall describe all hardware and software items provided. A detailed line by line specification compliance shall also be included. The software shall identify the process for programming repeating time schedules.

G. Driver/Lamp Coordination: The contractor shall submit to the manufacturer a complete matrix of all fixture drivers being controlled on the project and their associated control requirement. The manufacturer shall review this list for compatibility with their system components, approve, and provide this matrix in the submittal.

H. Copies: Manufacturer shall provide the quantity of submittals as required by Division 1, “Submittals”.

I. Graphics Screens: Manufacturer shall submit graphic screen layouts as part of a two-step approval process.

1. Contractor shall obtain and provide the manufacturer with current CAD drawings / reflected ceiling plans within 90 days of contract award for development of the graphic screens.
2. Contractor shall obtain and provide the manufacturer with the latest electronic CAD or Revit files for use in creating colored lighting control zone drawings. Colored lighting control concept drawings are available from the design team.
3. Initial Graphics Submittal: Manufacturer shall submit initial graphic screen layouts based on the requirements of this project a minimum of six months prior to substantial completion. Sample graphic screens from other projects are not acceptable.
4. Final Graphics Submittal: Manufacturer shall submit final graphic screen layouts a minimum of 60 days prior to substantial completion.

J. Maintenance Manuals: Furnish maintenance manuals which contain equipment cuts, operating instructions, troubleshooting procedures, and spare parts list for equipment. Ensure manual

includes operating instructions in addition to instructions for maintenance of the system's software package.

K. Service and Support Requirements: Provide the following for owner support and maintenance purposes after project completion and turnover.

1. Phone Support: Toll free technical support shall be available.
2. Remote Support: The bidder shall offer a remote support capability.
3. Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
4. Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The manufacturer shall provide a complete energy saving lighting control system capable of functioning and performing as required by these specifications and the plan drawings. It is the sole responsibility of the Electrical Contractor to ensure that all equipment meets the specifications.

B. Approved manufacturers: n-light, Lutron, Crestron, or approved equal.

C. Sensors shall be of the same or directly compatible manufacturer as the lighting control system.

D. Installer's Qualifications: The lighting control manufacturing firm shall have a minimum of 5 years of successful installation experience on projects with lighting control equipment work similar to that required for this project.

E. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction and NEC as applicable to construction, installation of lighting control equipment.
2. UL Compliance: Comply with applicable requirements of UL standard 486A, "Wire Connectors and Soldering Lugs for Use with Copper Conductors". Provide lighting control equipment and components which are UL-listed and labeled. Any custom cabinets that may be required shall be assembled by a U.L. listed panel shop that is approved for building industrial panels. Each panel shall bear a U.L. label detailing all requirements for industrial panel fabrication.
3. NEMA Compliance: Comply with applicable requirements of NEMA's Standard Pub No. 250, "Enclosures for Electrical Equipment (1000-Volts Maximum)".
4. All lighting control equipment shall be in compliance with FCC Emission Standards specified in Part 15 Subpart J for Class A applications.

1.5 WARRANTY

A. Installation Warranty: A written warranty shall be supplied by the installing contractor agreeing to provide the labor and materials to replace any portion of the lighting control system equipment or wiring that fails due to materials or workmanship for a period of twelve months after substantial completion.

B. Manufacturer's Warranty: A written warranty shall be supplied by the manufacturer agreeing to replace any equipment that fails due to materials or workmanship for a period of 5 years.

C. Warranty Commencement: Warranty shall begin at the point of substantial completion of the system, which is defined as the date when commissioning and owner training has been completed and the Owner obtains beneficial use of the system.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver lighting control equipment and components in factory-fabricated type containers or wrappings, which properly protect equipment from damage.

B. Store lighting control equipment in original packaging and protect from weather and construction traffic. Wherever possible, store indoors; where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle lighting control equipment carefully to prevent physical damage to equipment and components. Do not install damaged equipment; remove from site and replace damaged equipment with new.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. System Architecture: The system shall utilize an independent lighting low-voltage communications network to communicate between system components (server, system processors, modules, wall switches, etc.). System shall operate independently of building data network infrastructure and shall not rely on owner or tenant supplied equipment for operation.

B. Network Components: The manufacturer shall provide all network components (routers, switches, gateways, repeaters, etc.) as required to provide a complete distributed network. Network components such as servers, network processors, and network switches shall be provided within wall-mountable enclosures. Where rack-mounted components are provided by the manufacturer, the contractor shall provide wall-mounted network cabinets to house components. The contractor shall coordinate locations of these components within electrical

rooms. Each cabinet shall be provided with a rack-mounted PDU with power conditioning to provide power to the network components.

C. Lighting Control Server: Manufacturer shall provide a server to operate the lighting control software. This server shall be integrated into the lighting control equipment cabinets or shall be a rack-mountable server. The server shall be accessed via a remote terminal or web interface.

D. Lighting Control Software: The System shall offer two, separate levels of PC interface: (1) personal lighting control for the average building occupant to control and adjust basic lighting functions in their workspace, and (2) central energy control for the lighting administrator to perform energy management, configuration maintenance, monitoring operations, and providing support to building occupants.

1. GUI: Shall provide a Windows graphical user interface.
2. Central Control: Energy Control Software interface shall provide current status and enable configuration of all System zones including selected individual module availability, current light level, maximum light level, on/off status, occupancy status and emergency mode status.
3. Reports: Energy performance reports shall be printable in a printer friendly format and downloadable for use in spreadsheet applications, etc.
4. Personal Lighting Controls: The Personal Control Software interface shall provide current status and enable each user with the ability to dim and brighten lights, and turn them on and off by module. The Software shall offer user configurable light scenes, which may be programmed and then selected via the Software. Personal lighting control shall be available in open office environments.

E. Dimmers and preset dimming lighting controls shall operate the following sources/load types with a smooth continuous Square Law dimming curve. Dimmers shall also be capable of operating these sources on a non-dim basis. Dimmers shall be electronically assigned to the appropriate load type/dimming curve and can be reassigned at any time. Universal-type dimmers that do not adjust the dimming curve shall not be acceptable.

1. LED Drivers: Drivers and control modules shall be fully compatible and tested to ensure intended working operation.

    a. 0-10V Dimming shall provide dimming to specified level as listed on drawings.
    b. Phase Dimming including leading edge (forward phase), and trailing edge (reverse phase).

2. Magnetic Low-Voltage Transformer

    a. Dimmer shall contain circuitry specifically designed to control and provide a symmetrical AC waveform to the input of magnetic low-voltage transformers.
    b. Dimmer shall not cause a magnetic low-voltage transformer to operate above the transformer’s rated operating current and temperature.
    c. Dimmer shall contain circuitry to control dioded lamps.

3. Electronic Low-Voltage Transformer

    a. No flicker or interaction shall occur at any point in the dimming range.
    b. For integral dimming, an interface shall be required.

4. Non-Dim/Switched Loads

F. Non-dim shall be rated to 16A of resistive, tungsten, induction, or capacitive loads. Non-dim shall incorporate an air gap relay to open circuit when load is off.

G. Daylight Harvesting (Light Regulation Averaging): In a photo sensor-equipped System, the system processors shall rationalize changes to light levels when ambient (natural) light is available and shall maintain a steady light level when subjected to fluctuating ambient conditions. System shall utilize light level inputs from common and/or remote sensor locations to minimize the number of photo sensors required. The System shall operate with multiple users in harmony and not react adversely to manual override inputs. Daylight harvesting shall not impede personal lighting control and the ability to adjust light levels on a per fixture basis.

H. Time Clock Scheduling: The System shall be programmable for scheduling lights on or off via the Energy Control Software interface.

1. Override: Manual adjustments and occupancy sensor detection shall temporarily override off status imposed by time clock schedule.
2. Response to Power Failure: In the event of a power failure, the time clock shall execute schedules that would still be in progress had they begun during the power outage.
3. Flick warning: Each load shall be programmable to provide a warning five minutes prior to a scheduled lights-off event or expiry of a temporary override, the System shall provide two short light level drops as a warning to the affected occupants.

I. BAC Net Communications Interface: Manufacturer shall provide the capability for communications with a BAC Net network. Contractor shall coordinate with the mechanical controls contractor to provide a complete interface to the BAC Net.

J. Load Shed Mode: An automatic load shedding mode shall be available where, when activated through the System, the control unit will reduce its output to a programmable maximum electrical demand load. The System shall not shed more load than required and load shedding priority shall be centrally configurable by light fixture. The individual user shall retain the ability to override System light levels.

K. Emergency Mode: There shall be a mode, when activated through the System, that will immediately adjust lights to full light output and retain that level until the mode is deactivated. This setting shall override all other inputs. The System shall interface with the building emergency monitoring system at a convenient point and not require multiple connections.

L. Addressing: I/O Modules shall be centrally addressable, through the Lighting Control Software. To simplify installation and maintenance, the System shall not require manual recording of addresses for commissioning or reconfiguration.

M. Programmable Task Tuning: Maximum light level programmability shall be available by individual module.

N. Unoccupied State: The System shall provide two states when occupancy status is vacant as per an occupancy sensor: lights turn off or lights adjust to configurable light level.

O. Occupied State: The System shall not isolate occupants by turning off lights that are still required for convenience and safety, such as a hallway path to exit the premises.

P. Firewall Security: System firewall technology shall maintain network security.

Q. Low-Voltage Wiring: Wiring shall be topology independent and not require splicing or termination. Prefabricated, quick connecting wiring shall be utilized. The maximum connected length of wiring shall be no less than 425 meters (1,400 feet) per channel.

R. Reconfigurability: The assignment of individual fixtures to zones shall be centrally configurable by Energy Control Software such that physical rewiring will not be necessary when workspace reconfiguration is performed. Removal of covers, faceplates, ceiling tiles, etc. shall not be required.

2.2 PANEL HARDWARE

Provide the quantity of factory assembled and tested panels to control the zones indicated on the drawings. Each panel shall consist of:

A. Lighting Control Relay Panels:

1. General

    a. Addressing: All lighting control panels shall be individually addressable via Energy Control Software.
    b. Communication: All lighting control panels shall communicate via the same prefabricated, quick connecting low-voltage wiring as all other devices.
    c. Wiring: Relay control panels shall be interconnected with any other devices on the same wiring loop.
    d. Control panels shall have a minimum of 24 relays.

2. Mechanical:

    a. Backbox: It shall be shipped separate from the remainder of the equipment to allow for rough in of all conduits. It shall be made of code-gauge steel and contain no knockouts. Labels shall indicate the areas restricted to low-voltage wiring.
    b. Chassis: It shall be pre-assembled and contain all relays, electronic and the power supply. The sheet metal chassis shall divide the panel into line voltage and low-voltage compartments.
    c. Trim: A surface-mounted trim shall be provided that is painted the manufacturer's standard color. The trim shall contain a window for viewing the status LED's inside the panel. It shall contain a hinged, lockable door that, when open, gives access only to the low-voltage portion of the panel, including the relay manual overrides. A directory card shall be attached to the rear of the door. All doors shall be keyed alike.
    d. Provide a multi-voltage power supply transformer that shall provide all power for the panel. A secondary On/Off switch shall be provided to disconnect the control power from the panel for maintenance purposes. Provide internal overcurrent protection.
    e. Relays: Each controlled circuit shall be connected through a single pole, single throw mechanically latching relay. A minimum of 48 relays shall be provided for each panel indicated on drawings. If more relays are required, provide additional 48 relay panels to accommodate the loads plus 20% spare.

        1) The relay shall contain a single solenoid coil that toggles the contacts to the opposite position with each operation.
        2) The relay shall have an actuator device to allow manual actuation of the contacts. Manual actuation shall function both with and without control power present at the relay.
        3) The relay shall provide a mechanical means of visual indication of the contact position.
        4) The main contacts shall be rated: 20A, 125 VAC Tungsten; 20A, 277 Ballast, 1.0 HP, 125 VAC: 1.5 HP, 250 VAC.
        5) Relays shall have a minimum short circuit current rating (SCCR) of 14,000 amps.
        6) Dual line and load terminals shall be provided for power wiring that will accept #10 - 14# AWG wires
        7) Auxiliary contacts shall be provided for pilot lights and feedback.
        8) Mechanical action shall be suitable for zero cross control.
        9) Control wires shall terminate in a modular connector that attaches to the chassis electronics.

3. Control Capabilities:

    a. Positive Load Feedback: The system shall continuously monitor the position of all loads to provide position indication. It shall alarm all unexpected changes of status and command failures.

b. Selectable Switch Inputs: Each switch input shall be user definable as one of 7 modes.

1) Maintained Input: The load is turned on when it closes, and turned off when it opens.
2) Momentary Input: The load toggles to the opposite state with each closure. No action is taken on opening.
3) Time Delay: The load turns on when the switch closes and remains on for the pre-programmed period of time, after which it automatically turns off.
4) Pulse Accumulator: When connected to an energy meter containing output pulse contacts, this input records the number of pulses received, corresponding to the amount of energy used.
5) External: This input is broadcast over the network. It allows loads in this panel and anywhere in the network to respond to a switch input.
6) Alarm: This input is a momentary input that causes an alarm to be raised at the operator's station and adds an entry into the alarm log each time it is operated.
7) Interlock: This input is used for cleaning crews. It will turn on its associated load. When the next interlocked load is activated, the previous one is turned off. Interlocked loads shall not cancel a time schedule or occupant override.

c. Memory Loss Protection: Programs loaded to automation cards shall be maintained in non-volatile memory, not subject to power outages.
d. Power Fail Recovery: The micro-processor shall operate whenever incoming power is with rated voltage tolerance. When incoming power fails, the micro-processor shall automatically halt program execution in a safe manner. Upon return of power, the micro-processor shall automatically reboot and return the system to normal operation. Any time schedule events that should have occurred during the power outage shall be automatically updated.
e. Real Time Clock: A digital clock shall be provided time of day, day of week and date. Automatic leap year adjustment and selectable daylight savings time adjustments shall be provided.
f. Astronomical Clock: The clock shall automatically calculate sunrise and sunset based on the date and geographic location. Selectable offset of 0 to 120 minutes before and after either sunrise or sunset shall be programmable.
g. Time Scheduling: Schedule capacity shall be large enough to allow the user to program a complete year of events with exact on/off times for relays. In addition, each of the up to 48 loads in each panel shall be able to be uniquely programming with any combination of up to 12 "On" or "Off" events per day. The scheduler shall utilize a 12 month calendar in which repeating schedules for events can be easily redefined in the calendar-based scheduling software.
h. Programmable Matrixing. All switch inputs shall be programmable to control any load or combination of loads even if they exist in different switch groups (group overlapping). Any switch input shall be able to control loads anywhere in the network. All programming changes shall be made via programming. No rewiring or switches shall be required to accomplish these functions.

i. Occupant Warning. Each load shall be programmable to provide a warning blink prior to each scheduled “Off” time. Once the warning has occurred, the occupant may cancel the upcoming “Off” command by operating a local override switch. The load shall remain “On” until expiration of the time out period, or another “Off” command is received. Occupant warning time shall be adjustable between 5 and 30 minutes.

j. Load Sequencing. Multiple loads shall not operate simultaneously, even when triggered by the same switch input or time schedule. Each load operation shall be staggered to reduce the inrush effects on the power system. Sequencing choices shall be 1, 5, 10, 15, 20, 30 or 60 loads per second.

k. Load Priority. To avoid unnecessary confusion to the users, the system shall use a “last action” priority scheme. Time schedules and switch input overrides shall each cancel the action of each other. Momentary and maintained switches operating on the same load shall also cancel each other’s actions.

B. Dimming Panels

1. Mechanical:

a. Panel shall be wall or floor mounted NEMA grade, constructed of sheet steel plates not less than #16 U.S gauge. Contractor shall reinforce wall as required for wall-mounted panels.

b. Panel shall be completely pre-wired by the manufacturer. The contractor shall be required to provide input feed wiring, load wiring, and control wiring. No other wiring or assembly by the contractor shall be permitted.

c. Unless otherwise indicated, panels shall contain branch circuit protection for each dimming module. Branch circuit breakers shall have the following performance characteristics:

1) Be U.L. listed under U.L. 489 as molded case circuit breaker for use on lighting circuits.
2) Contain a visual trip indicator and shall be rated at 10,000 AIC (120V) or 14,000 AIC (277V), unless otherwise noted.
3) Be thermal-magnetic in construction for both overload and dead short protection. The use of fully magnetic breakers shall not be acceptable, even when used in conjunction with individual dimmer thermal cutouts.
4) Be switched duty (SWD) rated so that the loads can be switched off via the breaker.

d. Panel shall be shipped with each dimmer in a BYPASS position via a jumper bar inserted between the input and load terminals. These jumpers shall carry the complete load current and shall be reusable at any time.

e. Panels shall be cooled via free-convection, unaided by fans, and capable of continuous operation to all of these Specifications within an ambient temperature range of 0°C (32°F) to 40°C (104°F).

f. Panel shall provide capability to electronically assign each circuit any zone in the dimming system. Panels using mechanical switches, rewiring, or EPROMS shall not be acceptable.
g. Multiple panels shall be capable of operating in one system, up to a maximum of 32 panels and 768 dimmers. Panels shall have the ability to control individual circuits without controls.
h. For panels fed with normal/emergency feeder, panel shall include electronics to bring all circuits to full on condition upon loss of normal power and subsequent presence of emergency power. Electronics shall switch both the intensity signal and the on/off signal of each dimmer connected to an emergency circuit between the local and a full-on constant drive supply. This type of emergency may be used with either a normal/emergency generator or a constant hot secondary utility feed where the emergency transfer occurs on the line side (upstream) of the dimming panel and requires only a single normal/emergency feeder.
i. Panels shall have the following additional characteristics:

    1) Be designed to prevent any foreign objects from coming into contact with any part of the panel which would be at an elevated temperature, such as the dimmer extrusions or heat fins.
    2) Be designed to provide airflow across the heat sink areas and through the dimmer chassis. Panel sections which provide airflow only across heat sinks shall not be mounted one above another in order to allow for adequate heat dissipation.

2. Dimming Modules

a. One type of modular dimming card shall be used for all sources. Systems requiring different types of modules or modular dimming cards shall not be acceptable.
b. A positive air gap relay shall be employed with each dimmer to ensure that the load circuits are open when the “off” function is selected at a control station. These relays need not be integral to the dimming module but must be integral to the dimming panel. Lighting control manufacturer shall provide necessary control interface(s) as part of the control system.
c. All dimmers shall be voltage regulated so that a nominal change in the voltage shall not cause a perceptible change in output voltage.
d. The silicon thyristors used to control the power furnished to the loads shall be both designed and tested to withstand surges, without impairment to performance, of 6000VA, 3000A (equivalent to near lightning strike) as specified by ANSI/IEEE Standard C62.41. Upon request, the manufacturer shall provide a means to demonstrate conformance to this specification using the appropriate surge-generation equipment.
e. Under full-load conditions in a 40°C environment, all silicon thyristors shall operate at minimum 20°C safely margin below the component temperature rating.
f. Filtering shall be provided in each circuit so that the current rise time shall be at least 400 μsec at 50% rated dimmer capacity as measured from 10-90% of the load current waveform at a 90° conduction angle, and at no point rise faster than

30mA/µsec. Manufacturers should note that additional filters may be required to meet this specification. These filters need not be integral to the dimming module, but must be integral to the dimming cabinet.

g. Dimmer output voltage shall be a minimum 95% of input voltage at maximum intensity setting.
h. Minimum and maximum light levels shall be user adjustable for each dimmer.

3. Integral Dimming

a. Preset dimming controls shall be capable of operating at rated capacity without adversely affecting design lifetime.
b. Preset dimming controls shall mount individually in standard 2, 3, or 4-gang U.S wall boxes.
c. Preset dimming controls shall operate in an ambient temperature range of 0°C (32°F) to 40°C (104°F).
d. Preset dimming controls shall incorporate an airgap switch, which shall be accessible without removing faceplate. The airgap switch shall be capable of meeting applicable requirements of UL 20 for airgap switches in incandescent dimmers.
e. Preset dimming controls shall meet IEC 801-2, tested to withstand 15kV electrostatic discharge without damage or loss of memory.
f. Preset dimming controls shall meet ANSI/IEEE Standard C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges up to 200A without damage.
g. Preset dimming controls shall meet the UL 20 limited short circuit test requirement for snap switches.
h. Preset dimming controls shall be voltage regulated.
i. Preset dimming controls shall utilize an LC filtering network to minimize interference with properly installed radio, audio, and video equipment.
j. Minimum light levels shall be user adjustable in order to compensate for different sources and loading.
k. Separate power booster/interface(s) shall increase dimmer capacity. Capacity shall range from 1000W/VA to 30,000W/VA. Quantities and size of each type of power booster shall be provided to control each type of load shown on the load schedule and/or the drawings.

C. Control Devices

1. Momentary Switches and Plates. Low-voltage override switches shall be provided where indicated on the plans.

a. Switches shall be an individual momentary push button per load group, providing toggle action, “On” only action or “Off” only action as required. Selection of action shall be program settable within the system and changeable at a later date if usage patterns change.

b. Switches shall be supplied with bi-colored LED pilot light for status. Provide red LED for off and green LED for on. Switch shall flash during the five minute sweep warning.
c. Up to six switches shall be mountable in a 2" deep single gang box. More switches shall be mountable in multiple gang boxes.
d. Metallic switchplates and style frames shall be provided. Color combination shall be approved by the Architect prior to fabrication.
e. Each zone button shall be labeled to clearly identify the zone being controlled.

2. Photo Controller. An exterior photo controller with exterior photocell shall be provided to control exterior zones.

   a. An exterior weatherproof photocell shall be mounted on the roof facing a northerly direction, away from other artificial sources of light.

3. ACLR (Automatic Control Load Relay) Interface to allow control of emergency lighting. Device to comply with UL924 listing requirements.
4. BCELTS (Branch Circuit Emergency Light Transfer Switch). Interface to allow control of phased dimmed emergency lighting. Device to comply with UL1008 requirements
5. Wall Box Dimmers

   a. All devices shall be UL listed specifically for the required loads (i.e., incandescent, fluorescent, low voltage, electronic low voltage). Manufacturer shall provide file card upon request. Universal dimmers shall not be acceptable.
   b. Manufacturer shall maintain ISO 9001 certification. Provide a copy of the certificate as part of the submittal.
   c. All dimmers and switches shall incorporate an air gap which shall be accessible without removing the faceplate. The air gap switch shall be capable of meeting all applicable requirements of UL 20 and UL 1472 for air gap switches in incandescent dimmers.
   d. All dimmers and switches shall provide power failure memory. Should power be interrupted and subsequently returned, the lights will come back on to the same levels set prior to the power interruption. Restoration to some other default level is not acceptable.
   e. Dimmers and switches shall meet ANSI/IEEE Standard C62.41-1980, tested to withstand voltage surges of up to 6000V and current surges of up to 200A without damage.
   f. Dimmers and switches shall meet the UL 20 and UL 1472 limited short circuit test requirement for snap switches.
   g. Dimmer control shall be linear slide. Dimmer shall provide a smooth and continuous Square Law dimming curve.
   h. Dimmer shall be voltage regulated so that +10% variation in line voltage shall cause not more than a +5% variation in load voltage when dimmer is operating at 40V (5% light output).
   i. Dimmers shall utilize a LC filtering network to minimize interference with properly installed radio, audio, and video equipment.

j. Dimmer control slider shall be captured.
k. Faceplate shall snap on to device with no visible means of attachment. Heat-fins shall not be visible on front of device. At locations with multiple devices, one seamless, multi-gang faceplate shall be provided. Contractor is responsible for coordination of proper back box size and faceplate type.

6. I/O Module (IOM)

a. General:

1) I/O Module shall be the common interface to a driver, sensor, or power pack.
2) Addressing: I/O Module shall be individually addressable via Energy Control Software.
3) Response to Power Failure: In the event of a power failure, I/O Modules connected to light fixtures shall default to the “on” state at full light output.

b. Electrical Specifications

1) Ratings: Shall be low-voltage input.
2) Voltage Compatibility: Universal voltage control capability to 347 VAC maximum.
3) Primary Relay Rating: 347V, 0.8A/277V, 1A/240V, 1.2A/120V, 2.5A
4) Power: Shall supply 12 VDC @ 25 mA power to attached sensor.
5) Control Signal: Shall supply 0 to 10 VDC dimming signal to attached driver or receive control signals from attached sensor.
6) Memory: Retains all system settings in non-volatile memory.

c. Mechanical Specifications

1) Wiring: I/O Module shall not require wiring connections to the System apart from prefabricated, quick connecting low-voltage wiring.

d. Environmental Specifications

1) Operating Temperature Range: 0ºC to +40ºC
2) Relative Humidity: 20% to 90% non-condensing

7. Photo Sensors

a. Interior:

1) A sensor that measures ambient light in a finite area shall be available.
2) The sensor shall measure light from any source in the visible spectrum within at least a 60º cone. It shall measure light between 0 and minimum 75 foot-candles.
3) Electrical: Rating: Maximum 24VDC input voltage.

4) Mounting: The sensor shall be flush mounted on or recessed inside ceiling tile.

b. Exterior:

1) An exterior photo controller with exterior photocell shall be provided to control exterior circuits.
2) An exterior weatherproof photocell shall be mounted on the roof facing a northerly direction, but not into existing sources of light.
3) A low-voltage photo controller shall be mounted adjacent to one of the lighting control panels containing exterior circuits.

8. Occupancy Sensors

a. Sensors using passive infrared, ultrasonic, acoustic, and multi-technology adaptive technology shall be available.
b. Sensor timeouts shall be configurable by System software.
c. Electrical Rating: Maximum 24 VDC input voltage.
d. Mounting: Sensors for mounting on ceilings and walls, including corners, must be available.

9. Four Scene Preset Control

a. Controls shall provide access to 4 preset lighting scenes and off for up to 8 control zones. Control shall be capable of storing an additional 12 preset lighting scenes. Scenes shall be changeable as required. Up to 8 controls may be tied together for more than 8 zones. Controls shall incorporate built-in wide-angle infrared receiver, providing control via a separate a separate infrared wireless remote control transmitter from up to 50 feet away. Preset shall be set via easy-to-use raise/lower switches, one raise and lower switch per zone. The intensity for each zone shall be indicated via an illuminated bargraph Programming of preset scenes shall be accomplished without the use of an ENTER or STORE button. One or more zones may be temporarily overridden without altering the scene values which are stored in memory. Lighting levels shall fade smoothly between scenes at time intervals of 0-59 seconds or 1 to 60 minutes. The fade time shall be separately selectable for each scene. Additionally, control shall provide power failure memory for ten years.
b. Manufacturer shall maintain ISO 9001 certification. Provide a copy of the certificate as part of the submittal.

10. Dimming Accessory Control Options

    Provide the following controls for use with the preset control(s) as shown on the drawings and/or described in LIGHTING CONTROL DESCRIPTIONS:

    a. Two Scene Entrance Control(s) shall be capable of recalling Scene One plus Off, Scenes 7 and 8, or Scenes 13 and 14. Also can be used as raise/lower partition control and Lockout. All above based on dipswitch settings.
    b. Four Scene Control(s) shall be capable of recalling any one of four scenes, master raise/lower, and Off. Control shall provide access to up to 16 scenes.
    c. Fine Tuning Control(s) shall allow the temporary override of a particular zone or zones from the preset light level.
    d. Infrared Wireless Transmitter(s) shall be capable of recalling any one of four preset scenes and Off. In addition, a master raise/lower shall be provided. The transmitter shall be manufactured by the dimming system manufacturer. The range of the transmitter to any single receiver shall be at least 50 feet. Wall receiver shall incorporate buttons for four scene select, master raise/lower, and off. Ceiling receiver shall provide 360 degree view and an integral LED to provide feedback of proper infrared signal.
    e. Special Function Control(s) shall provide the following functions:

        1) Sequencing shall allow the user to set up and operate a sequence of 4, 12, or 60 steps. A sequence shall be defined as a series of steps, while a step shall be defined as the recall of a scene. Each step interval is adjustable from 1 second to 60 minutes.
        2) Zone lockout shall allow temporary changes without altering light levels preset for each scene.
        3) Scene lockout shall lockout the control, maintaining current scene and disabling all buttons on the preset dimming controls.
        4) Fade override shall set all fade times to zero.

    f. Partition Control(s) shall provide two or four buttons for operating multiple preset units independently or in combination. Each button shall have a corresponding LED to indicate status of a specific partition “door.”
    g. Photocell Interface Control(s) shall provide scene selection via daylight photosensor.
    h. Equipment Interface(s) shall allow access to preset dimming control(s) via one of the following methods:

        1) Isolated momentary/maintained dry contact closures. Where indicated on the drawings, each interface shall provide isolated maintained contact closures rated at 200mA at 30VDC for pilot light status feedback.
        2) For use with four scene preset control, RS232 serial communication.
        3) For use with four scene preset control, astronomic time clock with 60 events/day and 4 schedules.

4) For use with multiple area-centralized control, DMX512 interface with control of 32 continuous dimming zones via external DMX512 device.

2.3 NETWORK REQUIREMENTS

The lighting control system shall be a distributed intelligence system, consisting of multiple panels that operate on a network.

A. This network shall allow up to 500 lighting control panel(s) to be networked by a shielded dataline control wire. The dataline shall be Belden type or as required by the manufacturer with maximum length of 7500 feet without the use of repeaters. The network shall be self-powered. No external power supply shall be allowed.

B. Independent Operation. Network communications, time of day schedules, and input and load control shall reside in each panel. Each panel shall continue to function independently of other panels if a network failure occurs.

C. Fire Alarm Interface. Provide connection from the fire alarm system to energize specific lighting control zones based on a fire alarm event.

2.4 LIGHTING CONTROL SOFTWARE

A. The Lighting Control Computer (LCC) shall provide the ability to centrally program and monitor loads through application specific software and user-friendly, graphic oriented screens. It shall also provide backup for panelboard/panel data recovery. This computer shall allow access to all base area lighting control systems that are associated with the scope of new construction and renovation at the base area. The Main LCC shall be located the Base Area Operator's Office or Command Center.

1. Computer / touch screen shall be password protected based on user access level.
2. Computer shall be able to access all owner designated screens, programs, etc. Event lighting screens or overrides shall not be accessed from this location.

B. The Lighting Control Touch Screen(s) (LCTS) shall provide the ability to centrally access and monitor loads through application specific software and user friendly, graphic oriented screens. Secondary LCC's shall be located in each building Promenade/Plaza, Building B (Gondola Square), KVC (Sheraton). Each screen shall allow direct access to the entire building lighting control system associated with the scope of this project.

1. Computer shall be password protected based on user access level.
2. Computer shall allow keyboard / mouse operation.

C. Lighting control manufacturer shall provide a software program (windows based) that provides for programming and monitoring of the lighting control system.

1. The software shall be complete with multiple windows, point and click operation, dialog boxes, menu bar, scroll bars, status bar, control buttons, and context sensitive help screens.
2. The software shall be icon driven with each button corresponding to a major function of the lighting control system.
3. Security codes shall be assignable so that different operators shall have different levels of access to the system. Different security levels shall be provided for monitoring, override, programming and administrator access to the system.
4. Configuration dialog boxes shall be provided that allow assignment of descriptions to individual loads and inputs. These descriptions shall be carried over automatically to other screens.
5. A time schedule editor shall be provided which allows a time schedule for multiple loads or repeating events to be viewed, copied, and edited on the same screen and shall be programmed into the 12 month calendar.
6. A monitor and override screen shall be provided that shows each load in the system, its current status and the reason for the last change in operation. From this screen it shall be possible to manually turn loads On and Off.
7. A grouping function shall be provided that allows assigning of a time schedule or switch input to multiple loads located anywhere in the system. Once defined schedules for all loads can be changed by simply changing the group schedule. The software shall automatically update the database in each lighting control panel.

D. Event Control: The software shall be specifically custom designed to control lighting in multi-use facilities such as stadiums. Office building type software is unacceptable. The software shall be the product of the lighting control manufacturer and shall provide for customization to meet specific project requirements as specified herein.

E. The manufacturer shall provide the latest version of software available at the time of final acceptance of the system by the owner. This provision shall be at no additional cost to the owner, provided the improved software is fully compatible with the system hardware as installed.

F. Graphics Control Software (GCS). The software package shall be supplied that provides a graphical interface.

1. The software shall operate with the other control software installed. It shall be object oriented with pull down menus and built in help screens. Provide 40 graphic screens.
2. The operator shall be able to individually control any lighting load connected to the system. The operator shall be able to control the load by activating the graphic symbol representing the load or by activating control buttons.
3. Load status shall be indicated by changing the color of the graphics symbol or control button. Green shall indicate the load is On; Gray shall indicate the load is Off.
4. A 12 month calendar in which all games can be programmed for a full year.

G. Graphic Screens. Anticipated graphic screens are as follows:

1. Main Screen (Project Name, Graphics, etc.)
2. Floor Plan Screens

    a. Overall plan of each level. The main screen shall be provided that illustrates the overall building.

        1) When the cursor is moved to a portion of the building corresponding to a detail screen, the screen area shall become highlighted.
        2) Clicking the mouse while within the highlighted area shall automatically bring up the corresponding detail area screen.
        3) Movement between the main screen and subsequent screens shall also be possible by using control buttons.

3. Overall zone control – including single button on/off control for entire buildings zones.
4. Egress Lighting Control.

    a. Provide override control for egress lighting. Access to the egress lighting zones shall be password protected.
    b. Provide positive verification button which states: “You are about to turn off code required egress lights. Confirm that these areas are not occupied.”

5. Exterior Control Zones

    a. Site Lighting
    b. Ice skating rink – Non Event Mode
    c. Ice Skating rink – Event Mode
    d. Façade Lighting
    e. Site power

6. Event Lighting – Plan View

    a. Overall Site Plan
    b. Individual Quad/Area Plan
    c. Event Screen(s) – Ice skating, concert, maintenance, etc.

H. The manufacturer shall provide the latest version of software available at the time of final acceptance of the system by the owner. This provision shall be at no additional cost to the owner, provided the improved software is fully compatible with the system hardware as installed.

2.5 TOUCH SCREENS

A. Hardware Configuration:

1. Touch screens shall be surface or flush mounted. Platform-mounted touch screens are not acceptable.
2. Provide lockable cover or access credentials for locations subject to public access.

B. Basis of Design: n-light 'UNITOUCH' or FRESCO
Features shall include:

1. LCD touch screen able to show building graphics.
2. Interface module for Ethernet connection.
3. Onscreen keyboard and mouse capability.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting Control Panel:

1. Install lighting control panels as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation" and in compliance with recognized industry practices to ensure that products fulfill requirements.
2. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with torque tightening requirements specified in UL Standards 486A and B.
3. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.
4. Provide engraved, plastic laminate labels for all lighting control panels indicating name, voltage, phase, wire and short circuit rating. Refer to Section 26 05 53 for more information.
5. Provide typed relay directory card upon completion of installation work to match as-built conditions and nomenclature indicated on engineering drawings and submit directories to the Engineer for review prior to mounting in panel.

B. Dimming Panel:

1. Wiring from dimming panel to preset dimming control and accessory controls shall be low voltage Class 2 wiring. All lighting control wiring shall be in an approved raceway specified in Section 26 05 33.

2. Provide accessories as required for construction type indicated on Finish Schedule. Lighting control catalog numbers do not necessarily denote specific mounting accessories for type of wall or surface in which a lighting control may be installed.
3. Provide adequate and sturdy support for each lighting control component. Contractor shall be responsible for verifying weight and mounting method of all lighting controls and furnishing and installing suitable supports. Lighting control mounting assemblies shall comply with all local codes and regulations.
4. Contractor shall be responsible for mounting the lighting controls at the proper depth, and for coordinating the cutout size and shape in wall to ensure that the faceplate covers the cutout entirely. Refer to drawings for location and mounting height of controls.
5. Install lighting controls with vent holes free of air-blocking obstacles.
6. Support elements shall not be mounted to or in contact with ducts or pipes.
7. Mask the lighting controls as necessary to protect the controls during construction.
8. At the completion of construction, clean the face plates and exposed surfaces of all lighting controls, so as to render them free of any material, substance or film foreign to the lighting control. Use soft, non-abrasive cloth and a cleaning solution recommended by the lighting control manufacturer. If the lighting controls are deemed dirty by the Architect at the completion of the project, the Contractor shall clean them at no additional cost to the Owner. Lighting control components whose finishes are damaged shall be replaced at no cost to the Owner.
9. Contractor shall furnish all equipment, labor and materials for the proper installation and system setup of all lighting controls and components as shown on drawings and as specified. System setup includes defining each dimmer's load type, assigning each load to a zone, and setting the control functions. System setup shall take place before building is turned over to Owner, after regular working hours where required.

C. Control Devices:

1. Install lighting control devices in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
2. Install occupancy sensors and daylight sensors in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements. Confirm sensors provide coverage for the spaces in which they are installed and provide additional sensors as required for a completely functional system.

3.2 WIRING INSTALLATION

A. Install wiring between control devices for hard wired connections. All lighting control wiring shall be in an approved raceway specified in Section 26 05 33.

B. Coordinate with Division 26 for electrical work, including raceways, electrical boxes and fittings, as necessary to interface installation of lighting control equipment with other work. This Contractor shall route all raceways for lighting control circuits through the lighting control panel, furnish all line and load side conductors, and terminate the line and load side of the lighting control relays. This Contractor shall provide wiring for all remote lighting switches, devices, and their terminations as shown in the construction documents.

1. If the available fault at the panel feeding the branch circuits exceeds the SCCR of the relay, route the branch circuit an additional ten feet between the panel and the lighting control panel.

C. Provide all low-voltage terminations within the lighting control cabinets, to LCD remote control stations, and all required network cabling between lighting control panels.

3.3 GROUNDING

A. Provide equipment grounding connections for lighting control equipment. Tighten connectors to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounding.

3.4 CLEANING

A. Cleaning: The contractor shall remove all paint spatters and other spots, dirt and debris from the equipment. Clean equipment and devices internally and externally using methods and materials recommended by the manufacturers.

3.5 COMMISSIONING

A. Pre-functional Checklist: Contractor shall perform pre-functional checklist as required for the fundamental commissioning of the lighting control system.

B. Operational Test: This contractor shall provide a complete set of “as wired” drawings of the lighting control system to the owner. These drawings shall be prepared and verified prior to commissioning of the system. Any extra expenses incurred in commissioning the system due to inaccurate or incomplete wiring shall be borne by the electrical contractor.

1. Provide a factory technician to inspect the installation prior to energizing and starting up the lighting control system. This service shall be provided within fourteen days of written notification to the manufacturer that the installation is complete and ready for start-up.
2. The graphic screens shall be functional a minimum of three weeks prior to substantial completion.

C. Commissioning: The contractor shall arrange and pay for the services of factory trained representatives to commission the lighting control system. They shall verify that the contractor has properly installed and interconnected all supplied components. They shall start up all equipment and demonstrate that it meets the requirements of this specification.

D. Programming: Arrange and pay for the services of factory authorized service technicians to install an initial lighting control program into the system.

1. Coordinate operational schedules with the Owner so that a complete schedule is available at the time of commissioning. This Contractor shall be responsible for schedule updates until system is turned over to Owner.
2. Manufacturer shall install the graphics software onto the Lighting Control Computer (LCC) or a designated computer as determined by the owner.

E. Reports: Prepare written reports of tests and observations. Report defective materials and unsatisfactory test results. Record repairs and adjustments made.

3.6 CUSTOMER SUPPORT SERVICES

A. Training: As part of the commissioning procedures, the manufacturer shall train the owner's representatives in the operation of the system. The manufacturer shall attend all training sessions in person.

1. A minimum of 80 hours of on-site training shall be provided.
2. Training shall occur in at least three separate visits. The first two visits shall occur at least 30 days prior to substantial completion. Another visit shall occur 30 days after the opening of the facility. Training shall include but not be limited to the following:

    a. User group training for manual override locations, functions and sweeps.
    b. Control interface.
    c. Programming owner requested changes.

3. The manufacturer shall attend and provide technical support for the first of each type of event – football, soccer, or concert.

B. Technical Support: The manufacturer shall supply telephone support at no additional cost to the owner for the duration of the warranty period.

C. Spare Components: The manufacturer shall provide the following spare parts to the owner.

1. A minimum of 10 spare relays.
2. A minimum of 5 occupancy sensors.
3. A minimum of 2 daylight sensors.
4. A minimum of 2 spare panel communication cards.
5. A minimum of 2 key pads.

D. Replacement components: The manufacturer shall be able to ship replacement parts within 24 hours for any component that fails during the warranty period.

E. Extended Service Coverage: Maintenance agreements shall be available from the manufacturer to provide service for the system both during and after the warranty period.

END OF SECTION 26 09 43

SECTION 26 22 13 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this section.

B. Requirements of the following Division 26 Sections apply to this section.

1. "Electrical Requirements."

1.2 SUMMARY

A. This section includes general purpose and specialty dry type transformer with winding rated 600V or less, with capacities up to 1000 KVA.

B. Related Sections: The following Division 26 Sections contain requirements that relate to this section:

1. "Electrical Identification" for signs associated with transformer installations.

C. All switchboards, panelboards, switchgears, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the entire project unless specifically noted otherwise.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Product data for each transformer, including dimensional floor plans of electrical rooms, sections, and elevations showing minimum clearances, installed devices, and material lists.
2. Transformer physical characteristics, including dimensions, weight, KVA rating, voltage, % impedance, taps, insulation class and sound levels.
3. Wiring diagrams from manufacturer differentiating between manufacturer-installed and field-installed wiring.
4. Transformer no-load losses and efficiency ratings.
5. Product certificates, signed by manufacturer of transformers certifying that their products comply with the specified requirements.

6. Product Test Reports: Certified copies of manufacturer's design and routine factory tests required by the referenced standards.

1.4 PROJECT RECORD DOCUMENTS

A. Maintain a redline set of contract documents noting all revisions and deviations that are made during the course of the project.

B. Manufacturer shall provide copies of installation, Operation and Maintenance (O&M) procedures to owner in accordance with general requirements of Division 01 and Division 26.

C. Submit O&M data based on factory and field testing, operations and maintenance of specified product.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications: A firm member of NEMA who is regularly engaged in manufacturing components that comply with the requirements of these Specifications and that have been used on at least five projects of similar size and scope as this Project.

B. Field Testing Organization Qualifications: To qualify for acceptance, an independent testing organization must demonstrate, based on evaluation of organization-submitted criteria conforming to ASTM E 699, that it has the experience and capability to conduct satisfactorily the testing indicated.

1.6 REFERENCES

A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

B. ANSI/IEEE C57.96, Distribution and Power Transformers, Guide for Loading Dry-Type appendix to ANSI C57.12 standards.

C. ANSI/IEEE C89.2 – Dry Type Transformers for General Application.

D. IEEE C57.12.01, General Requirements for Dry-Type Distribution and Power Transformers including those with Solid Cast and/or Resin-Encapsulated Windings.

E. IEEE C57.12.91, Test Code for Dry-Type Distribution and Power Transformers

F. 2016 10 CFR Part 431 Energy Conservation Program: Energy Conservation Standards for Distribution Transformers

G. NEMA ST 20, Dry-Type Transformers for General Applications.

H. UL Listing and Labeling: Items provided under this section shall be listed and labeled by UL.

I. Nationally Recognized Testing Laboratory Compliance (NRTL): Items provided under this section shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle transformer in accordance with the manufacture's recommendations.

B. Transformers shall be located in well-ventilated areas, free from excess humidity, dust, dirt hazardous materials. Transformer shall be protected to prevent moisture from entering enclosure.

C. Transformer shall be shipped with edge and top protection that is adequate to protect the transformer enclosure from common dents and scratches.

1.8 WARRANTY

A. Manufacturer warrants equipment to be free from defects in material and workmanship for 1 year from substantial completion.

PART 2 - PRODUCTS

2.1 GENERAL PURPOSE, DRY-TYPE DOE 2016 TRANSFORMER

A. Comply with NEMA Standard ST 20 "Dry-Type" Transformers for General Applications.

B. Transformers: Factory assembled and tested air-cooled units of types specified, having characteristics and ratings as indicated on drawings. Units shall be designed for ratings as indicated in drawings and for 60 Hz service.

C. Cores: Core construction shall be of Grain oriented, non-aging silicon steel with high permeability, low hysteresis and low eddy current losses as need to achieve required efficiency levels. Core laminations shall be tightly assembled and magnetic flux densities shall be kept well below the saturation point.

D. Coils: Continuous windings without splices except for taps.

E. Internal Coil Connections: Brazed or pressure type.

F. Provide high quality copper windings. Wiring compartment and termination shall be accessible by removing enclosure front panels. Three phase transformers shall use one coil per phase in primary and secondary windings.

G. Transformers shall meet the energy efficiency requirements of 2016 10 CFR Part 431. The use of fans to obtain rated KVA or any published rating shall not be permitted for all transformer types.

H. Efficiency at 35% nameplate ratings shall meet or exceed:

1. 15 KVA –97.89%
2. 30 KVA – 98.23%
3. 45 KVA – 98.40%
4. 75 KVA – 98.60%
5. 112.5 KVA – 98.74%
6. 150 KVA – 98.83%

I. Sound Level: Sound levels shall not exceed the following: 150 KVA and below, 50 db; above 150 KVA, 60 db.

J. Transformers shall have the following features and ratings:

1. Enclosures shall meet UL 506 requirements.
2. Enclosure: Indoor, ventilated, drip proof in electric rooms.
3. Enclosure: Outdoor, ventilated raintight, NEMA 3R.
4. Insulation Class: 185°C class for 37½ KVA transformers or smaller; 220°C class for transformers larger than 37½ KVA.
5. Insulation Temperature Rise: 150°C maximum rise above 40°C, for 220°C class insulation; 115°C maximum rise for 185°C class insulation.
6. Taps: For transformer 3KVA and larger, full capacity taps in high-voltage winding as follows:

    a. 3 KVA through 30 KVA: Four 2.5% taps, two above and two below normal voltage.
    b. 30 KVA through 500 KVA: Four 2.5% taps, two above and two below rated normal voltage.

K. Accessories: As follows:

1. Weather shield kits for the ventilated transformer Type 3R.

L. Transformers: Factory assembled and tested air-cooled units of types specified, having characteristics and ratings as indicated on drawings. Units shall be designed for 60 Hz service.

M. Transformer core shall be constructed of high grade grain oriented silicon steel.

N. Coils shall use high grade magnet wire. Coils shall have clearly marked terminal pads attached to a rugged fiberglass termination strip. Windings shall be vacuum impregnated with nonhydroscopic thermosetting varnish for superior strength and heat transfer.

O. Transformer shall have (2) 2.5 percent above nominal and (4) 2.5 percent below nominal universal full capacity taps.

P. Insulation system shall be UL Recognized at 220 degree C and shall be capable of continuous operation at 40 degree C ambient without windings exceeding 150 degree C temperature rise. Surface temperature rise shall not exceed UL 50 degree C limit. Wiring compartment temperature rise shall not exceed UL 35 degree C limit.

Q. Floor-mount enclosure shall be constructed of heavy-gauge steel for indoor use. Weathershield kits shall be available to modify enclosures for NEMA 3R outdoor use.

R. Wiring compartment shall be sized for aluminum cable rated 125 percent of current, using long shanked crimp type connectors. Wiring compartment shall be accessible by removing enclosure front panel.

S. Vibration from core and coil assembly shall be isolated from enclosure by neoprene vibration pads and sleeves. A flexible copper grounding strap shall connect core to enclosure. A schematic connection diagram shall be located on enclosure nameplate for quick referral.

T. A premium electrostatic shield shall be included, consisting of a full width copper sheet placed between primary and secondary windings. Effective coupling capacitance shall be thirty picofarads. Average common mode noise attenuation shall be 120 db.

U. A rugged filter shall provide an average 60 db normal mode noise attenuation.

V. Surge suppression components shall be included to eliminate low-voltage spikes and surges.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Arrange equipment to provide adequate spacing for cooling air circulation.

B. Identify transformers in accordance with Division 26 Section “Electrical Identification.” Include on label, location of primary overcurrent protection device.

C. Tighten electrical connectors and terminals in accordance with manufacturer’s published torque-tightening values. Where manufacturer’s torque values are not indicated, use those specified in UL 486A and UL 486B.

3.2 EQUIPMENT BASES

A. Construct concrete equipment pads as follows:

1. Coordinate size of equipment bases with actual unit sizes provided. Construct base 4-inches high and 2-inches larger in all directions than the overall dimensions of the supported unit.
2. Form concrete pads with framing lumber with form release compounds. Chamfer top edge and corners of pad.
3. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
4. Place concrete and allow to cure before installation of units. Use Portland Cement conforming to ASTM C 150, 4000 psi compressive strength, and normal weight aggregate.

3.3 STRUCTURAL REVIEW

A. Based on submitted transformers, the Contractor shall submit intended structural support details to the project structural engineer to review to confirm structure is adequate.

3.4 GROUNDING

A. Ground transformers and tighten connections to comply with torque tightening requirements specified in UL Standard 486A.

3.5 FIELD QUALITY CONTROL

A. Inspect for physical damage, broken insulation, tightness of connections, defective wiring, and general condition.

B. Thoroughly clean unit prior to making any tests.

C. Perform insulation-resistance test. Calculate dielectric absorption ratio and polarization index. Make measurements from winding-to-winding and winding-to-ground. Test voltages and minimum resistance shall be in accordance with Table below:

Minimum dc Test Voltage	Recommended Minimum Insulation Resistance in Megohms
1000-Volts	500

D. Verify taps and connect transformer to desired tap, if applicable.

E. Energize primary winding with system voltage. Measure secondary voltage with the secondary load disconnected. Record results.

F. All transformers shall have a disconnecting means on the primary side of the transformer. If the disconnecting means is in a remote location or not within direct line of site of the transformer, the contractor shall provide a permanent phenolic label on the transformer with ¾" black lettering on a white background. The label shall indicate the room name and number indicating where the remote disconnect is located.

3.6 INFRARED INSPECTION (AFTER ENERGIZED)

1. The scan is to include all electrical distribution equipment.
2. All equipment should be energized at normal load levels during an event for at least 1 to 2 hours prior to being scanned.
3. Access covers are to be removed and reinstalled by the electrical Contractor for the testing agency to inspect and scan all electrical junctions, buss, and cable.
4. The IR Scan will be made using a Flir Thermal Imaging Camera. The camera shall provide infrared photos clearly indicating problem areas.
5. All problem areas will be noted as to location, description, and recommended solution by providing a typed report including infrared and digital pictures of all problem areas.

3.7 ADJUSTING AND CLEANING

A. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt and construction debris. Touch up scratches and mars on finish to match original finish.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

3.8 PROTECTION

A. Temporary Heating: Apply temporary heat in accordance with manufacturer's recommendations within enclosure of each transformer throughout periods during which equipment is not in a space that is continuously under normal control of temperature and humidity.

END OF SECTION 26 22 13

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Material and Methods sections apply to work specified in this section.

1.2 SUMMARY

A. Provide all panelboards and enclosure work, including cabinets and cutout boxes, as indicated by drawings and schedules, and a specified herein.

B. Types of panelboards, and enclosures required for the project include the following:

1. Power-distribution panelboards.
2. Lighting and appliance panelboards.

C. All switchboards, panelboards, switchgears, transformers, disconnect switches, starters, etc., shall be fabricated by same manufacturer throughout the entire project unless specifically noted otherwise.

D. Wires/cables, bus-way, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards, and enclosures are specified in other Division 26 sections.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s data on panelboards, and enclosures.

B. Wiring Diagrams: Submit wiring diagrams for panelboards showing connections to electrical power feeders and distribution branches.

C. Submit electrical room plan view drawings at ¼” scale showing all equipment, panelboards, disconnects and ratings, buss work, conduit areas, dimensions and mounting of equipment supplied.

D. Shop drawings showing dimensions, voltage, phasing, continuous current capacity, and short circuit rating.

E. The equipment product data, electrical room layouts and short-circuit study shall be submitted together in order to provide proper evaluation.

F. Submittals shall be in accordance with specification section 26 05 00.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: The manufacturer of this equipment shall be regularly engaged in manufacture of panelboards and enclosures, of types, sizes, and ratings required and have produced similar electrical equipment, for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

B. Codes and Standards

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 384 as applicable to installation, and construction of electrical panelboards and enclosures.
2. UL Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards", and UL's 50, 869, 486A, 486B, 891, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and labeled.
3. Special-Use Markings: Provide panelboards, constructed for special-use, with appropriate UL markings which indicated that they are suitable for special type of use/application.
4. NEMA Compliance: Comply with NEMA Standards Pub/No. 250, "Enclosure for Electrical Equipment (1000-Volts Maximum)", Pub/No. PB 1, "Panelboards", and Pub/No. PB 1.1, "Instructions for Safe Installation, Operation, and Maintenance of Panelboards Rated 600-Volts or Less".

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store panelboards in clean dry space. Protect units from dirt, fumes, water, construction debris and traffic; where necessary to store outdoors, store electrical components above grade and enclose with watertight wrapping.

B. Handle panelboards carefully to prevent internal components damage, breakage, denting, and scoring enclosure finish. Do not install damaged components; replace and return damaged units to equipment manufacturer.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 - PRODUCTS

2.1 PANELBOARDS (800 AMPS OR LESS)

A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated on drawings, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper numbers of unit panelboard devices as required for complete installation.

1. Prefabricated or pre-wired panelboards are not acceptable.

B. Power Distribution Panelboards: Provide dead-front safety type power distribution panelboards as indicated, with panelboards switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for use with copper conductors. Select unit with feeders connecting at top of panel. Equip with copper buss bars with not less than 98% conductivity, and with full-sized neutral buss; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connection. Provide molded-case main and branch circuit-breaker types for each circuit, with toggle handles that indicated when tripped. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Where multiple single pole breakers share a common neutral conductor, provide breaker tie bars as required so overload on one pole will trip all poles simultaneously. Provide panelboards with bare un-insulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturers as panelboards, which mate and match properly with panelboards. Employ bolt on breakers that are fully rated for the available short-circuit condition but of not less than 22,000 sym AIC.

C. Lighting and Appliance Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown. Equipped with anti-turn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting feeders at top of panel; equip with copper buss bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral buss for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturers as panelboards, which mate and match properly with panelboards.

1. Employ breakers that are fully rated for the available short-circuit condition but not less than 10,000 sym AIC at 120/208-Volts; and 14,000 sym AIC at 277/480-Volts.
2. Where multiple single pole breakers share a common neutral conductor, provide breaker tie bars as required so overload on one pole will trip all poles simultaneously.
3. All circuit breakers feeding food service loads or vending machines shall be GFCI type.

D. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple

knockouts and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges with door in door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for surface mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed.

E. Molded-Case Circuit Breakers: Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and ampere ratings as indicated on the drawings. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in ambient temperature of 40°C. Provide breakers with mechanical screw or compression type removable connector lugs, AL/CU rated. The breakers for 277/480V panelboards shall be industrial grade; breakers that allow or direct particles of combustion resulting from fault conditions out of the breaker are not acceptable, they shall be contained within its casing. For example; GE AE series panelboards with TEY circuit breakers are not acceptable, TED breakers are acceptable.

1. Breakers feeding the primary side of a transformer shall have provisions for locking the breaker on or off.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area and conditions under which panelboards and enclosures are to be installed, and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation" and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturers' published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with torque tightening requirements specified in UL Standards 486A and B.

C. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

D. Provide properly wired electrical connections for panelboards within the enclosures.

1. Prefabricated or pre-wired panelboards are not acceptable.

E. Provide engraved, plastic laminate labels for all panelboards indicating name, voltage, phase, wire and short circuit rating. Refer to Section 26 05 53 for more information.

F. At all recessed panel locations, provide three ¾" spare conduits stubbed to the accessible ceiling space for future use.

G. Provide typed panelboards circuit directory card upon completion of installation work to match as-built conditions and nomenclature indicated on engineering drawings and submit directories to the Engineer for review prior to mounting in panelboard.

3.3 GROUNDING

A. Provide equipment grounding connections as indicated herein. Tighten connection to comply with torque tightening requirements specified in UL Standard 486A to assure permanent and effective grounds.

B. Refer to Section 26 05 26 for additional grounding requirements.

3.4 FIELD QUALITY CONTROL

Tests shall conform to International Electrical Testing Association (INETA) Standard ATS, "Acceptance Testing Specifications for Electrical Power Distribution Equipment".

A. Infrared Inspection (After Energized)

1. The scan is to include all electrical panelboards or bussed distribution equipment.
2. All equipment should be energized at normal load levels during an event for at least 1 to 2 hours prior to being scanned.
3. Access covers are to be removed and reinstalled by the electrical Contractor for the testing agency to inspect and scan all electrical junctions, buss, and cable.
4. The IR Scan will be made using a Flir Thermal Imaging Camera. The camera shall provide infrared photos clearly indicating problem areas.
5. All problem areas will be noted as to location, description, and recommended solution by providing a typed report including infrared and digital pictures of all problem areas.

B. Panelboards:

1. Visual and Mechanical Inspection:

a. Inspect for physical damage and code violations.
b. Inspect for proper alignment, anchorage and grounding.
c. Inspect for proper identification of protective devices and switches.
d. Check tightness of accessible bolted buss joints.
e. Physically test all electrical or mechanical interlocks to assure proper function.
f. Clean interior and insulator surfaces once a month prior to job completion.
g. Inspect for proper operation of space heaters and thermostat settings (if they exist).

2. Electrical Tests:

a. Measure insulation resistance of each buss section phase-to-phase and phase-to-ground.
b. Check panelboards for electrical continuity of circuits and for short circuits.

3.5 ADJUSTING AND CLEANING

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.6 DEMONSTRATION

A. Subsequent to wire and cable hook-ups, energize and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Requirements of the following Division 26 Sections apply to this section.

1.2 SUMMARY

A. This Section includes the following:

1. Receptacles
2. Ground-Fault Circuit-Interrupter Receptacles
3. Plugs
4. Plug Connectors
5. Snap Switches
6. Wall Plates Wall Plates
7. Occupancy Sensors
8. Floor Boxes

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 26 Section “Motor Disconnects and Fuses” for devices other than snap switches and plug/receptacle sets used as disconnects for motors.

1.3 SUBMITTALS

A. Product data for each type of product specified.

B. Shop Drawings / Architectural Coordination Requirements:

1. Floor box locations and types indicated on drawings are schematic in nature and are not dimensioned locations. Contractor shall submit shop drawings and product data for final review and comment by the Architect, Owner, and Engineer, to ensure desired aesthetics are achieved.

2. Shop drawings shall include the following detailed information:

    a. Placement: Dimensioned floor box placement shown on floor plan with current furniture layer shown.
    b. Conduit: Show all conduit size and routing with labels for power, data, etc.
    c. Covers: Specific labels or notes to indicate where different cover types and finish are to be used, if applicable.

3. Occupancy Sensors Wired

    a. Submit a lighting plan clearly marked by manufacturer identifying product type, locations, orientation and coverage for each sensor.
    b. Submit any interconnection diagrams per major subsystems showing proper wiring.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following codes.

1. NFPA 70 “National Electrical Code.”

B. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL, Federal Specification and comply with applicable UL and NEMA standards.

1. UL 943

1.5 SEQUENCE AND SCHEDULING

A. Schedule installation of finish plates after the surface upon which they are installed has received final finish.

PART 2 - PRODUCTS

2.1 WIRING DEVICES

A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards.

B. Color of Devices: Color of all devices shall be coordinated with the Architect, except special purpose devices shall be black, Stand-by power system devices which shall be red.

C. Receptacles: As scheduled in Table 1 in Part 3 indicated herein. Comply with UL 498 and NEMA WD 1 and WD 6. Damp and wet location receptacles to be listed as weather resistant. Plug tail devices are not acceptable.

D. Receptacles, Industrial Heavy Duty: Provide pin and sleeve design receptacles conforming to UL 498. Comply with UL 1010 where installed in hazardous locations. Provide features indicated.

E. Receptacles, USB charging type: 2 port, 5 Amp minimum, 5-Volt D.C, WR rated as required.

F. Ground-Fault Circuit-Interrupter (GFCI) Receptacles: As scheduled in Table 1 in Part 3 indicated herein: Provide “terminal” or feed-through type ground fault circuit interrupter, as indicated on drawings, with integral heavy-duty NEMA 5-20R duplex receptacles. Provide unit designed for installation in a 2-3/4-inch-deep outlet box without adapter, grounding type, Class A, Group 1 per UL Standard 943 including self-testing.

G. Snap Switches: As scheduled in Table 2 in Part 3 indicated herein.

H. Wall Dimmer: As scheduled in Table 2 in Part 3 indicated herein.

1. Incandescent wall dimmers shall be 120-Volt, solid state type with slide control handle, preset button and semi-flush mounting. Dimmers shall be sized to continuously carry the load they are connected to, the minimum size shall be 1000 watts, and shall be rated larger if indicated on the drawings or required to serve the load.
2. Dimmers indicated on the drawings to serve low-voltage incandescent lamps shall be the same as specified for incandescent lamps and in addition shall be specifically rated for the low-voltage transformer load. Dimmer shall be UL listed for use with low-voltage fixtures.
3. Dimmers indicated to serve fluorescent lamps shall be 120v or 277v, as required for circuit served, solid state type for use with fluorescent dimming ballasts. Control shall be slide handle and dimmer shall be for semi-flush mounting.
4. Dimmers indicated to serve 0-10V loads shall be 120V or 277V, as required for circuit served, solid state type for use with 0-10V ballasts/drivers. Control shall be slide handle and dimmer shall be for semi-flush mounting.
5. All dimmers shall be of the same manufacturer. Faceplate shall be the same color as device plates specified.

I. All exterior weatherproof receptacles located on the roof, receptacles located in elevator pits and machine rooms shall be GFCI type or GFCI protected and have cast metallic “in use” covers.

J. All devices shall be premium specification grade.

2.2 OCCUPANCY SENSORS

A. Layouts shown on plan drawings are intended to show general control concepts (i.e., wall sensors, ceiling sensors, or switch sensor) for an area. The contractor shall provide sensor coverage of the entire space based on the concept shown, as well as all other devices required (power packs, control wiring, switching, etc.) for a complete and working system. Low voltage switching to allow local override of the sensors shall be provided at all entries to areas shown as controlled by ceiling or wall mounted sensors. In areas that require two or more sensors for full coverage, the sensors shall be interconnected together to provide a single switching zone for the entire space, regardless of the number of circuits.

B. Wall switch sensor shall be capable of detection of occupancy up to 300 square feet and gross motion up to 1000 square feet. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 Volts, 0 to 1200 watts at 277 Volts and shall have 180° coverage capability. All wall switches shall utilize zero crossing circuitry, field deselectable option (automatic – on to manual on).

C. Wall dimmer sensor shall be capable of detection of occupancy up to 300 square feet and gross motion up to 1000 square feet. Wall dimmer sensor shall accommodate loads from incandescent, halogen, MLV, ELV and 0-10V.

D. Ceiling mounted sensors shall be dual technology (passive infrared and ultrasonic). The sensor shall offer day lighting foot candle adjustment control and be able to accommodate dual level lighting. Sensors shall be immune to false triggering from RFI and EMI.

E. All sensors shall utilize automatically adjustable time delay and sensitivity settings. Settings shall be located on sensor.

F. In the event of failure, a bypass override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall diver to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

G. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both test and normal operation.

H. Sensors shall have an internal additional isolated relay with normally open, normally closed and common outputs for use with HVAC control, data logging and other control options.

2.3 FLOOR BOXES

A. General Information:

1. Poke Thrus floor boxes shall be manufactured with all metal die-cast aluminum construction or steel with die-cast aluminum covers. Devices shall be designed to fit in core hole opening or be cast in place.

2. Covers shall be manufactured with all metal die-cast aluminum or solid metal finish construction. At a minimum, device cover shall be available in the following options; Black, Gray, Nickel, Brass, Bronze and Brushed Aluminum.
3. Miscellaneous: Specific device mounting plates and bottom housing assemblies shall be provided for various applications. Contractor shall be load rated for 1000 pounds and provide all components per drawings and/or manufacturer recommendations for a complete solution. Refer to Power and/or Technology drawing details for additional information.

B. Poke-Thru Device (Power / Low Voltage)

1. Application: Elevated slab floor mounted device locations and Modular Furniture Feed floor mounted device locations, as applicable. 6-inch poke-thru shall be used for power only or power/data locations. 8-inch poke-thru shall be used (as applicable) for any locations with AV connectivity.
2. Fire Rating: Poke Through shall be UL listed for use in 2 hour fire rated floors (minimum).
3. Conduit Openings: Poke Thru shall have through floor fitting with a minimum of (1) 3/4-inch conduit for power and pass through channels for low-voltage cabling.
4. Flexible Conduit Feed: Black 2-inch Polytuff flexible conduit shall be provided to extend low-voltage device cabling from floor box knock-out to modular furniture, as applicable.

   Products: Refer to Appendix 1 Floor Box Equipment Schedules for a list of benchmark manufacturer's part numbers.

2.4 WIRING DEVICE ACCESSORIES

A. Wall Plates: Single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide plates possessing the following additional construction features:

1. Material and Finish: 0.03-inch-thick, type 302 satin finished stainless steel. Plate shall be Hubbell "S" Series or approved equal.
2. Emergency receptacles shall have red cover plates.

B. For all devices installed which are exposed to the weather, moisture or where indicated on the drawings, device plates shall be weatherproof. Device cover plates shall be cast metallic in-use type with gasketing to prevent entrance of moisture when closed.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other work.

C. The mounting height of devices is indicated in the legend on the drawings. Where finished walls are exposed concrete block, brick or tile, the height shall be adjusted to allow outlet box for device to be mounted at a joint.

D. Receptacles above countertops shall be installed with major axis horizontal above the backsplash.

E. Install GFCI receptacles or GFCI breakers in all areas as required per NEC 210.8, including but not limited to bathrooms, kitchens, rooftops, outdoors, within 6 feet of a sink, locker rooms, garages, crawl spaces and unfished occupied areas of basements.

F. Install tamper resistance on 15& 20A 120V receptacles in all areas as required per NEC 406.12, including but not limited:

1. Child care facilities
2. Education facilities
3. Business offices, corridors, waiting rooms and the like in clinics
4. Medical office corridors and waiting rooms, and out patient facilities
5. Public areas of assembly occupancies

G. Mount all devices within outlet boxes to allow device plates to be in contact with wall on all sides. Align devices with major axis of device parallel to adjacent predominant building feature, i.e., door frames or countertops.

H. Install wall switches on the strike side of doors.

I. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

J. Provide a current carrying conductor, neutral, equipment grounding conductor and an insulated grounding conductor to each isolated ground "IG" receptacle.

K. Install galvanized steel wall plates in unfinished spaces.

L. Install wiring devices after wiring work is completed.

M. Install wall plates after painting work is completed.

N. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torque requirements are not indicated, tighten connectors and terminal to comply with tightening torque requirements specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

O. Provide hardwire connection to all modular furniture system power entry cables.

3.2 PROTECTION

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing test wiring devices and demonstrating compliance with requirements, operate each operable device at least six times.

B. Test ground-fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

C. TABLE 1

RECEPTACLES

Designation (1)	Current Rating Amps	Voltage Rating	Single/ Duplex	NEMA Config.	Hubbell Catalog #(3)	Notes
-	20	125	Duplex	5-20R	HBL5362	-
-	20	125	Single	5-20R	HBL5361	-
-	20	125	Duplex	5-20R	HBL5362C2	(7)
USB	20	125	Duplex	5-20R	USB20AC5	(6)
IG	20	125	Duplex	5-20R	IG5362	Isolated Ground
WP	20	125	Duplex	5-20R	GFR5362SG/ WP826 (4)	In Use Weather-proof

Designation (1)	Current Rating Amps	Voltage Rating	Single/ Duplex	NEMA Config.	Hubbell Catalog #(3)	Notes
GFCI	20	125	Duplex	5-20R	GF5362SG	Integral GFCI (2)
-	20	125	Duplex	5-20R	HBL5362SA	Surge Suppression
-	20	125	Duplex	5-20R	HBL8300SGA	Tamperproof

NOTES

1. Letter designations are used where symbols alone do not clearly designate on plans locations where specific receptacle types are used.
2. Protecting downstream receptacles on same circuit is not acceptable.
3. Refer to Section 26 05 03 for additional acceptable manufacturers. Color of device shall be verified with Architect (ivory, gray, white, etc.). All emergency receptacles shall be red.
4. Where required per NEC or local code, provide Hubbell 'WP26E' in-use water-proof cover for two-gang devices.
5. Where receptacles are located in damp or wet locations per article 406 in the National Electric Code, provide receptacles that are listed weather resistant. Use Hubbell HBL5362WR or approved equal receptacles where GFCI is not required at the receptacle location. Use Hubbell GFR5362 or approved equal where GFCI is required at the receptacle location.
6. Provide USB20AC5WR as required where weather resistance is needed.
7. Controlled receptacles shall be marked with power symbol and labeled as "Controlled" as required by the NEC 406.3E.

D. TABLE 2

SNAP SWITCHES

Designation (1)	Typical Application	Load Rating	Voltage Rating (AC)	Poles	Hubbell Catalog #(3)	Notes
S	Control Lights	20A	120/277	1	HBL1221	-
S3	Control Lights	20A	120/277	3-way	HBL1223	-
S4	Control Lights	20A	120/277	4-way	HBL1224	
Sp	Switch and Pilot Light	20A	120/277	1	HBL1221PL	(2)
Sk	Key Switch	20A	120/277	1	HBL1221L	

Designation (1)	Typical Application	Load Rating	Voltage Rating (AC)	Poles	Hubbell Catalog #(3)	Notes
Swp	Wp Switch and Cover Plate	20A	120/277	1	HBL1281/HBL 1750	

NOTES

1. For snap switches, designation is the same as the symbol used on plans for the device. Type of switch is determined from plan context including type of device or circuit being controlled.
2. Pilot light "on" when switch is "on."
3. Hubbell basis of design. Refer to Section 26 05 03 for additional acceptable manufacturers. Color of device shall be verified with Architect (black, gray, white, etc.).

E. TABLE 3

WALL BOX SENSORS/DIMMER SWITCHES

Load Type (1)	Load Rating	Voltage Rating (AC)	Lutron Part # (2)	Notes
Occ/Vac Sensing 0-10v Dimmer	8A	120/277	MRF2S-8SD010-XX	
Occ/Vac Sensing Switch	8A	120/277	MRF2S-8SS-XX	
Switch	8A	120/277	MRF2S-8S-DV-XX	
CFL/LED Incandescent/MLV Dimmer	150W CFL/LED 600W Inc/MLV	120	MRF2S-6CL-XX	
Incandescent/MLV Dimmer	600W	120	MRF2S-6ND-120-XX	
ELV Dimmer	150W LED 600W ELV	120	MRF2S-6ELV120-XX	

NOTES

1. Provide dimmer wattage size to handle load served. Derate dimmer switch per manufacturer's recommendations where dimmers are ganged together. Provide dimmer model as required based on application, i.e., voltage rating, load, and load type.
2. Lutron basis of design. Refer to Section 26 05 03 for additional acceptable manufacturers. Color of device shall be verified with Architect (black, gray, white, etc.)

END OF SECTION 26 27 26

APPENDIX 1 - FLOOR BOX EQUIPMENT SCHEDULE

NOTES:

1. This specification is intended to be performance based, thus all products listed in the table below are benchmark products. Hubbell's equivalent products are acceptable. Contractor may propose other alternate manufacturers and/or models, but alternates are subject to approval by the Owner, Engineer, and/or Architect.
2. Contractor shall provide complete solution including all necessary components for installation of power and low-voltage systems. Refer to power and low-voltage drawings and/or drawing details and manufacturer recommendations for additional information.

Table 3.1 - Poke-Thru Floor Boxes

Item	Part Name/Description	Manufacturer	Part Numbers
1	6-inch Poke-Thru Device	Legrand / Wiremold	6ATCFFxx, 6ATC2Pxx, 6AT2Pxx, 6PPS
2	6-inch Poke-Thru Center Mount Device Plates	Legrand / Wiremold	6B (blank), 6ACT8A (data)
3	8-inch Poke-Thru Device	Legrand / Wiremold	8ATC2Pxx, 8AT2Pxx, 8PPS
4	8-inch Poke-Thru Center Mount Device Plates	Legrand / Wiremold	8B (blank), 8ACT8A (data)

SECTION 26 43 14 - SURGE PROTECTIVE DEVICE (SPD)

PART 1 - GENERAL

1.1 SUMMARY

A. This specification includes requirements for a high energy, field-mounted, Surge Protective Device (SPD) Type 1 (formerly known as Secondary Surge Arrestor/TVSS) and SPD Type 2 (formerly known as Transient Voltage Surge Suppressor) electronic filtering system used to protect low-voltage AC electrical distribution from the effects of lightning, utility switching events, temporary over voltages (TOV), and impulses generated internally within a facility.

1.2 RELATED DOCUMENTS

A. The specified unit shall be designed, manufactured, tested and installed in compliance with the following standards:

1. ANSI/IEEE C62.41.1-2002, C62.41.2-2002 and C62.45-2002
2. Canadian Standards (CUL)
3. Federal Information Processing Standards Publication 94 (FIPS PUB 94)
4. National Fire Protection Association (NFPA 70 (NEC), 75 and 78)
5. Underwriters Laboratories Listed (UL 96A, 198, 248-1, 489, 1283 and 1449-Third Edition)

1.3 SUBMITTALS

A. Product Data: Provide complete product data detailing manufacturer’s model number, specifications, features and options.

B. Test Data: Manufacturers shall submit certified independent 3rd party test data verifying the following: life cycle testing, overcurrent protection, UL1449 Third edition as tested by Underwriters Laboratories (UL), noise attenuation and surge current capacity. Data shall include type classification (Type 1, Type 2), voltage protective rating (VPR), actual MCOV test value, nominal discharge current test (I_n) rating.

C. Shop Drawings: Provide electrical and mechanical drawings that include detail on unit dimensions, weights, field connections and mounting provisions.

D. Installation, Operation and Maintenance Manuals: Provide one copy of the installation, start-up, operation and maintenance data for each unit supplied.

1.4 ACCEPTABLE MANUFACTURER

A. These specifications detail performance requirements for a surge suppression system manufactured by Current Technology, Citel (Panelboards only), Emerson/Liebert, Square D/Schneider, Eaton/Bussmann, General Electric, Mersen, Siemens or Thor. Substitute, value-engineered or alternate products shall meet all performance and reliability aspects of this specification, including the substitute/alternate products submittal requirements.

1.5 SUBSTITUTION PRE-APPROVAL PROCEDURES

A. Manufacturers requesting approval of their products shall identify the full model number and submit product data and specifications.

1.6 WARRANTY

A. The manufacturer shall provide a ten (10) year limited warranty for service entrance and switchboard units, and a ten (10) year limited warranty for panelboard units from the date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer’s installation, operation and maintenance instructions.

1.7 LOCAL SERVICE SUPPORT

A. A dedicated support organization shall be located within 150 miles of the project location, and shall have experience supporting at least twenty other projects of similar complexity within the last three years.

PART 2 - PRODUCTS

2.1 HIGH PERFORMANCE SUPPRESSION SYSTEM

A. The suppression system shall incorporate metal oxide varistor (MOV) arrays and filtering capacitors. These components shall optimally share surge currents to ensure maximum performance and long-term reliability. The system shall not utilize gas tubes, spark gaps, silicon avalanche diodes, or other components that might short or crowbar the line, thus leading to power interruption.

2.2 UL 1449 THIRD EDITION UL TYPE 1 AND TYPE 2 DEVICE

A. The unit shall be certified as a Type 1 or Type 2 device suitable for use in these applications. The nominal discharge current shall be 20 KA, and the applied MCOV value shall be the actual

MCOV of the unit's suppression components (i.e., between 115% and 130% of nominal installed voltage, according to Section 2.4).

2.3 UNIT OPERATING VOLTAGE

A. The operating voltage and configuration shall be 277/480-Volt or 120/208-Volt grounded wye as indicated on the drawings.

2.4 MAXIMUM CONTINUOUS OPERATING VOLTAGE (MCOV)

A. The MCOV shall be greater than 115 percent (%) of nominal voltage, but no greater than 130 percent (%).

2.5 PROTECTION MODES

A. All modes on all phases shall be protected (e.g., line-to-line, line-to-neutral, line-to-ground and neutral-to-ground).

2.6 RATED SINGLE PULSE SURGE CURRENT CAPACITY

A. The proposed product shall be single pulsed surge current tested in all modes at the rated surge currents by an industry recognized independent test laboratory. The test shall include a surge impulse (6kV (1.2x50 µs), 500 amp (8x20 µs) waveform) to benchmark the unit's suppression voltage. The applied impulse is followed by a single pulse surge of the maximum rated surge current magnitude, followed by a second 6kV (1.2x50 µs), 500 amp (8x20 µs) impulse as a means of measuring clamping deviation (component degradation). Compliance is achieved if the two measured suppression voltage do not vary by more than 5%.

Rated Single Pulse Surge Current Capacity				
Location	L-N	L-G	N-G	L-L
Service Entrance & Switchboards	120,000 A	120,000 A	120,000 A	120,000 A
Panelboards	50,000 A	50,000 A	50,000 A	50,000 A

2.7 MINIMUM REPETITIVE SURGE CURRENT CAPACITY

A. Per ANSI/IEEE C62.41 and ANSI/IEEE C62.45-2002, every mode of the suppression filter system shall be designed to survive multiple Category C 20 KV, 10 KA impulses. Test

documentation shall detail the unit's ability to survive the following number of events (at one minute intervals) without any performance degradation.

Repetitive Surge Current Capacity - Number of Impulses				
Locations	L-L	L-N	L-G	N-G
Service Entrance & Switchboards	>12,000	>12,000	>12,000	>12,000
Panelboards	>4500	>4500	>4500	>4500

2.8 HIGH FREQUENCY EXTENDED RANGE FILTER

A. Noise Attenuation: The filter shall provide an attenuation of 63 db max from 10 kHz to 100MHz, per 50 Ohm Insertion Loss Methodology from MIL 220A. The system shall provide up to 120-dB insertion loss from 100 kHz to 100 MHz when used in a coordinated facility system

B. For installations that install multiple downstream filters, the filters shall be coordinated to provide minimum noise rejection/attenuation as follows:

1. NOTE: Insertion loss data shall be based on a minimum of 100 feet of #4 AWG conductor between filters.

2.9 UL 1449 THIRD EDITION VOLTAGE PROTECTIVE RATING

A. The voltage protective rating (VPR) for grounded wye circuits at applicable voltage shall not exceed the following:

System Voltage	**Mode**	**UL 1449 Third Edition VPR**
120/208	Line to Line (L-L) Line to Neutral (L-N) Line to Ground (L-G) Neutral to Ground (N-G)	1200 700 700 700
277/480	Line to Line (L-L) Line to Neutral (L-N) Line to Ground (L-G) Neutral to Ground (N-G)	2000 1200 1200 1200

2.10 REDUNDANT OVERCURRENT PROTECTION

A. Each suppression element shall utilize individual tested fuses to ensure that the failure of a single suppression component, or operation of any single fuse does not render the entire mode, phase or product deficient by more than twenty percent (20%). All fuses shall be capable of withstanding the rated single pulse surge current capacity of the individual components they protect without failure.

2.11 INTERNAL CONNECTIONS

A. Internal surge current paths shall utilize low-impedance copper bus bar. No plug-in modules or quick-disconnect terminals shall be used in the surge current-carrying paths.

2.12 ENCLOSURE

A. The service entrance unit shall utilize a NEMA 1 metallic enclosure for interior locations.

2.13 ADDITIONAL FEATURES/EQUIPMENT

A. Advanced Monitoring Feature. A battery-powered audible alarm with event counter display and two sets of form C dry contacts (N.O. or N.C.) shall be provided. The alarm shall indicate single or multiple phase failure of the filter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The service entrance, switchboards, and panelboard filters shall be installed external to the switchgear/panelboard as close as possible to the connection point following the manufacturer's recommendations for conductor size and minimal bends. The SPD shall be independently immediately above the protected equipment and fed from a breaker mounted at the top of the bus.

B. All insulation resistance tests shall be performed without being connected to the distribution equipment.

3.2 START UP SERVICES

A. Complete start up checks according to manufacturer's written instructions.

3.3 EQUIPMENT MANUAL

A. An equipment manual shall be provided that details installation, operation, and maintenance instructions for the filter. Information shall include unit dimensions, weights, mounting provisions, connection details and a layout diagram.

END OF SECTION 26 43 14

SECTION 26 50 00 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including general and supplementary conditions and Division 1 Specification sections, apply to work of this section.

B. Division 26 Basic Electrical Materials and Methods sections apply to work specified in this section.

C. Refer to Appendix “A” for Light Fixture Cutsheets and specification section 26 56 13 Poles and Standards.

1.2 SUMMARY

A. Extent, Relative location, and details of lighting fixture work are indicated on drawings and in schedules. Refer to Architectural Reflected Ceiling (landscape Architect) Plans for precise fixture locations.

B. Types of lighting fixtures in this section include the following:

1. Incandescent.
2. Light Emitting Diode, LED
3. Other lamps as noted on fixture schedule.

C. Fixture: A complete lighting unit Includes lamps, wiring, controls and parts required to securely support fixture.

D. Exact ceiling construction shall be verified and coordinated with fixture type and mounting prior to ordering. Minor changes in ceiling construction shall not be an extra cost to the project.

1. All materials, accessories, and any other equipment necessary for the complete and proper installation of all lighting fixtures included in this Specification shall be furnished by the Contractor.
2. Specialty ceiling systems that require unique lighting fixtures tailored to a specific manufacturer’s ceiling system shall be submitted with ceiling materials and layouts to ensure coordination and verification of ceiling details prior to ordering the light fixtures.
3. Fixtures shall be manufactured in strict conformance with the Contract Drawings and Specifications.

4. Specifications and scale drawings are intended to convey the salient features, function and character of the fixtures only, and do not undertake to illustrate or set forth every item or detail necessary of the work.
5. Minor details, not usually indicated on the drawings nor specified, but that are necessary for the proper execution and completion of the fixtures, shall be included, the same as if they were herein specified or indicated on the drawings.
6. The Owner shall not be held responsible for the omission or absence of any detail, construction feature, etc., which may be required in the production of the fixtures. The responsibility of accurately fabricating the fixtures to the fulfillment of this specification rests with the Contractor.

E. Where a catalog number and a narrative or pictorial description is provided, the written description shall take precedence and prevail.

F. General Contractor shall provide electrical subcontractor with entire lighting specification (including fixture cut sheets, illustrations and sketches); electrical subcontractor shall provide each specified manufacturer with complete information about the fixtures they will supply.

G. The contractor shall include the installation of an additional 30 exit signs in the base price for future request for exit signs by the Fire Department or Building Official. This quantity shall apply to all base area projects associated with Phase 1 (Summer 2021) construction.

H. Fixture details shown may be modified by the manufacturer provided all of the following conditions have been met:

1. Fixture performance is equal or improved.
2. Structural, mechanical, electrical, safety, and maintenance characteristics are equal or improved.
3. Cost to the Owner is reduced or equal.
4. Modifications have been reviewed by the Architect and have been approved by the Architect in writing.

1.3 SUBMITTALS

Submit shop drawings, samples, and prototypes as specifically instructed below.

A. Shop drawings shall include but not be limited to:

1. For standard catalog items with no modifications, submit catalog cut sheets prepared by the manufacturer which clearly show all elements to be supplied and all corresponding product data (including lamping; ballast manufacturer and model number; voltage; accessories or options and any miscellaneous items detailed in the written description of the specification). If cut sheet shows more than one (1) fixture type, all non-applicable information shall be crossed out.

2. For lamps, submit catalog cut sheets prepared by the manufacturer which clearly shows manufacturer, CRI, CT, wattage, base type, lumen output, lamp life, and any other pertinent information.
3. For custom fixtures, modified fixtures or linear fixtures mounted in continuous rows, submit a reproducible drawing prepared by the manufacturer showing all details of construction, lengths of runs, lamp source type and location, pendant locations, power locations, finishes and list of materials. Drawings must be to scale. Contractor shall provide manufacturer with field dimensions where required. Should these custom/modified fixtures be specific to a manufacturer's ceiling system, provide both the fixture submittal and the ceiling submittal simultaneously.
4. For all submittals under paragraphs 1 through 3 above, manufacturer shall provide submittals within two weeks of receipt of order. All submittals shall have project name and fixture type clearly shown.
5. The Architect/Engineer shall make the final determination as to whether or not the submittal contains sufficient information and reserves the right to request a shop drawing if the fixture cut is insufficient.
6. Maintenance Data: Submit maintenance data and parts list for each lighting fixture, accessory and also include "trouble-shooting" maintenance guide. In addition to the product data and shop drawings, a maintenance manual in accordance with general requirements of Division 1 shall be provided.

B. Samples:

1. It shall be the responsibility of the Contractor to provide a sample(s) fixture when requested or as stated herein. A minimum of (5) samples are anticipated. When samples are called for the manufacturer shall provide one working samples, unless otherwise noted, complete with lamp, ballast (rated for 120-Volt operation) and 6' pig-tail 3-prong Edison plug.
2. The sample(s) shall be shipped to a location that is determined by the Architect. Shipping and return shipping costs shall be provided as part of the contract.
3. The purpose of the sample is to review manufacturing techniques, detailing, lamping and scale. Sample fixtures must be approved prior to fabrication of fixtures for the project. Minor modifications, if any, shall be considered part of these Specifications and shall be accomplished with no additional cost to the Owner.
4. Sample fixtures may not be used on the project.
5. In the event the submissions are disapproved, the fixtures will be returned to the contractor to immediately make a new submission of fixture or fixtures meeting the contract requirements.
6. All costs associated for samples are to be paid by the Contractor. No additional costs to the Owner for samples or mockups will be allowed.

C. Shop drawings and samples requested shall be submitted for approval before fabrication. Any material produced prior to the approval of shop drawings or samples, and not in conformance with the Contract Documents, shall be disapproved with the Contractor bearing full responsibility and cost.

D. No variation from the general arrangement and details indicated on the drawings shall be made on the shop drawings unless required to suit the actual conditions on the premises, and then only with the written acceptance of the Architect. All variations must be clearly marked as such on the drawings submitted for approval.

E. Wiring Diagrams – as needed for special operation or interaction with other system(s).

F. Substitutions: Manufacturers or light fixtures not listed on fixture schedule must be prequalified prior to bid. This is demonstrated by an "Approved Alternate" listing in the manufacturer column. It in no way implies approval. For approval of all manufacturer/fixture substitutions, the bidders shall comply to specifications herein and as outlined below for submitting alternate fixtures:

1. No substitutions shall be accepted when the LIGHT FIXTURE SCHEDULE includes a three-name manufacturer specification.
2. Should only one manufacturer be listed, with no "Approved alternate" statement, no substitutions are allowed.
3. Light fixture bids must be priced separately and shall not be bundled with any other material or product bids, including but not limited to lighting control devices and lighting control systems.
4. Manufacturer shall have not less than five years of experience in design and manufacture of lighting fixtures of the type and quality shown. Prequalification submissions must include a list of completed projects and data catalogue pages and drawings indicating length of experience.
5. Bidders wishing to obtain approval on brands other than those specified by name and catalog number or as an approved alternate in LIGHTING FIXTURE SCHEDULE shall submit their requests not later than fifteen (15) business days before the bid opening. Approval will be in the form of an addendum to the specifications issued to all prospective bidders indicating that the additional brand or brands are approved, as equal to those specified as far as the requirements of the project are concerned.
6. If the bidders do not elect to obtain prior approval during the time so specified above, the Owner/Architect/Engineer or Lighting Designer has no obligation to review or consider any such article after the contract award.
7. Contractor shall pay professional fees at current standard hourly rates and reimburse expenses directly to all designers (Architect, Engineer and Lighting Designer) for time spent reviewing substitutions proposed by the Contractor after the bid has been awarded. If payment by the Contractor is not made within 60 days of invoice date, the Owner shall deduct the amount due from subsequent payments to the Contractor in order to reimburse designers.
8. Request for approval shall be accompanied by working fixture samples (with an appropriate lamp, complete photometric, mechanical and electrical data, list of materials and finishes and unit cost to the Owner) of both the specified brand and the proposed substitutes as required to make complete comparison and evaluation. These samples shall be in addition to those required by Lighting Fixture Specification. The above data shall be delivered separately to the Architect and the Engineer. The fixture samples shall be furnished and installed at the bidder's expense, at a location selected by the Architect. In

addition, the bidder shall furnish the Architect and the Engineer with the name and location of at least one completed project where each proposed substitute has been in operation for a period of at least six (6) months, as well as the names and addresses of the Owner, the Architect and the Engineer.

9. Point by point lighting calculations of areas affected by proposed substitution will be done by the bidder for review.
10. The Architect and Engineer shall determine whether the prototype sample complies with the specifications and shall reserve the right to disqualify any bidders.
11. When required and requested by the Architect, or Engineer, samples submitted as per above shall be subjected to photometric, thermal, mechanical, electrical or water testing at an independent test laboratory at no expense to the Owner.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of lighting fixtures of sizes, types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer's Qualifications: Firms with at least 5 years of successful installation experience on projects with lighting fixture work similar to that required for this project.

C. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Articles 220, 225, 250, 410, and 500 as applicable to installation and construction of building lighting fixtures.
2. NEMA Compliance: Comply with applicable requirements of NEMA Standards Pub/No's LE 1 and LE 2 pertaining to lighting equipment.
3. IES Compliance: Comply with IES RP-1 pertaining to office lighting practices and RP-15, regarding selection of illuminance values for interior office lighting. Comply with IES RP-8, 19, 20, and PB-15 pertaining to exterior, parking, and roadway lighting practices and fixtures.
4. UL Compliance: Comply with UL standards, including UL 486A and 486B, pertaining to lighting fixtures. Provide lighting fixtures and components which are UL-listed or ETL listed and labeled.
5. American National Standards Institute (ANSI)

    a. ANSI C82.11 – Performance requirement for high frequency ballasts
    b. ANSI/IES RP-16-10 – Nomenclature and definitions for illuminating engineering
    c. ANSIE1.20 - Remote Device Management Over DMX512 Networks
    d. ANSI C62.41 – Recommended practice in low power circuits

6. International Electrotechnical Commission (IEC).

    a. IEC 61347-1 – General and safety requirements for lamp control gear
    b. IEC 61347-2-13 – Particular requirements for electronic control gear for LED modules
    c. IEC 62384 - DC or AC supplied electronic control gear for LED modules – performance requirements
    d. IEC 61000-3-2 - Harmonic current emissions
    e. IEC 61547 - EMC immunity requirements
    f. IEC 62386-101/102/207 – Digital addressable lighting interface (DALI)

7. European Mark for electrotechnical products (ENEC)

    a. EN55015 – Radio disturbances <30 Mhz
    b. EN55022 – Performance requirement for EMC, Information technology and Telecommunications equip.
    c. EN60929/IEC60929 – Performance requirement for AC supplied electronic equipment

8. Federal Communications Commission (FCC) rules – Part 15 Class B: Radio Frequency Devices.

    a. Commercial rated

9. Entertainment Services and Technology Association

    a. ESTA E1.3 - Entertainment Technology - Lighting Control System - 0 to 10V Analog Control Protocol

D. Special Listing and Labeling: Provide fixture for damp locations, wet locations, recessed in rated ceilings and walls, hazardous that are UL listed and labeled for specific use.

E. Fixtures mounted within air plenum spaces shall meet National Electrical Code, Building Code and NFPA definitions and requirements for equipment installed in plenum spaces. Assume all interior fixtures recessed mounted in or above ceilings or mounted in coves, shall be required to be suitable for use in plenums.

F. Materials and Equipment:

1. Materials, equipment, and appurtenances as well as workmanship provided under this Section shall conform to the highest commercial standards, and as specified and as indicated on drawings. Fixture parts and components not specifically identified or indicated shall be made of materials most appropriate to their use or function and as such resistant to corrosion and thermal and mechanical stresses encountered in the normal application and function of the fixtures.

2. All fixtures shall be manufactured to a consistent level of quality. Size, color, and component parts shall be identical for all fixtures of the same type.

G. Manufacturer: Minimum 5 years of experience in manufacture of dimmable electronic lighting drivers.

H. Recognized by UL for use in the US and Canada. Provide evidence of compliance upon request.

1.5 DELIVERY, STORAGE, HANDLING, AND WARRANTY

A. Deliver lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from damage.

B. Store lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, extreme temperature, humidity, laid flat and blocking off ground.

C. Handle lighting fixtures carefully to prevent damage, breaking, and scoring of finishes. Do not install damaged units or components; replace with new.

D. Provide a 5-year warranty of failure in materials, workmanship, ballast, driver, etc., in addition to and not limited to other rights the Owner may have under the contract documents. A full warranty shall apply for the first year, and a prorated warranty for the last four years.

1.6 SEQUENCING AND SCHEDULING

A. Coordinate with other work including wires/cables, electrical boxes and fittings, and raceways to properly interface installation of lighting fixtures with ceiling requirements.

B. Sequence lighting installation with other work to minimize possibility of damage and soiling during remainder of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The Contractor shall base bid for lighting fixtures on the manufacturers listed on the fixture schedule only.

B. Alternate manufacturer’s identification by means of manufacturer’s names is to establish basic features and performance standards. Alternate manufacturers or substitutions must meet or exceed the standards of the primary manufacturer listed.

C. Qualifications: The contractor is allowed 60 days after the contract has been awarded to submit independent photometric tests and samples for all approved alternate fixtures. If these fixtures fail to comply with the specification requirements at that time, the Contractor will furnish acceptable fixtures at no additional cost to the Owner and with no delay to the project.

D. Any submittals for cost reduction alternates or value engineering shall include unit prices for the specified manufacturer, the specified equal manufacturer, and the proposed alternates. Refer to Part 1.3 for approval process.

2.2 FIXTURES MODIFICATIONS

A. the Contractor shall supply the project with fixtures to be modified by the Manufacturer as required by the Project Fixture Schedule, Fixture Cuts, or drawings.

B. Modified fixtures include, but are not necessarily limited to Type F4 (catenary mount) and Type F7 (mounting bracket).

2.3 FINISHES

A. Fixture finishes shall be applied in a manner that will assure a durable, wear resistant surface.

1. Prior to finishing, all surfaces shall be free from foreign materials such as dirt, rust, oil, polishing compounds and mold release agents.
2. Where necessary, surfaces shall be hot cleaned by accepted chemical means and shall receive corrosion inhibiting (phosphating) treatment assuring positive paint adhesion.
3. Provide all ferrous metal surfaces with a protective finish having rest-inhibiting properties. Painted finishes shall be a minimum of 1.5 mils thick and shall have a balance between hardness and bending properties suitable for application. White finishes shall have 87 percent minimum reflectance. Application and cleaning shall be performed so as to prevent any loss of reflectance capability.

2.4 WIRING

A. All wiring shall comply with the following:

1. All wiring devices within lighting fixtures or from the fixture to the splice with the project branch circuit wiring shall be as specified below.
2. Wiring shall be protected with tape or tubing at all points where abrasion may occur.
3. Wiring shall be concealed within the fixture construction except where design or mounting dictates otherwise.
4. Connections of wires to terminals of lampholders and other accessories shall be made in a neat and workmanlike manner and electrically and mechanically secure with no protruding or loose strands. The number of wires extending to or from the terminals of a

lampholder or other accessory shall not exceed the number which the accessory is designed to accommodate.

5. Joints in wiring within lighting fixtures and connections of the fixture wiring to the wiring of the building shall be specified in Division 26.
6. Wiring channels and wireways shall be free from projections and rough or sharp edges throughout, and all points or edges over which conductors must pass and may be subject to injury or wear shall be rounded and bushed.
7. Insulated bushings shall be installed at points of entrance and exit of flexible wiring.
8. Junction boxes attached to lighting fixtures shall be manufactured in accordance with the National Electrical Code and approved for the number of conductors indicated on the drawings. Supplementary junction boxes shall be installed where required to comply with Code.
9. When exposed, all junction boxes and conduit to be painted as per the Architects' direction at no additional cost to the Owner.
10. Cord types shall be suitable for application and be fitted with proper strain relief and watertight entries where required by application.
11. Furnish code approved wiring in ceiling cavities forming air plenums. Wiring and raceway installed in plenums shall be suitable for plenum use. All interior lighting raceway shall be suitable for plenum use.

2.5 MARKING OF FIXTURES

A. Fixtures designed for voltages other than 110-125-Volts shall be marked with operating voltage.

B. Fixtures equipped for operation of rapid start lamps shall be clearly marked "USE RAPID START LAMPS ONLY."

C. Fixtures designed for operation of lamps below the rated enclosure maximum shall be clearly marked "Lamp Watts Not to Exceed _____" to maintain the design energy load.

2.6 THERMAL PROTECTORS

A. Provide thermal protectors as required by the N.E.C., or as required by local Code, to prevent operation of lighting fixtures in enclosed spaces or adjacent to combustible materials at temperatures at or above 90ºC (194ºF).

B. Fixtures approved for operation in fire-resistant material at temperatures up to 150ºC (302ºF) shall be plainly marked.

C. All incandescent fixtures shall be provided with thermal protectors except where otherwise indicated or where approved for operation without such protectors by the N.E.C. and by the local building authority.

2.7 LAMPS

A. Provide lamps as shown in the fixture schedule or as modified in reviewed shop drawings.

B. Lamps as specified for the individual luminaries or lighting equipment shall be delivered and installed in fixtures and lighting equipment leaving these completely lamped and in normal operating condition.

C. Provide all incandescent lamps inside frosted, unless noted otherwise. Refer to light fixture schedule for details.

D. LED lamp sources shall conform to the IESNA LM-79 and LM-80 published standards. They shall have a color temperature binning that does not exceed +/-200K. LED Lamp life shall be rated at 70% of initial lumens remaining. LED drivers shall be used @ 100% output for lumen output rating and not be underdriven or overdriven.

E. Lamps shall be by the same manufacturer and produced by the following acceptable manufacturers:

1. General Electric Lighting
2. Osram Sylvania, Inc.
3. North American Philips Lighting
4. Venture Lighting International, Inc.
5. Others only where specified.

2.8 LAMPHOLDERS

A. Lamp sockets shall be rigidly attached to fixture enclosure or housing.

B. Incandescent lamp sockets shall be made of heavy-duty heat-resistant porcelain.

C. Provide nickel plated brass or nickel and silver plated contacts in all lampholders for tungsten halogen lamps, lamps in outdoor fixtures, and mogul base incandescent.

D. All lamp sockets shall be suitable for the indicated lamps and shall be set so that lamps are positioned in optically correct relation to all lighting fixture components. All adjustable sockets shall be preset at the factory for lamp specified.

2.9 LIGHT EMITTING DIODE (LED)

A. All LED light fixtures shall conform to the IESNA LM-79 and LM-80 published standards.

B. Initial delivered lumens – thermal losses should be less than 10% when operated at a steady state at an average ambient operating temperature of 25°C, and optical losses should be less than 15%.

C. Average Delivered Lumens – Average delivered lumens over 50,000 hours should be minimum of 85% of initial delivered lumens.

D. LED boards, drivers and associated components shall have a Warranty of 5 years on the LEDs, 5 years on the driver, 5 years on the paint finish.

E. LED Power Supply

1. Power supplies shall meet or exceed the technical and performance standard all power supplies shall meet or exceed the following basis:

a. The LED power supply shall accept an input voltage range of 120-277VAC +/- 10%
b. The LED power supply shall have a power factor of 0.9 or higher
c. The LED power supply shall have a maximum THD of 20% at full load (@ 120V or 277V)
d. The minimum efficiency of the LED power supply shall be 85% at full load
e. Control Input

1) Power supplies with dimmable outputs shall indicate whether the output is Pulse Width Modulated (PWM), Constant Current Reduction (CCR), or a combination. For PWM dimming, the frequency shall be >1000hz to minimize risks of strobe effect.
2) Phase control

a) Dimming of the input power source down to 1% of the power supply output. It shall be the responsibility of the installing contractor to coordinate phase control dimming technology with the lighting control devices.

f. Phase-controlled power supply shall indicate the preferred method of phase-controlled input (forward or reverse)

1) 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers

a) Compatible with Passive or solid state current sink devices down to 1% of the power supply output
b) The 0-10VDC dimming circuit shall not exceed 15V DC in an unloaded or loaded condition.
c) Must meet IEC 60929 Annex E for General White Lighting LED drivers
d) Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 mA per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
e) Must meet ESTA E1.3 for RGBW LED drivers

f) Interface with 0-10 dimming driver shall be completely isolated from AC power to prevent AC voltage on the 0-10V wires.
g) The available sink current from each driver on the 0-10V interface shall not exceed 1 mA.

2) Digital (DALI Low-Voltage Controlled) Dimming Drivers

a) Must meet IEC 62386

3) Digital Multiplex (DMX Low-Voltage Controlled) Dimming Drivers

a) Must meet DMX / RDM: USITT DMX512A and ANSI E1.20 (Explore & Address)
b) Capable of signal interpolation and smoothing of color and intensity transitions

g. The LED power supply shall comply with FCC Part 15 (Class A or Class B)
h. The LED power supply shall have a Class A sound rating.
i. The LED power supply shall have two cycle inrush current when power is applied that does not exceed 20 times steady state current per power supply.
j. Total Harmonic Distortion less than 20% percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.
k. The LED power supply shall have transient protection – ANSI C62.41 Category A
l. The LED power supply shall be UL 8750 Class 2 Recognized or Listed, Damp rated.
m. The LED power supply output voltage should not exceed 60V (Complies with Class 2 for US)
n. Driver should be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.
o. The LED Power supply shall have a minimum of 50,000 hours of rated lifetime at maximum operating conditions.
p. The LED Power supply shall have a minimum of 5-year warranty Tc of 75C or higher point.

2.10 REFLECTORS

A. Reflectors and reflecting cones or baffles shall be as follows:

1. Absolutely free of any tooling marks including spinning lines, indentations caused by riveting or other assembly techniques.
2. No rivets, springs, or other hardware visible after installation.
3. First quality polished, buffed and anodized finish, “Alzak” or approved equal.
4. Specular finish color as selected by the Architect or as specified in the fixture schedule.

B. Other aluminum reflectors shall be as follows:

1. Formed and finished as noted on the Drawings and elsewhere in the Specification.
2. Reflectors free from blemishes, scratches, or indentations which would distort their reflective function.
3. Finished by means of the “Alzak” process or approved equal unless otherwise noted.

C. Reflector and housing shall comply completely enclose the fixture’s source in downlights in a plenum ceiling and provide the full rated output of the lamp. Fixtures that vent through the downlight reflector into the plenum are not acceptable.

2.11 LENSES

A. All lenses secured by positive means with neoprene or silicone gasketing or washers as required to hold the lens tight within a frame or attach to housing.

B. All glass lenses shall be heat treated (tempered) or sealed with a clear acrylic laminate layer to provide a “safety glass” rating. All lenses which require removal for relamping or normal maintenance shall be attached to the fixture housing by a minimal length of safety chain to prohibit the lens from falling and striking surrounding surfaces.

C. Acrylic lenses shall be 100 percent virgin acrylic polymer and colorless. For lenses with pattern of pyramids or cones, specified minimum thickness refers to distance from flat surface to base of pyramids (cones), or thickness of undisturbed material. All lenses shall be a minimum .156” thick.

D. The quality of the raw acrylic material must exceed IES, SPI, and NEMA Specifications by at least 100 percent which, as a minimum standard, shall not exceed yellowness factor of 3 after 2,000 hours of exposure in the Fade-o-meter or as tested by an independent test laboratory. Acrylic plastic lenses and diffusers shall be properly cast, molded or extruded as specified, and shall remain free of any dimensional instability, discoloration, embrittlement, or loss of light transmittance for at least 15 years.

2.12 LOUVERS

A. All louvers shall be fabricated of the specified material.

B. Louver finishes shall be provided as specified.

C. All plastic parabolic louvers shall be destaticized before and after fabrication to insure minimum maintenance.

D. All metal louvers shall be coated with anti-rust material and electrostatically painted.

E. All louvers shall be heat tested to withstand lamp operating temperatures with no deformation of shape, paint blistering or discoloration.

2.13 FIXTURE TRIMS

A. Fixtures shall have finish trim designed for the following types of ceiling systems: Ceiling Type Trim Type

1. Recessed Incandescent or LED

a. Plaster - Overlap Trim.
b. Concrete - Overlap Trim.
c. Tile - Overlap Trim.
d. Gypsum - Overlap Trim.
e. Metal Pan, Concealed M - Modular, Fit-in Support.
f. Lay-in - Modular, Tile with Flush Fit-in.

B. Provide trim details as shown on the Drawings or as specified, which are indicative of appearance and dimensional requirements. The trim finish and dimensions subject to the approval of the Architect.

C. Trimless fixtures shall be installed per manufacture’s guidelines and shall be installed and coordinated with other trades as required.

D. Mitered corners shall be continuously welded and smoothed before shop finish is applied. No lapping of trim metal for all flush-mounted ceiling trims for rectangular or square recessed fixtures.

E. Provide a mounting frame or ring with lock recessed or semi-recessed light fixture to secure the mounting frame to the ceiling and support any reflectors, trims, or lenses. Ring shall be compatible with the ceiling and of sufficient strength to rigidly support the fixture and any stress applied in relamping.

F. Catalog numbers are included in the Lighting Fixture Schedule for reference. Provide all accessories and design features described herein regardless of whether such features are included in catalog reference including, mounting hardware, louvers, lenses, filters, transformers, etc.

2.14 LIGHTING FIXTURE TYPES AND CATALOG NUMBERS

A. General: Various fixture types required are indicated on Lighting Drawing Fixture Schedule. Fixtures must comply with minimum requirements as stated herein. Review architectural drawings and specifications to verify and coordinate ceiling types, modules, suspension systems appropriate to installation.

2.15 AUXILIARY SUPPORTS FOR SUSPENDED FIXTURES

A. Provide separate and isolated suspension for all fixtures required by code and seismic requirements. This includes rod hangers, hook hangers, or single stem hangers.

2.16 EMERGENCY LIGHTING UNITS

A. Provide 90-minute battery pack emergency lighting fixtures with two lamp heads for all mechanical equipment rooms, electrical equipment room, generator area, etc. Battery units shall be self-contained, self-diagnostic, sealed, maintenance free, lead-acid type with 10-year normal life warranty.

B. Provide continuous current carrying conductor from power source to emergency battery. Conductor shall be connected ahead of any switching conductors.

C. Light produced by these emergency fixtures shall provide one foot-candle maintained have chargers and wire guards.

D. All Exit signs shall come complete with mounting hardware directional chevrons, mirrored backing and graphics. Single face exit signs shall be constructed so they can be read from only the path of egress side.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which lighting fixtures are to be installed, and associated substrate for supporting lighting fixtures. Notify Contractor in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 INSTALLATION OF LIGHTING FIXTURES

A. Contractor to coordinate exact quantities and critical dimension with field conditions.

B. Contractor to verify and coordinate that appropriate framing, support structures, mounting brackets, and other required structural connections are provided by the General Contractor or other trades to insure a timely, correct and neat installation of all luminaries.

C. Contractor to coordinate and provide any associated mounting hardware, conduit connections, or associated appurtenances to effectively install the luminaries. Provide each light fixture with complete installation instructions. All light fixtures to be installed in strict conformance with manufacturer’s recommendations and instructions.

D. Install lighting fixtures in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation," NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.

E. Exact locations of all lighting fixtures including mounting heights and plan dimensions are as per the Architectural and/or Landscape Drawings. Any ambiguities or conflicts in this dimensional information to be identified to the Architect prior to installation.

F. Provide fixtures and/or fixture outlet boxes with hangers to properly support fixture weight. Submit design of hangers, method of fastening, other than specified herein, for review by Architect.

G. Install flush-mounted fixtures properly to eliminate light leakage between fixture frame and finished surface.

H. Provide plaster frames for recessed fixtures installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

I. Fasten fixtures securely to structural supports, and ensure that pendant fixtures are plumb and level. Provide individually mounted pendant (cable or rigid stem), fixtures longer than an overall length of 2 feet with diagonal corrosion resistant aircraft cable bracing to minimize sway. Provide rigid stem hanger with ball aligners and provisions for minimum one-inch vertical adjustment. Mount continuous rows of fixtures with an additional stem hanger greater than number of fixtures in the row.

J. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified on UL Standards. 486A and 486B and the National Electrical Code.

K. Support pendant-mounted fixtures greater than an overall 2 feet in length at a point in addition to the outlet box fixtures stud with an appropriate safety cable. Certain decorative pendant fixtures may not require a safety cable, verify with Architect, Engineer or Lighting Designer.

L. Fasten electrical lighting fixtures and brackets securely to indicate structural supports, including poles/standards, and ensure that installed fixtures are plum and level.

M. Rigidly align all continuous rows of fixtures for true in-line appearance.

N. Do not install exposed fixtures, reflectors or trims until all plastering and painting that may mar fixture finish is completed. Replace blemished, dented, damaged or unsatisfactory fixtures as directed.

O. Support all fixtures independent of suspended ceiling, ductwork or piping.

3.3 FIELD QUALITY CONTROL

A. Replace defective and burned out lamps for 3 months following the Date of Substantial Completion.

B. At Date of Substantial Completion, replace lamps in lighting fixtures which have been operational over 400 hours and have a lamp life of less than 4,000 hours.

1. Refer to Division 1 sections for the replacement/restoration of lamps in lighting fixtures, where used for temporary lighting prior to Date of Substantial Completion.

C. Refer to Lighting Fixture Schedule for Attic Stock Requirements. Deliver replacement stock as directed to Owner's storage space.

3.4 AIMING AND ADJUSTMENT

A. All adjustable lighting units shall be aimed, focused, locked, etc., by the Contractor under observation of the Architect, Engineer and/or Lighting Designer. It is the responsibility of the Contractor that all fixtures scheduled for aiming shall be operational prior to the aim work session. All aiming and adjusting shall be carried out after the entire installation is complete. All ladders, scaffolds, etc., required shall be furnished by the Contractor. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely. The aiming and adjustment of luminaires must take place after the project's amenities have been completely installed. These amenities shall include but are not limited to plantings, furniture, artwork, graphics and signage.

B. Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing, aiming shall be accomplished at night.

C. Lighting levels and Lighting Scenes shall be set by the Contractor as directed by the Architect, Engineer, or Lighting Designer. All exterior work and a significant amount of the interior work during these sessions will be done at night.

1. It is the responsibility of the Contractor to have all fixtures and control systems operational prior to the level setting work sessions. The contractor will provide a factory technician from the specified Controls Manufacturer who will be present during all of the light level setting sessions to program the desired settings and scenes, as well as to instruct the Owner's maintenance staff in how to operate and program the control systems.
2. The Contractor is responsible for scheduling the light level adjustment and aiming sessions. Aiming will be required first and immediately following will be light level adjustments.
3. Three months after completion of the Project, the Control Manufacturer's factory technician will revisit the site and readjust light levels and scenes as requested by the

Owner or Design Team. This visit will be coordinated and paid for by the Contractor as part of this contract.

3.5 CLEANUP

A. Clean lighting fixtures of dirt and construction debris upon completion of installation. Clean fingerprints and smudges from lenses. Two weeks prior to substantial completion, re-clean all fixtures for dust, fingerprints, and smudges from all visible parts of the fixture.

B. Protect installed fixtures from damage during remainder of construction period.

C. At the time of final acceptance by the Owner, all lighting fixtures shall have been thoroughly cleaned with materials and methods recommended by the manufacturers, all broken parts shall have been replaced, and al lamps shall be operative.

3.6 GROUNDING

A. Provide equipment grounding connections for lighting fixtures as indicating. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

3.7 DEMONSTRATION

A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION 26 50 00

SECTION 26 90 00 - PROJECT CLOSEOUT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:

1. Copies of all warranties
2. Operation & Maintenance Manuals
3. Required tests
4. Certifications
5. Record drawings
6. Permit requirements

B. The contractor shall compile a closeout manual which shall include:

1. A list of all required tests and a place for signoff of date completed.
2. A list of all submittals with dates of acceptance by the engineer.
3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
4. Test procedures to be used for optional systems.
5. Project close out check list.

C. The final closeout manual shall include the following:

1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
3. Copies of all warranties.

D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

1.2 SUBMITTALS

A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:

1. A list of all required tests.
2. Preliminary schedule showing major milestones for completion of the electrical and technology systems.

B. Within 30 days of the first major milestone submit the completed closeout manual as described in Part 1.

C. Within 2 weeks of substantial completion submit a completed “Project Closeout Check List”, and the Final Closeout Manual.

D. Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary - Electrical

☐ The following tests have been completed. Submit test report for record.

- ☐ Feeder Testing and Reporting (Megger Result)
- ☐ Transformers Testing and Reporting
- ☐ Grounding System Testing and Reporting
- ☐ Infrared Scans, Testing and Reporting

☐ All main components of the electrical system cleaned and vacuumed. This includes unit substations, switchboards, distribution boards, panel boards, etc. Provide ME Engineers with schedule when this is going to occur and a letter stating it has been completed.

☐ The contractor shall schedule a walk through with the engineer to inspect all feeder sizes. Covers for panel boards and distribution boards should be removed by the contractor for visual inspection of feeder sizes.

☐ The fire alarm system manufacturer shall provide the Owner/Architect with a “Letter of Certification” indicating the system is fully functional and meets all manufacturers requirements as well as code and design requirements. Fire department must sign off the system.

☐ Provide spare fuses and fuse cabinets ((1) in each switch gear room) per specifications.

☐ Panelboard directories completed with typed print outs.

☐ Record drawings submitted.

☐ All lighting control systems complete with controls fully operational for visual inspections. The lightning protection system manufacturer shall provide the Owner/Architect with a "Letter of Certification" indicating the system meets all manufacturers requirements as well as code and design requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EQUIPMENT STARTUP AND TESTING

A. Prior to completion and punch list by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

3.2 LIFE SAFETY SYSTEMS

A. All life safety systems shall be fully and successfully tested by the contractor before being witnessed by the engineer or building official.

B. The contractor shall provide a detailed test procedure, with instrumentation to be used, for approval by the engineer and building official prior to any testing.

C. Once tested by the contractor and fully operation the systems shall be demonstrated to the engineer. Once accepted by the engineer the system shall be demonstrated to the building and fire officials.

3.3 COORDINATION WITH OTHERS

A. The Division 26 contractor shall coordinate their requirements with the general contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of the Division 26, 27 and 28 systems.

3.4 PUNCH LISTS

A. The contractor shall submit in writing that the project is ready for final review by the engineer.

B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.

C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.

D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION 26 90 00

SECTION 27 05 00 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendixes: Refer to Appendix 1, Equipment Schedules within each specification section for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals but are not intended to be an all-encompassing bill of materials.

B. Part 1 and Part 3 of this specification applies to all Division 27 specification sections.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

F. Rough carpentry is specified in a Division 6 section.

1.2 SUMMARY

A. Project Expectations: **Within one week after award of contract, the Contractor shall arrange a "CA kickoff" meeting and/or conference call with the General Contractor, Construction Manager, Architect, Engineer, and Owner (when applicable) to discuss general project expectations.**

B. The term "provide" used throughout this specification and drawings shall mean "furnish, install, test, and certify".

C. Coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Construction Manager and/or General Contractor and all necessary trades to ensure successful completion of work.

D. Phasing, temporary distribution/equipment, cut-over and implementation as called out within the plans, shall be coordinated with Owner, Construction Manager and/or General Contractor, Architect, and Engineer prior to execution.

E. Extent of communications infrastructure work is indicated by Division 27 specifications and Technology drawings and schedules and is hereby defined to include, but not by way of limitation, the provisions of:

1. Raceway systems including but not limited to conduits, sleeves, telecommunication services entrance, manholes, pull-boxes, junction boxes, back-boxes, etc. as required and specified in Division 27 sections and/or select Division 26 sections. The Construction Manager and/or General Contractor shall coordinate this with the Sub-Contractor performing work and determine how scope of work is assigned. The purpose of this specification is to establish design intent and general system scope.
2. All communications infrastructure shall be provided as part of the Project including but not limited to raceway, cable, cable terminals, and comm room fit-out.
3. Backbone cables between the Main Cross-connect (MC) and each Intermediate Cross-connect (IC) or Remote Hub location. Refer to Technology Drawings (one-lines and floor plans) for specific locations and sizes.
4. Horizontal or station cables between each communication device outlet and the nearest Intermediate Cross-connect (IC) location.
5. Backbone and horizontal cable termination and terminals including but not limited to wiring panels/blocks, patch panels, fiber optic terminals and panels, and outlets/jacks.
6. Patch cords, jumper cables, and cross-connect cables to interconnect wiring terminals as well as electronic equipment.
7. Communication room hardware and component fit-out including cabinets, racks, cable tray, backboard, and raceways for terminating cable and installation of electronic equipment.
8. Power distribution within equipment racks and cabinets including power strips.
9. Grounding and bonding of all metallic hardware components to the nearest telecommunications grounding bus (TGB) bar including but not limited to equipment racks, cabinets, cable trays, ladder rack, metallic cable sheaths, wall mounted wiring terminals, conduits, sleeves, metallic ductwork, and frames.
10. All physical cable management hardware including, but not limited to: “J-hooks” in accessible ceiling areas, “D-rings” on backboards, vertical and horizontal managers on racks and cabinets, vertical and horizontal ladder-type or wire basket cable tray within communication rooms, etc.
11. Fire stopping as required. Contractor shall provide fire stopping for all low-voltage openings (including empty low voltage raceway) once cable installation is complete. Confirm specific fire stopping scope requirements with General Contractor and/or Construction Manager.
12. Testing of all communications cable infrastructure and grounding systems as noted by specification, drawings, and applicable industry standards.
13. Labeling of all communication infrastructure components, hardware, cable, and terminations with mechanically printed labels.
14. Preparation and submission of product data, shop drawings, testing reports, as-built drawings, and cabling documentation as required in this specification.
15. Construction and Installation warranties.
16. Manufacturer components, channel and solutions warranties.
17. Installation and testing of all system and components.

18. Onsite administrative and user training.
19. Manufacturer training of components.

1.3 SUBMITTALS

A. General Description and Requirements

1. Refer to Product Data and Shop Drawing Submission Checklist (appendix) at the end of this specification section for additional requirements specific to each Division 27 section.
2. Contractor shall not submit product data for review without submitting corresponding shop drawings as part of the same submittal package. Partial submittals will be returned as “revise and resubmit”.
3. Submittal Schedule:

    a. Within (1) week after award of contract, the Contractor shall submit a proposed schedule for submitting product data and shop drawings. At a minimum, the following items shall be included:

        1) Submittal date for Compliance Matrix.
        2) Submittal date for Construction Schedule.
        3) Submittal date for Product Data and Shop Drawings.
        4) Submittal date for Commissioning and/or Test Results.
        5) Submittal date for As-Builts.

    b. Within **15** days after award of contract or as dictated by the construction schedule (whichever period of time is shorter), the Contractor shall submit prefabrication submittals consisting of product data and shop drawings for approval. Partial submittals will not be accepted without prior written approval from the Architect.

4. In addition to the requirements noted herein, refer to Division 1 Specification for additional requirements. As a minimum, Contractor shall ensure all requirements listed here are met.
5. Review of the Prefabrication Submittals by the Architect and Engineer is for purposes of tracking the work and contract administration and does not relieve the Contractor of responsibility for any deviation from the Contract Documents, or from providing equipment and/or services required by the Contract Documents which were omitted from the prefabrication submittals.
6. No portion of the project shall commence nor shall any equipment be procured until the prefabrication submittals (including product data and shop drawings) have been approved in writing by the Architect. All installations shall be in accordance with the Contract Documents.
7. A detailed completion schedule shall be submitted with the prefabrication submittals.
8. Prefabrication submittals shall be accompanied by a letter of transmittal identifying the name of the project, Contractor's name, date submitted for review, and a list of items transmitted.

B. Compliance Matrix:

1. Compliance Matrix: Provide a specification compliance matrix indicating compliance or deviation for each item in the specification. Refer to the SPECIFICATION RESPONSE section within this specification and Appendix 2 for additional requirements.

C. Product Data:

1. Warranty Information: Provide all warranty information as described in this specification section for review and approval.
2. Component List: Provide complete submittal component list (i.e., table of contents) at the beginning of the submittal package. Component list and manufacturer cut-sheets shall be compiled to match the order of each Appendix. Component list shall include:

    a. Component name
    b. Manufacturer
    c. Specific product number (to clearly indicate special options, colors, etc.)

3. Cut-Sheets: Submit manufacturer's cut-sheets on all components listed within this specification and corresponding appendix. All components and parts being used shall be highlighted in color on cut-sheets to distinguish specific product/part numbers, options, colors, accessories, etc.
4. Product Substitutions: These specifications are intended to be performance based, thus all products listed in each respective Appendix 1: Equipment Schedules are "benchmark" products. The Contractor may submit (as a proposed alternate solution) substitute manufacturers and models that may be more cost effective or readily available. All substitutions shall meet or exceed the minimum functional, physical, and technical specifications. Acceptance of such substitutions is at the discretion of the Owner, Architect, and Engineer. Additionally, the requirements of Division 1 Specifications shall apply and may supersede requirements noted herein.

D. Prefabrication Shop Drawings: (Refer to Appendix-3 for additional requirements)

1. General: All shop drawings shall be provided on contractor specific title block. Contractor may use Technology Drawing files as a "starting point" for shop drawings but additional information shall be added and/or updated as noted below.
2. Symbol Legend, Abbreviations, and Description: Drawings shall include the following:

    a. General project information, contractor company name, etc.
    b. Descriptions of all abbreviations and symbols
    c. Typical device mounting heights
    d. General notes and/or scope description, exclusions, etc.

3. One-Line Wiring Diagrams: Provide backbone raceway one-line, backbone and horizontal cabling, copper pair and fiber strand counts, cable quantities, splice

enclosures, etc. Include conduit allocation and fill ratios for all conduits on the raceway one-line diagram.

4. Site Plan: Provide complete site and exterior plans indicating all site and building façade mounted communication device outlets, equipment, and components proposed to be installed. Additionally, manholes, pull-boxes, and all major raceway routing shall be indicated for conduits 2-inches and larger. Shop drawings shall represent final conduit routing and manhole and/or pull-box placement as coordinated and/or confirmed with Service Provider, Civil Engineer and other trades.
5. Enlarged Plans:

    a. Provide ¼" = 1'-0" enlarged plans of all communication rooms (as applicable) indicating the position of equipment cabinets and/or racks, wiring terminals, patch panels, grounding equipment, cable tray, fiber and copper terminations, and other low voltage systems equipment layout within the rooms.
    b. Shop drawings shall clearly indicate final conduit/riser (core drill and/or block-out) locations and sizes as coordinated and/or confirmed with Structural Engineer and any field conditions that impact proposed location.
    c. Shop drawings shall clearly indicate areas where equipment clearances may be limited, for review and approval by Owner, Architect, and Engineer.

6. Details: Document method of attachment of racks to the floor and ladder tray systems, method of attachment of wall mounted distribution frames, grounding details indicating grounding method for cabinets, racks, cable tray, cable management, and power details for rack mounted power distribution.
7. Elevations:

    a. Rack elevations (produced in Visio, ACAD, or similar) indicating exact placement of patch panels, fiber terminals and enclosures, vertical and horizontal cable managers, rack mounted power strips or distribution units, empty rack-units, etc.
    b. Wall elevations shall detail any and all known components to be mounted on the walls, whether those items are provided by Contractor producing shop drawings or not. Components shall include, but not be limited to, electrical and/or fire alarm panels, security panels, distributed antenna system (DAS), CATV, communication infrastructure distribution frames with block size, cable routing, cable management, pair counts, method of attachment, etc.

8. Drawing Scale: Shop drawings shall be drawn to scale and completely dimensioned as to clearly show construction detail.
9. Labeling: Provide documentation of all labeling schemes for conduit, back-boxes, cables, outlets, wiring blocks and/or patch panels, device faceplates, etc.
10. Documentation: Provide submittals and documentation as required by the project manual (in addition to electronic copies) for review or as indicated in Division 1 general conditions.

E. Record As-Built Drawings:

1. All record as-built drawings shall be provided on contractor specific title block. Contractor may use Technology Drawing files and/or shop drawings as a "starting point" for as-built drawings. As-built drawings shall comply with shop drawing requirements above, but shall be updated to align with actual installation. Additionally, area plan drawings shall indicate all device labeling including, but not limited to, tele/data port labels.

1.4 QUALITY ASSURANCE

A. Codes and Standards: All materials and installations shall comply with current applicable codes and standards, including but not limited to:

1. TIA-526: Standard Test Procedures for Fiber Optic Systems.
2. TIA-568-C.0: Generic Communications Cabling for Customer Premises.
3. TIA-568-C.1: Commercial Building Communications Cabling Standards, Part 1: General Requirements.
4. TIA-568-C.2: Balanced Twisted-Pair Communications Cabling and Components Standard.
5. TIA-568-C.3: Optical Fiber Cabling Components Standard.
6. TIA-569-A: Commercial Building Standard for Telecommunications Pathways and Spaces.
7. TIA-606-A: Administrative Standard for Commercial Telecommunications.
8. ANSI/J-STD-607-A: Commercial Building Grounding and Bonding Requirements for Communications.
9. TIA-758-A: Customer-Owned Outside Plant Communications Cabling Standard.
10. TIA-942: Telecommunications Infrastructure Standard for Data Centers.
11. ASTM: American Society for Testing and Materials
12. BICSI CO-OSP Design Manual (current edition): Customer-Owned Outside-Plant Design Manual.
13. BICSI Electronic Safety and Security (ESS) Design Reference Manual (current edition).
14. BICSI TDM Telecommunications Distribution Methods Manual (current edition).
15. TIA TSB67: Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling.
16. ICEA: Insulated Cable Engineers Association
17. IEEE-802.3: 10Mb/s, 100Mb/s, 1Gb/s, and 10Gb/s Ethernet Standards as applicable based on media types (twisted pair copper, fiber optics, etc.)
18. IEEE-802.3ak: 10Gb/s Ethernet (evolving copper standard).
19. IEEE-802.3af: Power-over-Ethernet (PoE).
20. IEEE-1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
21. IEEE-241: Recommended Practice for Electric Power Systems in Commercial Buildings.
22. ISO/IEC 11801: International Standard on Information Technology – Generic Cabling of Customer Premises.

23. NESC: National Electrical Safety Code
24. NEMA Std 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
25. NFPA-70/NEC: National Electrical Code.
26. NFPA-72: National Fire Alarm and Signaling Code
27. UL Compliance: Provide products which are UL-listed and labeled.
28. USDA Bulletin 1751F-643: Underground Plant Design.

B. Manufacturer and Product Qualifications

1. Provide products from manufacturers regularly engaged in the production of communications infrastructure components, including but not limited to, raceway, horizontal copper cabling, copper and fiber optic backbone cabling, and connecting hardware.
2. Provide products from manufacturers whose products of similar types, capacities, and characteristics have been in satisfactory use in similar type projects for not less than five years.

C. Contractor Qualifications:

1. Firms with at least seven (7) years of successful installation experience with projects utilizing communications structured cabling, media systems, infrastructure, raceway and equipment similar to that required for this project.
2. The company shall have a fully staffed office with technical installations support personnel within 30 miles of the project. (Exceptions to this shall be confirmed through approval by the Owner, Architect, Contractor, and Engineer.)
3. The Low Voltage Raceway Contractor shall be a certified installer (current and in good standing with proven history) of the selected manufacturer’s raceway systems and shall provide a 25-year warranty on installation and applications.
4. The Low Voltage Cabling Contractor shall be a certified installer (current and in good standing with proven history) of the selected manufacturer’s structured cabling systems, and shall provide a 25-year warranty on structured cabling installation and applications.
5. The company shall have a BICSI RCDD on staff.

D. All materials shall be Underwriters Laboratories (UL) or Intertek Testing Services (ETL) Listed unless otherwise indicated.

E. Coordinate with local communications service provider(s) for primary and diverse service to Telecommunications Demarcation location(s) within the facility.

F. Coordinate with electrical work and other trades to properly interface installation of telephone system with other work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment and components in factory-fabricated containers or wrappings, which properly protect equipment from damage.

B. Store equipment and components in original packaging. Store inside in a well-ventilated space protected from weather, moisture, soiling, humidity, and extreme temperatures.

C. Handle equipment and components carefully to prevent damage. Do not install damaged units or components; replace with new.

1.6 SEQUENCING AND SCHEDULING

A. All work shall be reviewed and coordinated with the Construction Manager and/or General Contractor prior to commencing.

B. Communication systems, infrastructure, raceway and equipment are sensitive to environmental conditions including but not limited to temperature, dirt, dust, and water. The contractor shall ensure the storage and installation of all communication components are sequenced and scheduled accordingly to prevent any damage, loss of performance, and warranty void of such systems. All mis-installed components shall be replaced with new parts and re-installed at the Contractor’s expense.

C. Coordinate installation with Structural, Electrical, HVAC, Plumbing, Fire Protection, and other trades to eliminate disruption and/or conflict with other systems.

D. Coordinate underground installation with Civil, Structural, Electrical, and other trades to eliminate disruption and/or conflict with other systems (paving, curb and gutter, etc.).

E. Sequence installation of communications systems and infrastructure with other work to minimize possibility of damage and soiling during remainder of construction.

1.7 PROJECT SITE CONDITIONS

A. Prior to submitting a proposal, the Contractor shall inspect the Contract Documents, and shall become fully informed as to laws, ordinances, and regulations affecting the project. The Contractor shall immediately bring to the Owner, Architect, and Engineer’s attention, in writing, any existing condition or statute that contradicts, is in conflict with, or negates the Contract Documents. Failure of the Contractor to become fully informed as to all above mentioned items shall in no way relieve the Contractor from any obligations with respect to their proposal.

B. The Technology Drawings depict equipment locations, backboxes, conduit runs, cabling, etc. in a schematic manner. Field conditions and coordination with related trades may warrant relocations of field devices. No additional compensation will be allowed due to these revisions.

1.8 WARRANTY

A. The manufacturer shall provide a warranty with a minimum term of 25-years for structured cabling and all communications cable infrastructure components. This warranty shall cover all components including cables, jacks, patch panels, and wiring panels, etc. to maintain the specified performance, physical criteria, and applications assurance. Any such components, link, or channel shall be replaced by the Manufacturer at no cost to Owner during this period. The Contractor and Manufacturer shall submit all information and documentation on Warranty.

B. A one (1) year warranty on the Work shall be provided by the Contractor. If, within one (1) year after the date of final acceptance of the installation or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or provided by a manufacturer, any of the work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition. Such notice shall be provided by Owner representatives, to be identified, either verbally or in writing.

C. Nothing contained in the Contract Documents shall be construed to establish a shorter period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents or any manufacturer's warranty. The establishment of the time period noted above, after the date of final acceptance or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents, relates only to the specific obligation of the Contractor to correct the work or equipment, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the work or equipment.

D. If system operation is not fully restored during the warranty period within two (2) business days, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.

E. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities, provided that the expansion is done by a firm which is an authorized dealer or agent for the equipment of system being expanded.

1.9 SPECIFICATION RESPONSE

A. Compliance

1. Provide a specification COMPLIANCE MATRIX indicating compliance or deviation for each item in the specification. The matrix shall be comprised of a list of all numbered paragraphs that appear in this Specification. This matrix is critical for proposal evaluation. Failure to submit may result in the disqualification of the bid. See example Compliance Matrix template in Appendix 2.
2. Additionally, as described in this Specification, bidders shall submit the following information with their submittal:

    a. Manufacturer's literature sheets for all standard manufactured items included in the equipment list and as proposed in the Voluntary Alternate Bid form, if applicable.
    b. Workload and capability statements. The statements shall detail projects that will be active during the completion of this project, and the manpower that would be available for this project.
    c. Confidentiality and return statements. The statements shall guarantee that the Contract Documents shall not be copied or distributed physically or verbally. The Contractor shall also assure the Owner that the Contract Documents shall be returned in their entirety upon request. The successful Contractor will be provided with as many copies as requested.
    d. Copy of manufacturer’s certification certificate.

1.10 DEFINITIONS

A. Acronyms and Definitions

1. Refer to Technology Symbol Legend and Abbreviations shown on drawings.

PART 2 - SPECIFICATIONS

2.1 GENERAL REQUIREMENTS

A. Refer to each of the specification sections listed below for requirements:

1. 27 05 26: Telecommunications Grounding and Bonding
2. 27 05 33: Telecommunications Raceway and Boxes
3. 27 05 36: Cable Trays
4. 27 05 43: Underground Ducts, Raceways and Manholes
5. 27 11 00: Communications Equipment Room Fit-out
6. 27 13 13: Communications Copper Backbone Cabling

7. 27 13 23: Communications Fiber Optic Backbone Cabling
8. 27 15 00: Communications Horizontal Cabling

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. General:

1. The Contractor shall comply with all project expectations and submittal requirements as indicated in Part 1 of this specification. This includes initiating a “CA kickoff” meeting to discuss general project expectations with the project team.
2. Examine areas and conditions under which communications systems and infrastructure are to be installed. Notify Owner, Architect, and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer.
3. The Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.
4. The Contractor is required to coordinate their efforts with the other trades and sub-contractor who may be working within the same vicinity to avoid conflict and lost time.
5. The Contractor shall be responsible for furnishing all materials indicated on the drawings or as specified herein for a complete communications system.
6. The Contractor shall supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.
7. All communications infrastructure shall be installed in an aesthetically pleasing fashion. All surface raceway in new buildings must be approved by the Owner, Architect, and/or Engineer.
8. All communications infrastructure shall be installed for optimal performance.
9. All communications infrastructure shall be installed to allow for convenient operation, testing, and easy adds, moves, and other changes in the future.
10. All components noted in Technology drawings and specifications shall be provided and completely setup and installed.
11. The Contractor shall verify space requirements and locations before starting cable installations and terminations. Inappropriate conditions shall be immediately reported to Construction Manager or General Contractor, Owner, Architect, and Engineer prior to initiating installation.
12. The contractor shall not install any component in a manner or condition that will void manufacturer and/or contractor warranty. Any such conditions that prevent an acceptable install shall be immediately reported to Construction Manager or General Contractor, Owner, Architect, and Engineer prior to initiating installation. All mis-installed components will be removed and replaced with new at the Contractors expense. No additional cost will be submitted to Owner.

B. Communications Room Fit-out:

1. Construction within communication rooms must be substantially complete before the installation of telecommunications cabling. This includes, but is not limited to, the installation of plywood backboard, cable tray or ladder rack, electrical outlets, light fixtures, sprinklers and ductwork. All walls shall also be painted before the installation of telecommunications cabling.
2. Communications rooms must be free from dust, dirt, and other foreign materials before the installation of any termination hardware or the termination of copper or fiber optic cables. The door to the telecommunication rooms must be installed and closed during termination.
3. Floor to floor distribution shall be provided with concrete floor sleeves or conduits as noted on the drawings, and as required by the architectural design.

C. Communications Raceway Infrastructure:

1. Contractor shall provide conduits through walls and across inaccessible ceiling spaces to ensure unobstructed pathway back to the nearest communications room or cable tray.
2. Provide protective cable bushings on all conduits immediately after installation.
3. Use only electrical 45º or 90º conduit elbows with long bend radii as follows:

    a. 6:1 bend radius of the inside conduit diameter for sizes less than 2-inches.
    b. 10:1 bend radius of the inside conduit diameter for sizes 2-inches and greater.

4. Do not place more than two 90º sweeps or exceed 100 ft. between pull boxes without providing a pull box.
5. Fire-seal all raceway penetrations and openings to maintain fire rating after communications cables are installed.
6. Cable fill in riser conduits shall not exceed 40% cable fill.
7. Where applicable, the Contractor shall verify existing cable fill in riser conduit before installation of additional cables so as not to exceed 40% cable fill. Contractor will be responsible for installation of additional riser conduit, where additional cables to be added will exceed the 40% cable fill.

D. Communications Cabling Infrastructure:

1. Contractor shall not paint cables and/or spray cables with fire proofing material as it can affect cable performance and will void the cable warranty.
2. All communications cable routed within communications rooms shall be bundled and combed to provide a neat and organized appearance. Cables shall be bundled using only manufacturer and industry approved Velcro wire ties (zip ties shall not be used) with tensions that do not deform and damage cable resulting in loss of transmission or performance. Any bundles and combing methods used shall not exceed manufacturer or industry standards recommendations for that cable type.
3. Contractor shall provide dedicated J-hooks at 48-inches on-center for all communications cabling not run in conduit or cable tray.

4. The contractor shall not install any cable in conduits that do not have the appropriate protect bushings on conduit ends. All mis-installed cable will be removed, bushings installed, and new cable re-installed at the Contractors expense. No additional cost will be submitted to Owner.
5. Cable bends shall not be greater than that recommended by the manufacturer of the cable.
6. Care shall be taken so as not to damage cable during the installation process and that manufacturer's pull tension specification is not exceeded.
7. Provide a minimum 8'-0" and maximum 10'-0" of slack. Loop at the IC-rooms to be contained on the horizontal cable tray or ladder rack.
8. Provide a minimum of 3'-0" of slack for all device cable termination points. Slack shall be contained in accessible ceiling near the final termination point or in the cable tray nearby when continuous conduit is routed back to cable tray.
9. Communications cabling that is bundled within cable trays and supported from j-hooks shall be snugly wrapped using Velcro reusable cable ties as minimum of every 3'-0" for cable organization. Velcro ties shall be tightened so as not to deform cable jackets and thus affect cable performance. Plastic cable tie wraps shall not be used anywhere on the project.
10. Any other Low Voltage scopes including but not limited to BMS, Fire Alarm, AV and Broadcast cabling that are run in common communications infrastructure shall comply with the installation requirements in the division 27 specifications. The Contractor shall ensure that all scopes that use the installed infrastructure comply with these guidelines or provide dedicated pathways for those systems.

3.2 LABELING

A. All communications components shall be clearly labeled using labeling devices (i.e., handwritten labels are not acceptable) with white label and black text. All labels shall be consistent font type and size (for respective components).

B. The following indicates the recommended labeling scheme for various components. The final labeling scheme shall be coordinated with the Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.

1. Backbone Cables (to TRs):

a. Label provided at both ends shall indicate origin room such as MTR (Main Telecom Room), the TR room designator (where cable is routed to) and a cable number if multiple cables are provided to a single TR location.

1) Example: "MTR-3A" = single cable from MTR to TR on level 3, riser A.
2) Example: "MTR-3A-2" = cable 2 of multiple cables from MTR to TR on level 3, riser A.

2. Backbone Cables (to Remote Hubs):

    a. Label provided at both ends shall indicate point of origin (i.e., MTR or TR designator), enclosure designator (where cable is routed to) and a cable number if multiple cables are provided to a single TR location.
    b. Enclosure boxes shall be indicated by an "E" followed by a number for the enclosure.

        1) Example: "MTR-E1" = single cable from TR to enclosure box "1".
        2) Example: "3A-E4" = single cable from TR-3A to enclosure box "4".

3. Horizontal Cables:

    a. Label provided at both ends shall indicate point of origin (i.e., MTR or TR designator), patch panel designator (A, B, C, etc.), and port number (01, 02, 03, etc.).

        1) Example: "MTR-A.23" = horizontal cable originating from port "23" on patch panel "A" at the MTR.
        2) Example: "3A-C.23" = horizontal cable originating from port "23" on patch panel "C" at TR-3A.

4. Device Faceplates:

    a. Label provided at each faceplate shall indicate point of origin (i.e., MTR or TR designator) for cables terminated at that device.

        1) Example: "MTR" = Device faceplate for cables originating from the MTR.
        2) Example: "3A" = Device faceplate for cables originating from TR-3A.

5. Device Outlets:

    a. Label provided at each device jack/outlet shall indicate patch panel designator (A, B, C, etc.) and port number (01, 02, 03, etc.) for cable point of origin.

        1) Example: "A.23" = horizontal cable originating from port "23" on patch panel "A" at the room indicated on the faceplate label.

6. Patch Panels (Horizontal and Backbone Cable Terminations):

    a. Labels provided at patch panels for HORIZONTAL cable terminations shall start with "A" for the first patch panel (in each room) and letter sequentially (B, C, etc.) thereafter.
    b. Labels provided at patch panels for BACKBONE cable terminations shall start with "AA" for the first patch panel (in each room) and letter sequentially (BB, CC, etc.) thereafter.

c. Patch panel ports shall be labeled for each panel starting with “1” or “01” and numbering each port sequentially.

7. Fiber Termination Panels

a. Label provided at termination panels for backbone or horizontal fiber optic cabling shall start with “1” for the first panel (in each room) and number sequentially (2, 3, etc.) thereafter.
b. Fiber termination panel ports shall be labeled for each panel starting with “1” or “01” and numbering each port sequentially.

8. Wiring Blocks (Copper Backbone Terminations, if applicable)

a. Label provided at termination panels for copper backbone cabling shall start with “1” for the first block (in each room) and number sequentially (2, 3, etc.) thereafter.

9. Cabinets / Racks

a. Label provided at cabinets shall start with “CABINET-1” for the first cabinet (in each room) and number sequentially (CABINET-2, etc.) thereafter.
b. Label provided at racks shall start with “RACK-1” for the first rack (in each room) and number sequentially (RACK-2, etc.) thereafter.

10. Grounding Busbars

a. Labels are not required for the grounding busbars.

11. Grounding Conductors

a. Label provided at the TMGB end of the Telecommunications Bonding Backbone (TBB) shall indicate the Communications Room where the cable originates from.

1) Example: “5A” = TBB originating from TR-5A, routed down through Riser-A Communications Rooms and terminated on the TMGB.

b. Label provided at each end of a Grounding Equalizer (GE) cable interconnecting two I-TGBs shall indicate both Communications room designators.

1) Example: “3A-3D” = GE routed between I-TGBs in TR-3A and TR-3D.

c. Label provided at each end of grounding cable routed from a ground busbar to the nearest Electrical Ground Busbar shall indicate the Communications room designator and “EGB” for nearest “Electrical Grounding Busbar.”

1) Example: “3A-EGB” = Grounding conductor routed between TGB in TR-3A and the EGB in the nearest Electrical Room.

d. Label provided at each end of the Equipment Bonding Conductors (EBC) interconnecting each rack, cabinet, ladder rack, etc. within a Communications Room back to the TGB or TMGB shall start with "1" for the first cable (in each room) and number sequentially (2, 3, etc.) thereafter.

12. Conduits

    a. Label provided each end of Low Voltage conduits shall indicate the point of origin for the opposite end, such as the Communications Room designator or device location Room Number.
    b. Final room number labeling shall be coordinated with the Owner, Architect, and Engineer prior to initiating work.
    c. Horizontal device conduit originating from a nearby cable tray (if applicable) shall indicate "TRAY" at the device end and the device location (i.e., room number) at the cable tray end.
    d. Horizontal device conduit originating from accessible ceiling directly above a device does not require labels at either end.
    e. Conduit sleeves (10-ft or shorter) do not require labels at either end.

13. Pull-boxes

    a. Label provided pull-boxes or conduit ends terminating into a pull-box shall clearly indicate where each conduit originates from, based on "conduit" section above.

END OF SECTION 27 05 00

APPENDIX 1 - EQUIPMENT SCHEDULE

NOTE: There is no product number appendix for this section. Refer to other Division 27 specification sections for specific product information.

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

APPENDIX 3 - PRODUCT DATA & SHOP DRAWING SUBMISSION CHECKLIST

NOTE: Contractor shall utilize checklist below to ensure comprehensive product data and shop drawings are submitted for review, including submittals compiled between multiple sub-contractors (as applicable). This checklist is intended help establish submittal expectations specific to each specification section and to serve as a pre-check document for each contractor. Refer to submittal section of these specifications for additional requirements.

	GENERAL ITEMS
	Compliance matrix
	Proposed project schedule (procurement, installation, final testing/punch, etc.)
	PRODUCT DATA
	Manufacturer warranty information
	Equipment component list
	Equipment specification sheets
	Refer to 27 05 00 section 1.3-C for additional requirements.

	SHOP DRAWINGS
	27 05 00 (General requirements, applicable to all specification sections)
	All shop drawings, product data and compliance matrix to be submitted together
	Combined legends, plans, details, etc. may be provided to encompass multiple specification sections
	Refer to 27 05 00 section 1.3-D for additional requirements.

	27 05 26
	27 05 26 and 27 11 00 to be submitted together
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate all cable types/rating, routing, connection points, labeling, etc.
	Details: indicate busbar components, connection types/points, etc.

	27 05 33
	27 05 33, 27 05 36, and 27 05 43 to be submitted together
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate riser conduits / tray, conduit allocation per system (including spares), etc.
	Site plan: indicate other utilities, manholes, conduit types, entry points, light pole tie-ins, etc.
	Floor plans: indicate rated walls/floors, tray/conduit routes, floor boxes, pull-boxes, plenum boxes, etc.
	Details: indicate conduit support systems, grounding, fire-proofing methods, etc.

	27 05 36 (submit cable tray specific shop drawings with RCPs shown)
	27 05 33, 27 05 36, and 27 05 43 to be submitted together
	Legend: indicate symbol key (including mounting height tags), scope clarification notes, etc.
	RCPs: indicate ceiling types, rated walls/floors, tray/conduit routes, access/clearances, etc.
	Details: indicate tray support systems, grounding, fire-proofing methods, etc.

	27 05 43
	27 05 33, 27 05 36, and 27 05 43 to be submitted together
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	Site plan: indicate other utilities, manholes, conduit types, entry points, light pole tie-ins, etc.
	Floor plans: indicate conduit stub-up locations within building, conduit type transition points, etc.
	Details: indicate conduit trench, spacers, grounding, etc.

	27 11 00
	27 05 26 and 27 11 00 to be submitted together
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	Floor plans: indicate rack positions, ladder rack, conduit allocation and stub-up locations, etc.
	Wall elevations: indicate wall mounted cable tray, conduit stub-ups, wall mounted SCPs, CATV, DAS, etc.
	Rack elevations: indicate patch panels, cable managers, PDUs, UPS, network equipment, etc.
	Details: indicate cable tray mounting details, conduit supports, rack-to-floor attachments, etc.

	27 13 13
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate all cable types/rating, routing, termination types, labeling, etc.
	Rack elevations: submit with 27 11 00
	Details: indicate termination plate details and placement in remote enclosures, AV racks, etc.

	27 13 23
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	One-lines: indicate all cable types/rating, routing, termination types, labeling, etc.
	Rack elevations: submit with 27 11 00
	Details: indicate termination plate details and placement in remote enclosures, AV racks, etc.

	27 15 00
	Legend: indicate symbol key, labeling scheme, scope clarification notes, etc.
	Site plan: indicate OSP cable routes, encoder locations, light poles, pedestals, etc.
	Floor plans: indicate updated comm room divider lines, device labels, typical conduit paths, etc.
	Rack elevations: submit with 27 11 00
	Details: indicate termination plate details and placement in remote enclosures, AV racks, etc.

SECTION 27 05 26 - TELECOMMUNICATIONS GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals, but are not intended to be an all-encompassing bill of materials.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

F. Rough carpentry is specified in a Division 6 section.

1.2 SUMMARY

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Extent of telecommunications grounding and bonding work is indicated by Technology Drawings (one-line, enlarged plans, and details) and as specified herein. Grounding and bonding work is defined to encompass systems, circuits, and equipment.

C. A dedicated telecommunications ground system shall be provided with insulated bonding backbones (TBB) as applicable, equalizing conductors (TEC) as applicable, and pre-drilled tinned copper busses (TMGB and TGB) shall be provided at each communications room to bond metallic equipment and hardware components.

D. Applications of telecommunications grounding and bonding work in this section includes, but may not be limited to: raceways such as conduits and cable trays, metallic cable sheaths, equipment enclosures, cabinets and racks, building structure, electrical power and/or grounding systems components, service equipment, etc.

E. Refer to other Division 26 and Division 27 sections for wires/cables, telecommunications raceways, boxes and fittings, and wiring devices which are required in conjunction with telecommunications grounding and bonding work; not work of this section.

1.3 SUBMITTALS

A. General Description and Requirements

1. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Product Data:

1. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

C. Prefabrication Shop Drawings:

1. One-Line Wiring Diagrams: Include one-line wiring diagrams for telecommunications grounding and bonding work which indicate layout of ground rods, location of system grounding electrode connections, routing of grounding electrode conductors, equipment grounding connections and busbars.
2. Details: Indicating grounding method for cable tray and cabinets and/or racks.
3. Labeling: Provide documentation of all labeling schemes for grounding busbars and grounding conductors.
4. Documentation: Provide an electronic copy for review or as indicated in Division 1 general conditions.

1.4 QUALITY ASSURANCE

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of grounding and bonding products, of types, and ratings required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes and plate electrodes, and bonding jumpers whose products have been in satisfactory use in similar service for not less than 5 years.

C. Installer’s Qualifications: Firms with at least 5 years of successful installation experience on projects with telecommunications grounding work similar to that required for project.

D. Codes and Standards:

1. Electrical Code Compliance: Comply with applicable local electrical code requirements of the authority having jurisdiction, and the current edition of the NEC as applicable to electrical grounding and bonding, pertaining to systems, circuits and equipment.
2. UL Compliance: Comply with applicable requirements of UL Standards No.'s 467, Electrical Grounding and Bonding Equipment", and 869 "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Std 486A, "Wire Connectors and soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL-listed and labeled for their intended usage.
3. IEEE Compliance: Comply with applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.
4. TIA Compliance: Comply with applicable requirements and recommended installation practices of the current editions of TIA Standards 568, 569, and 607.
5. BICSI Compliance: Comply with applicable requirements and recommended installation practices of the current editions of BICSI Standards TDM, CO-OSP, Data Network Design Reference Manual, and Wireless.

PART 2 - SYSTEM REQUIREMENTS

2.1 GENERAL

A. Materials and Components:

1. Provide telecommunications grounding and bonding system; with assembly of materials, including, but not limited to, cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, surge arresters, and additional accessories needed for a complete installation. Where more than one type component product meets indicated requirements, selection is installer's option. Where materials or components are not indicated provide products which comply with NEC, UL, IEEE, NEMA, ANSI, TIA, and BICSI requirements and with established industry standards for those applications indicated.

2.2 BUS BARS

A. Materials and Components:

1. Provide telecommunications grounding bus bars with a TIA J-STD-607-A style and BICSI recommended bolt pattern.

B. Telecommunications Grounding Busbar (TMGB, TGB):

1. Refer to Technology Drawings (grounding details) for additional requirements such as bonding conductor connections and dual busbar locations (such as TMGB) as applicable. Contractor shall provide multiple busbars if necessary, to accommodate the quantity of grounding cables that shall tie into the busbar, in particular the TMGB on larger projects.
2. Provide tinned copper UL listed bus with pre-drilled two-hole bonding lugs.
3. Pre-drilled holes shall be primarily for 4 AWG two-hole bonding lugs. Holes shall be a nominal diameter of 5/16-inch (8mm) with 5/8-inch (16mm) between the holes centerline.
4. Grounding busbar shall also have a minimum of (6) pre-drilled two-hole lug points for #3/0 AWG bonding lugs. Holes shall be a nominal diameter of 7/16-inch (11mm) with 1-inch (25mm) between the holes centerline.
5. Grounding busbar shall have isolated stand-offs to provide a minimum 1-inch clearance off of wall.
6. Physical Size: 20-inch x 4-inch x 1/4-inch (600mm x 100mm x 6mm).

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600V unless otherwise required by applicable Code or authorities having jurisdiction.

1. Telecommunications Bonding Backbone (TBB): Provide #3/0 AWG, unless noted otherwise.
2. Telecommunications Grounding Equalizers (GE): Provide #3/0 AWG, unless noted otherwise.
3. Tap Conductors: Provide #3/0 AWG unless noted otherwise.
4. Equipment and Component Bonding Conductors (EBC): Provide No. 4 or No. 6 AWG, insulated stranded conductors based on conductor distances.
5. ESD Floor Bonding Strap: Provide/install bonding strap in accordance with the flooring manufacturers requirements.

2.4 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Compression Fittings: All cable splices from bonding backbone to tap conductors shall use irreversible compression fittings to join cable ends.

C. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

D. Welded Connectors: Exothermic-welding kits of types recommended by Cadweld (or approved equal) manufacturer for materials being joined and installation conditions.

E. Compression Fittings: All cable splices from bonding backbone to tie cables shall use irreversible compression fittings to join cable ends.

2.5 GROUNDING ELECTRODES

A. Ground Rods and Electrodes for use in telecommunications manholes:

1. Ground Rods: Copper clad steel; 3/4 inch by 10 feet (19 mm by 3 m) in diameter.
2. Chemical-Enhanced Grounding Electrodes: Copper tube, straight or L-shaped, charged with nonhazardous electrolytic chemical salts.

a. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
b. Backfill Material: Electrode manufacturer's recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Stranded conductors shall be used for all telecommunication ground cables, unless otherwise indicated.

B. Underground Grounding Conductors: Install, #3/0 AWG insulated copper conductors in conduits.

1. Bury at least 24 inches (600 mm) below grade or below frost line (whichever is deeper).
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Telecommunications Main Grounding Bus (TMGB):

1. Refer to Technology drawings for exact location.
2. Install bus on insulated spacers 1-inch (25 mm) minimum, from wall and 12-inches (300 mm) above finished floor, unless otherwise indicated.
3. The TMGB shall be connected to the main electrical service ground bus with an insulated #3/0 (120mm^2) stranded grounding conductor installed in continuous conduits.

4. The TMGB shall be connected to building steel if existing within room with an insulated #3/0 AWG (120mm^2) stranded grounding conductor.

D. Telecommunications Grounding Bus (TGB):

1. Install in all low voltage or communication rooms. Refer to Technology drawings for exact locations.
2. Install bus on insulated spacers 1-inch (25 mm), minimum, from wall and 12-inches (300 mm) above finished floor, unless otherwise indicated.
3. The TGB shall be connected to the TMGB bus via the TBB with an insulated #3/0 AWG (120mm2) stranded grounding conductor installed in continuous conduits.
4. The TGB shall be connected to the nearest AC electrical panel ground bus with an insulated #3/0 AWG (120mm2) stranded grounding conductor installed in continuous conduits.
5. The TGB shall be connected to building steel if existing within room with an insulated #3/0 AWG (120mm2) stranded grounding conductor.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2, TIA and BICSI grounding requirements

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

3.3 EQUIPMENT AND COMPONENT GROUNDING

A. Install insulated equipment grounding conductors to all telecommunications equipment and components.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70, NEMA, ANSI, TIA and BICSI:

1. Armored and metal-clad cable sheaths.
2. Equipment Cabinets and Racks.
3. Cable trays and ladder racks.
4. Conduits sections and conduit sleeves.
5. Equipment and Power Supply Enclosures.
6. Wall mounted cable terminals.
7. Other metallic components as necessary.
8. ESD Flooring

3.4 EXAMINATION

A. Examine areas and conditions under which telecommunications grounding and bonding connections are to be made and notify Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.5 INSTALLATION OF TELECOMMUNICATIONS GROUNDING AND BONDING SYSTEMS

A. General: Install telecommunications grounding and bonding systems in accordance with manufacturer's instructions and applicable portions of NEC, NECA's "Standard of Installation", and in accordance with recognized industry practices to ensure that products comply with requirements.

B. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

C. Coordinate with other electrical and telecommunications work as necessary to interface installation of telecommunications grounding and bonding system work with other work.

D. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

E. Ground Rods: Drive rods until tops are 2-inches (50 mm) below finished floor or final grade, unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

F. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
3. Coordinate with flooring contractor prior to installation for proper installation of bonding straps installed during the flooring installation.

G. Install all connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

H. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 486A to assure permanent and effective grounding.

I. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed, which are subjected to corrosive action.

J. Install all connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.6 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding and bonding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground is over 5 ohms,

take appropriate action to reduce resistance to 5 ohms, or less, by driving additional ground rods; then retest to demonstrate compliance.

END OF SECTION 27 05 26

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:

1. This specification is intended to be performance based, with the expectation that an "end-to-end" solution is provided by one of the "pre-approved" manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish "benchmark" products from one or more of the "pre-approved manufacturers". The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Chatsworth-CPI
   b. General Cable
   c. Panduit
   d. Southwire

Table 1 - Telecom Grounding Components

Item	Part Name/Description	Manufacturer	Part Number
1	Telecom Grounding Busbar - 4"W x 20"L	Chatsworth-CPI	40153-020
		Legrand / Ortronics	GB4X20TMGB
		Panduit	GB4B0624TPI-1
2	Compression Lugs - #6AWG	Chatsworth-CPI	40162-951
		Legrand / Ortronics	CL2LB6A
		Panduit	LCC6-14JAW-L
3	C-Type Compression Taps	Chatsworth-CPI	40163-059
		Legrand / Ortronics	CTHD4666
		Panduit	CTAP4/0-4/0-X
4	3/0 Grounding Conductor (Green)	Southwire	GN:556123
		*Other	Submit for approval
5	#6 AWG Bonding Conductor (Green)	Southwire	GN:204974
		*Other	Submit for approval

Table 1 - Telecom Grounding Components			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
6	Ground Strap	Chatsworth-CPI	40159-009
		Legrand / Ortronics	GS-8
		Panduit	GACBJ

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 27 05 33 - TELECOMMUNICATIONS RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: There is no product number appendix for this section. Submit proposed raceway products as described within this specification and on the Technology Drawings.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Basic Electrical Materials and Methods section.

F. Division 26 Raceway and Boxes section for conduit connectors, fittings, and couplings.

G. Division 7 Section “Firestopping” for conduit penetrations through rated walls and slabs.

1.2 SUMMARY

A. Drawings are diagrammatic. All bends, boxes, fittings, couplings are not necessarily shown. Supply as necessary to comply with the National Electric Code.

B. This Section includes raceways for Communications and Security cabling. Types of raceways, boxes and fittings in this section include the following:

1. Electrical metallic tubing (EMT).
2. Intermediate metal conduit (IMC).
3. Rigid non-metallic conduit (RNC)
4. High-density Polyethylene conduit (HDPE)
5. Outlet boxes.
6. Junction boxes.
7. Pull boxes.
8. Bushings.
9. Locknuts.
10. Knockout closures.

1.3 SUBMITTALS

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Product Data: This section does not have a "benchmark" product Appendix; thus, Contractor shall submit product data for all applicable products as required per Technology Drawings including, but not limited to:

1. Raceways and fittings.
2. Wireways and fittings.
3. Boxes and fittings.

C. Installation Instructions: Manufacturer's written installation instructions for wireway, surface raceway, and nonmetallic raceway products.

1.4 QUALITY ASSURANCE

A. In addition to Section 27 05 00 requirements, the following shall apply to this specification section.

1. NEMA Compliance: Comply with applicable requirements of NEMA standards pertaining to raceways.
2. NEMA Compliance: Comply with applicable requirements of NEMA Stds/Pub No.'s OS1, OS2 and PUB 250 pertaining to outlet and device boxes, covers and box supports.
3. Federal Specification Compliance: Comply with applicable requirements of FS W-C 586, "Electrical Cast Metal Conduit Outlet Boxes, Bodies, and Entrance Caps."

PART 2 - SYSTEM REQUIREMENTS

2.1 METAL CONDUIT AND TUBING

A. Electrical Metallic Tubing (EMT) and Fittings: ANSI C80.3.

1. EMT shall be used for standard device outlet raceway, unless otherwise noted.
2. EMT shall be used for backbone conduit sleeves stubbed through floors.

B. Intermediate Metallic Conduit (IMC) and Fittings:

1. IMC shall be used for device outlets mounted below 10-ft in high traffic areas such as garages, loading docks, service tunnels, etc.
2. IMC shall be used for extending service entrance cable from building point of entrance to termination or transition point when the distance exceeds 50 feet.

2.2 NONMETALLIC CONDUIT AND DUCTS

A. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 and UL 651, Schedule 40 or 80 PVC.

1. RNC shall be used for all permanent underground incoming service and/or “campus” backbone conduits to additional buildings.

B. High-Density Polyethylene (HDPE) Conduit and Tubing Fittings: Schedule 40 or 80, NEMA TC 7; match to conduit or conduit/tubing type and material.

1. HDPE shall be used for all temporary underground incoming service and/or “campus” backbone conduits to additional buildings.
2. Conduit shall be smooth outer wall and ribbed inner wall design.

C. Conduit, Tubing and Duct Accessories: Types, sizes and materials complying with manufacturer’s published product information. Mate and match accessories with raceway.

D. Electrical non-metallic tubing (ENT): NEMA TC13 and UL1653.

2.3 CONDUIT BODIES AND FITTINGS

A. General: Types, shapes, and sizes as required to suit individual applications and NEC requirements. Provide matching covers with gaskets secured with corrosion-resistant screws.

B. Metallic Conduit and Tubing: Use metallic conduit bodies. Use bodies with threaded hubs for threaded raceways. Use conduit bodies conforming to UL514B.

C. EMT Conduit Bodies: Use bodies with steel set screw connectors and couplings for interior applications and steel compression gland connectors and couplings for exterior applications.

D. HDPE: Use nonmetallic conduit bodies conforming to UL651A.

E. Bushings: Insulated type, designed to prevent abrasion of wires without impairing the continuity of the conduit grounding system, for rigid steel conduit, IMC and EMT, larger than 3/4-inch size.

F. Expansion Fittings: Each conduit that is buried in or secured to the buildings construction on opposite sides of a building expansion joint and each long run of exposed conduit that may be subject to excessive stresses shall be provided with an expansion fitting. Expansion fittings for rigid steel conduit shall be hot-dipped galvanized malleable iron with factory installed packing and a grounding ring. Expansion fittings for rigid non-metallic conduit shall be of the short type in runs 25-feet (7.6m) or less, and the long type in runs 26 to 80-feet (7.9 to 24.3m). The long type shall be a two piece barrel and piston joint, providing 6-inch (150mm) of the total movement range in 3/4-inch (19-mm)through 6-inch (150mm)” conduit sizes. The short type

shall be a one piece, coupling with O-ring, providing 2-inch (50mm) of total movement range in 3/4 to 2-inch (19 to 50mm) conduit sizes.

G. Seal Off Fittings: Threaded, zinc or cadmium coated, cast or malleable iron type for steel conduits. Fittings used to prevent passage of water vapor shall be of the continuous drain type.

2.4 FABRICATED MATERIALS - BOXES

A. Device Outlet Back-Boxes: Provide galvanized flat rolled sheet-steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes (two-gang, 4 11/16-inch x 4 11/16-inch 2 1/8-inch deep (120mm x 120mm x 54mm)), including box depths as required, suitable for installation at respective locations. Construct outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

1. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Installer’s code-compliance option.
2. Outlet Box Device Covers: Provide box covers as an individual component. In no instance shall a pre-fabricated box with a fixed box cover be utilized. All device covers shall be inter-changeable in the field based on openings requirements at respective locations. Box covers shall not be used as the box mounting bracket or as the mounting mechanism.

B. Rain-tight and Weatherproof Outlet Boxes: Weatherproof devices shall be provided at all exterior locations and any location susceptible to water and other exterior conditions. Provide corrosion-resistant cast-metal rain-tight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening telecommunications conduit, cast-metal and plastic face plates with spring-hinged watertight covers (polycarbonate) suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners. Watertight cover shall allow for patch cords to be plugged in and sealed while in operation.

C. Junction and Pull Boxes: Provide galvanized code-gauge sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers. Pull boxes installed in finished spaces must be flush mounted cabinets provided with trim, hinged door and flush latch and lock to match flush mounted panel board trim. Exact size

shall meet minimum industry standards based on conduit quantities and stacking arrangement, as indicated in the table below:

Conduit Trade Size mm (in)	Width mm (in)	Length mm (in)	Depth mm (in)	Width Increase for Additional Conduit mm (in)
27 (1)	101 (4)	406 (16)	76 (3)	51 (2)
35 (1-1/4)	152 (6)	508 (20)	76 (3)	76 (3)
41 (1-1/2)	203 (8)	686 (27)	101 (4)	101 (4)
50 (2)	203 (8)	914 (36)	101 (4)	127 (5)
63 (2-1/2)	254 (10)	1067 (42)	127 (5)	152 (6)
78 (3)	305 (12)	1220 (48)	127 (5)	152 (6)
91 (3-1/2)	305 (12	1370 (54)	152 (6)	152 (6)
100 (4)	381 (15)	1525 (60)	203 (8)	203 (8)

D. Exterior junction or pull boxes, flush with grade:

1. Junction or pull box to be mounted flush with grade shall be polymer composite raintight with screw cover lids. Minimum box dimensions shall be 30-inch W x 60-inch L x 24-inch D (750mm x 1500mm x 600mm) or as indicated on the drawings. Exact size shall be provided to meet industry standards based on conduit quantities and stacking arrangement. Covers shall be polymer composite suitable for pedestrian traffic secured to box with stainless steel screws. Box to be furnished with continuous neoprene gasket to seal cover. Conduit entry shall be on side of box with bell ends.

E. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

2.5 FIRESTOPPING - UL 1489

A. Provide firestopping pillows, bricks or puttys as required in all conduit openings to maintain rating of the wall. Fireproofing shall consist of ready to use, intumescent fibrous material enclosed in a strong polyethylene envelope. Contractor shall assume this is to be included in the raceway scope of work, unless directed otherwise by the Construction Manager and/or General Contractor.

PART 3 - EXECUTION

3.1 WIRING METHOD

A. Outdoors: Use the following installation methods:

1. Exposed: Intermediate metal conduit.
2. Concealed: Intermediate metal conduit.
3. Underground, Single Run: Rigid non-metallic conduit. PVC coated GRC 90° elbows.
4. Underground, Grouped: Rigid non-metallic conduit. PVC coated GRC 90° elbows.
5. Temporary: HDPE PVC Sch40/80.

B. Indoors: Use the following installation methods:

1. Exposed (below 10 ft. to floor): Intermediate metal conduit
2. Exposed (above 10ft. or in electrical room): Electrical metallic tubing.
3. Concealed: Electrical metallic tubing.
4. Service entrance extension beyond 50-feet: Intermediate metal conduit.

3.2 INSTALLATION OF RACEWAYS

A. General: Install telecommunications raceways in accordance with manufacturers' written installation instructions, applicable requirements of NEC, NEMA, ANSI, TIA, BICSI, and as follows.

B. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

C. Clearances: Telecommunications raceway shall be routed to maintain appropriate clearances from potential interfering electrical sources per NEC, NEMA, ANSI, TIA, and BICSI requirements. Provided below are minimum requirements of key components that shall be maintained. For any instances where field conditions do not allow for the minimum clearances, the Contractor shall notify the Architect and Engineer so that an acceptable solution can be coordinated.

1. 120V Power Conduits: 6-inches (150mm)
2. 208V and Higher Power: 24-inches (600mm)
3. Lighting System: 12-inches (300mm)
4. Transformers: 48-inches (1200mm)
5. Motors and Fans: 48-inches (1200mm)

6. Other Interfering Sources to be field verified and coordinated by Contractor with Architect and Engineer.

D. Unobstructed Cabling Pathways:

1. Raceway installer shall provide conduit sleeves through all walls and continuous segments above inaccessible ceiling spaces to ensure unobstructed cable pathways are provided from each device location back to the appropriate HC. (Refer to Technology Drawings for additional information.)

E. Horizontal Distance Limitations:

1. Communications horizontal cabling shall not exceed a total cable length of 295-feet (90m) for the permanent basic link. The channel length shall not exceed 325-feet (100m) when patch cords are installed.
2. Contractor(s) responsible for providing the communications horizontal raceway shall ensure that unobstructed pathway to each device location does not cause cable to exceed 295-feet (90m) length from to the nearest horizontal cross-connect (HC) location. This may require unobstructed pathway to be no more than 250-ft (76m) to accommodate necessary cable slack. Contractor shall bring any distance concerns to the attention of the Architect and Engineer during the bid process and/or at a minimum during the shop drawing process, prior to installation.

F. Telecommunications conduits shall maintain large bends and sweeps. Provided below are the ratios for minimum conduit bend radius to conduit size diameter.

1. Smaller than 2-inches (50mm) : 6:1
2. 2-Inches (50mm) and Larger: 10:1

G. Conceal conduit and EMT, unless indicated otherwise, within finished wall, ceilings, and floors. Keep raceways at least 6-inches (150mm) away from parallel runs of flues and steam or hot water pipes. Install raceways level and square and at proper elevations.

H. Elevation of Raceway: Where possible, install horizontal raceway runs above water and steam piping.

I. Complete installation of telecommunications raceways before starting installation of conductors within raceways.

J. Provide supports for raceways as specified elsewhere in Electrical and/or Communications specification sections and in accordance with NEC and local authorities' seismic requirements.

K. Prevent foreign matter from entering raceways by using temporary closure protection.

L. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab. All elbow penetration through the slab shall be PVC coated rigid metallic conduit Ells.

M. Make bends and offsets so the inside diameter is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

N. Use raceway fittings that are of types compatible with the associated raceway and suitable for the use and location. For intermediate steel conduit, use threaded rigid steel conduit fittings except as otherwise indicated.

O. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions except as otherwise indicated.

P. Install exposed raceways parallel and perpendicular to nearby surfaces or structural members and follow the surface contours as much as practical. All exposed conduit runs shall be approved by the Architect prior to installing.

Q. All exposed conduits in public areas shall be painted to match surrounding walls. Verify exact color with the Architect. Painting specified herein shall be provided by others.

R. Run exposed, parallel, or banked raceways together. Make bends in parallel or banked runs from the same center line so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel. This requires that there be a change in the plane of the run such as from wall to ceiling and that the raceways be of the same size. In other cases, provide field bends for parallel raceways. All exposed conduit routing shall be approved by the Architect prior to installing.

S. Join raceways with fittings designed and approved for the purpose and make joints tight. Where joints cannot be made tight, use bonding jumpers to provide electrical continuity of the raceway system. Make raceway terminations tight. Where terminations are subject to vibration, use bonding bushings or wedges to assure electrical continuity. Where subject to vibration or dampness, use insulating bushings to protect conductors. Use expansion fittings at building expansion joints.

T. Tighten set screws of threadless fittings with suitable tool.

U. Terminations: Where raceways are terminated with locknuts and bushings, align the raceway to enter squarely and install the locknuts with dished part against the box. Where terminations cannot be made secure with one locknut, use two locknuts, one inside and one outside of the box. All conduit connections to junction boxes shall have insulated bushings.

V. Where terminating in threaded hubs, screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align the raceway so the coupling is square to the box, and tighten the chase nipple so no threads are exposed.

W. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave no less than 12 inches of slack at each end of the pull wire.

X. Telecommunications raceways shall have a maximum pulling length of 100 feet and a maximum of two 90° bends or equivalent. A pull-box or junction-boxes shall be provided where necessary to comply with these requirements.

Y. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

1. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces, air-conditioned spaces and walk-in coolers.
2. Where required by the NEC.

Z. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling threaded inside for plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit. Where equipment connections are not made under this contract, install screwdriver-operated threaded flush plugs flush with floor.

AA. Flexible connection: Use flexible conduit with a maximum length of 6-feet (3m) for furniture feeds. Use liquid-tight flexible conduit in wet locations. Install separate equipment grounding conductor across flexible connections.

BB. PVC externally coated rigid steel conduit: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduit.

CC. All underground conduits shall be installed a minimum of 24-inches (600mm) below finish grade or below frost line, whichever is deeper.

DD. Telecommunications service entrance cables that extend beyond 50-feet from the building point of entrance shall be in IMC from the point of entrance to the point of termination without breaks as require by the NEC.

EE. Daisy Chaining of pathways shall not be allowed unless specifically noted on the drawing or detailed on drawings. Each backbox shall be installed with a dedicated pathway. Any proposed or required daisy chaining will be detailed in contractor shop drawings and submittals and approved prior to installation. Any remediation to dedicated pathways as required will be the total responsibility of the Contractor at no additional cost to Owner.

FF. Provide pedestrian walk over guards for all temporary surface conduit routed in pedestrian zones.

3.3 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices, and raceway installation work.

C. Provide rain-tight or weatherproof covers for all communications device outlets at all interior and exterior locations exposed to weather or moisture.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Install electrical boxes in those locations which ensure ready accessibility to enclosed electrical wiring.

F. Installing boxes back-to-back in walls shall not be permitted. Provide no less than 12-inches (150mm) of separation.

G. Position recessed outlet boxes accurately to allow for surface finish thickness.

H. Do not use round boxes where conduit must enter box through side of box, which would result in difficult and unsecure connections when fastened with locknut or bushing on rounded surfaces.

I. Fasten telecommunication and electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embedded electrical boxes in concrete or masonry.

J. Exterior junction or pull boxes shall be mounted flush with grade, unless noted otherwise or indicated to be above ground on the drawings. Boxes shall be surrounded on all sides with 6 inches minimum of concrete. Top of concrete shall flush with grade. Seal all conduit entries into box with duct seal to prevent entrance of moisture, after conductors are installed.

K. Tap and splices, where permitted by these specifications within exterior junction boxes, shall be performed with an encapsulating watertight splice or tap kit which insulates and moisture seals the connection. Kit shall consist of the appropriate size and type mold, encapsulating resin and end sealing tape.

L. Subsequent to installation of boxes, protect boxes from construction debris and damage.

M. Outlet back-boxes shall be installed straight on walls to provide a neat appearance of faceplates on finished walls.

3.4 GROUNDING

A. Upon completion of installation work, properly ground telecommunications boxes and demonstrate compliance with requirements.

3.5 ADJUSTING AND CLEANING

A. Upon completion of installation of raceways, inspect interiors of raceways; clear all blockages and remove burrs, dirt, and construction debris.

END OF SECTION 27 05 33

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:

1. This specification is intended to be performance based, with the expectation that an “end-to-end” solution is provided by one of the “pre-approved” manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish “benchmark” products from one or more of the “pre-approved manufacturers”. The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Abesco
   b. Hilti
   c. STI

Table 1 - Fire Stopping			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	EZ Path Smoke pathway *Sizes per drawings (4"x4")	STI	NEZ44 *Others as applicable
2	Flexible Firestop Block	Hilti	CFS-BL
3	Cable Transit Firestop Device - Round *Sizes per drawings (2" dia, 4" dia)	Abesco	31938, 31950 *Others as applicable
4	Cable Transit Firestop Device - Square *Sizes per drawings (2.5", 4")	Abesco	31940, 31942 *Others as applicable

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 27 05 36 - CABLE TRAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals, but are not intended to be an all-encompassing bill of materials.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

1.2 SUMMARY

A. Extent of cable tray system work is indicated by drawings. Cable trays are defined to include, but not limited to, supports, straight sections, reducers, bends, tees, crosses, elbows, covers, dividers and other applicable accessories.

B. Types of cable tray systems required for project include the following:

1. Wire Basket type.
2. Horizontal and Vertical cable runway routed within Communications Rooms is specified in specification section 27 11 00.

1.3 SUBMITTALS

A. General Description and Requirements

1. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Product Data:

1. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

C. Shop Drawings and As-Built Drawings shall include:

1. Floor Plans: Provide scaled building floor plan drawings (with current reflected ceiling plan layer shown) based on architectural background indicating installation of cable tray systems and accessories including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies and fittings. Plans shall show accurately scaled components, mounting heights/elevations, and spatial relationships (clearances) to adjacent structure and equipment, including but not limited to, HVAC ductwork, piping, and light fixtures. Shop drawings shall clearly indicate areas with cable tray clearance limitations and/or other cable access limitations for review and approval by Owner, Architect, and Engineer.
2. Details: Submit cable tray support detail drawings indicating installation of cable tray systems and accessories including clamps, brackets, hanger rods, splice plate connectors, expansion joint assemblies and fittings, and all grounding components.
3. Documentation: Provide submittals and documentation as required by the project manual (in addition to electronic copies) for review or as indicated in Division 1 general conditions.

PART 2 - SYSTEM REQUIREMENTS

2.1 CABLE TRAY SECTIONS AND COMPONENTS

A. General: Except as otherwise indicated, provide metal cable trays, of types, classes and sizes indicated; with splice plates, bolts, nuts and washers for connecting units; capable of supporting concentrated loads at any given point and maximum deflection of 1-inch (25mm) at full cable load, also indicated below. Construct units with rounded edges and smooth surfaces; in compliance with applicable standards; and with the following additional construction features:

1. Wire Basket Type

a. Tray Material: ASTM A510 high strength steel wires.
b. Cross Rungs: Standard 2-inch (50mm) x 4-inch (100mm) wire mesh pattern.
c. Bends and Fittings: 24-inch (600mm) minimum radius.
d. Construction: 2-inch (50mm) deep Steel wire side flanges and rounded wire ends.
e. Tray Finish: ASTM B 633 Electrozinc (Interior Locations) and ASTM Type 304 L stainless steel passivation per ASTM A380 (Exterior, Wet, and Corrosive Locations).
f. Lengths shall not exceed 10’-0” (3.0m).

g. Loading Criteria: Cable tray supports shall be provided per manufacturer recommendations to meet the following minimum loads:

1) Point Load Rating: 50-lb (0.23 kN) at any given point.
2) Continuous Load Rating: 50-lb/ft (0.75 kN/m).

h. Supports: Cable tray supports shall be provided for each section and/or fitting and shall comply with NEMA VE-2 installation guidelines for maximum distance from support to the end of each section and/or fitting. Aircraft cable shall not be permitted as a means of supporting cable tray. Additionally, cable tray shall not be supported with center mount trapeze supports.

2.2 CABLE TRAY ACCESSORIES

A. Provide all necessary cable tray accessories as per manufacturer recommendations including, but not limited to, items described below and or indicated within cable tray details.

B. Provide all grounding and bonding components including, but not limited to, conductors, jumpers, clamps, etc. as recommended by cable tray manufacturer in order to maintain electrical continuity in the cable tray system.

C. Provide dropouts (waterfalls), conduit adapters, hold-down devices and blind ends, as indicated, and as recommended by cable tray manufacturer. Dropouts shall be provided for all cable tray segments that provide a vertical cable transition point (i.e., where cable tray dead-ends into a Communications Room, transitions to vertical cable tray, transitions to horizontal cable tray at a different elevation, etc.).

D. Provide pull-strings through any cable tray segment that has limited clearance accessibility, to ensure cables can be installed. Pull-strings shall be provided for each section when cable tray dividers are provided.

2.3 SUPPORTS AND CONNECTORS

A. Provide all necessary cable tray support mechanisms as per manufacturer recommendations including, but not limited to, items described below and or indicated within cable tray details.

B. Provide cable tray supports and connectors as indicated within cable tray details, including but not limited to, uni-strut, trapeze mount threaded robs, wall mounted cantilever brackets, threaded rod protective sleeves, bonding jumpers, etc.

2.4 FIRESTOPPING - UL 1489

A. Provide firestopping pillows and/or bricks as required in all cable tray openings to maintain rating of the wall. Fireproofing shall consist of ready to use, intumescent fibrous material

enclosed in a strong polyethylene envelope. Contractor shall assume this is to be included in the cable tray scope of work, unless directed otherwise by the Construction Manager and/or General Contractor.

PART 3 - EXECUTION

3.1 INSTALLATION OF CABLE TRAY SYSTEMS

A. Install cable trays in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that cable tray equipment complies with requirements. Comply with requirements of NEC 392, and applicable portions of NFPA 70B and NECA's "Standard of Installation" pertaining to general electrical installation practices.

B. All walls where cable tray is installed with wall mounted brackets shall be internally reinforced as necessary at all bracket locations to support cable tray loads. Contractor shall coordinate this with the applicable trades in addition to the Architect and Engineer, prior to installing supports and/or cable tray at these locations.

C. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

D. Coordinate with other low voltage, electrical, and mechanical work as necessary to properly interface installation of cable tray work with other work.

E. Accessibility Clearances: Coordinate and provide cable tray clearances as indicated within the cable tray details and these specifications, to allow for appropriate accessibility for initial and future cable installation. Coordinate location of cable trays with all other trades to ensure clearances are obtained. For any instances where field conditions do not allow for the minimum clearances, the Contractor shall notify the Architect and Engineer so that an acceptable solution can be coordinated.

1. 6-12" W x 2" D Wire Basket Tray (Minimum Clearances):

    a. Side Access: 18" clearance on one side
    b. Top Access: 6" clearance above tray for continuous segments.

2. Exceptions: Cable tray segments may have limited clearances at intermittent crossings with structure or MEP systems. The following guidelines shall apply for such cases, provided there is clear access at both sides/ends of the conflict zone:

    a. For areas where conflict zones span up to an 8'-0" segment of tray, clearances of 6" between the top of the cable tray rail and the structural or MEP system will be permitted
    b. For areas where conflict zones consist of a beam, duct, conduits, or pipes crossing over a short segment of tray (3'-0" or less), clearances of 2-3" between the top of the cable tray rail and the structural or MEP system will be permitted.
    c. All other major cable tray conflict zones which may prevent the Contractor from maintaining appropriate cable tray clearances shall be reviewed with the Owner, Architect, and Engineer during the submittal process.

F. Electrical Clearances: Telecommunications raceway shall be routed to maintain appropriate clearances from potential interfering electrical sources per NEC, TIA, and BICSI requirements. Provided below are minimum clearance requirements of key components that shall be maintained.

1. 120V Power Conduits: 6-inches (150mm)
2. 208V and Higher Power: 12-inches (300mm)
3. Lighting System: 12-inches (300mm)
4. Transformers: 48-inches (1200mm)
5. Motors and Fans: 48-inches (1200mm)
6. Other Interfering Sources to be field verified and coordinated by Contractor with Architect and Engineer.

G. Cable Tray Grounding:

1. Ground cable trays according to NFPA 70 unless additional grounding is specified. Comply with requirements in Section 270526.
2. Cable trays with powder-coat paint should have coating mask completely removed at factory supplied grounding locations, and be spliced with listed connectors per manufacturer recommendation.
3. Electrically ground cable trays and ensure continuous electrical conductivity of cable tray system in accordance with manufactures instructions. Provide maximum of 1.0 ohms resistance to building ground connection. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground.

H. Support cable tray per manufacturer recommendations to accommodate the loading criteria as indicated within this specification.

I. Provide UL listed "Firestopping" for all cable tray penetrations through fire rated walls and slabs according to Division 07 Section "Penetration Firestopping". Install E90 certified cable tray for critical circuits, hallways, or in areas of egress as shown in drawings. Refer to Division 7 for additional requirements.

J. Wall openings that cable tray passes through that don't require Firestopping per code shall be stopped or sealed to maintain the building envelope and/or acoustical requirements. Refer to architectural floor plans, details and specifications for additional requirements.

K. Remove burrs and sharp edges of cable trays, wherever these could possibly be injurious to wiring insulation or jacketing.

3.2 TESTING

A. Test cable trays to ensure electrical continuity of bonding and grounding connections, and to demonstrate compliance with specified maximum grounding resistance. Submit results to Engineer for approval.

3.3 WARNING SIGNS

A. After installation of cable trays is completed, install warning signs, either on or in proximity of cable trays, where easily seen by occupants of space, and indicating warning with following wording, "WARNING! NOT TO BE USED AS WALKWAY." Provide 1-1/2"-high yellow lettering on black background, of style selected by Architect/Engineer. Temporary signage shall be installed during installation to notify other contractors that the tray shouldn't be used as a walkway.

END OF SECTION 27 05 36

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:

1. This specification is intended to be performance based, with the expectation that an "end-to-end" solution is provided by one of the "pre-approved" manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish "benchmark" products from one or more of the "pre-approved manufacturers". The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. B-Line by Eaton
   b. Cablofil Legrand
   c. PW Industries Legrand
   d. MP Husky

Table 1 - Cable Tray (Wire Basket Type)

Item	Part Name/Description	Manufacturer	Part Number
1	Wire Basket Tray - 4" deep	Eaton / B-Line	FT4X--X10
		Legrand / Cablofil	CF105/XXXEZ
		Panduit	WG8BL10 + WGSW4BL
3	Horizontal / Vertical Bend Fitting Kits	Eaton / B-Line	WASHER SPL KIT
		Legrand / Cablofil	CE40EZ + WASHER-EZ
		Panduit	WGHRDWKTBL
4	Cable Tray Drop-Out (Waterfall), Aluminum	Eaton / B-Line	DROP OUT
		Legrand / Cablofil	CABLEXIT
		Panduit	WGSWF4BL
5	Cable Tray Dividers, Aluminum (Straight / Flexible / etc.)	Eaton / B-Line	4 IN DIVIDER 6 IN DIVIDER
		Legrand / Cablofil	COT105 KITPG COT150 KITPG
		Panduit	WGDW4PG
6	Cable Tray Grounding Components	Eaton / B-Line	GROUND BOLT
		Legrand / Cablofil	GNDSB
		Panduit	GACBJ6 GB2B03

Table 1 - Cable Tray (Wire Basket Type)			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
7	Miscellaneous Components (Expansion / Splice plates, etc. as applicable)	Eaton / B-Line	WASHER SPL KIT *Others as applicable
		Legrand / Cablofil	EDRNEZ
		Panduit	WGSPL1218BL
		MonoSystems	TM-CPL-JN3-XX
8	Cable Tray Support Components (as applicable)	Eaton / B-Line	WB46H, FTBXXCT *Others as applicable
		Legrand / Cablofil	FASP
		Panduit	WGCB12BL

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 27 05 43 - UNDERGROUND DUCTS, RACEWAYS AND MANHOLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: There is no product number appendix for this section. Submit proposed raceway products as described within this specification and on the Technology Drawings.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 3 Concrete

F. Division 26 Basic Electrical Materials and Methods section

G. Division 27 Telecommunications Grounding and Bonding

H. Division 27 Telecommunications Raceways and Boxes

I. Division 31 Earthwork

1.2 SUMMARY

A. Provide all necessary components including, but not limited to, conduits, manholes and grounding for telecom service entrance from property line to each demarcation/main communications room.

B. Drawings are diagrammatic. All bends, fittings, and couplings are not necessarily shown. Supply as necessary to comply with the National Electric Code.

C. Furnish all labor, materials, tools, equipment, and services for all underground service and manholes as indicated, in accordance with provisions of Contract Documents.

D. Completely coordinate with work of all other trades.

1.3 SUBMITTALS

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Product Data: This section does not have a “benchmark” product Appendix, thus Contractor shall submit product data for all applicable products as required per Technology Drawings including, but not limited to:

1. Manholes, Pull Boxes, Handholes.
2. Duct bank materials, including spacers and miscellaneous components.
3. Warning tape and tracer wire.
4. Conduits.
5. Inner-Ducts

C. Shop drawings:

1. Site plan: Provide complete site plan showing all existing and proposed utilities. Manholes, handholes, and major raceway 2-inches and larger shall be indicated. Shop drawings shall represent final conduit routing and manhole/handhole placement as coordinated with Service Provider, Civil Engineer, and other applicable trades.
2. Details:

    a. Duct bank sections: Provide duct bank section drawing for each unique length of trench.
    b. Manholes, Pullboxes, Handholes: Provide details indicating:

        1) Conduit size and entry locations
        2) Cover design
        3) Racking type and locations
        4) Grounding details

3. One-Line Drawings: Provide one-line drawings indicating connection to existing site infrastructure.

D. Test reports as required for compaction and concrete work in Division 3 and 31.

1.4 QUALITY ASSURANCE

A. Manufacturer qualifications

1. Provide products from manufacturers regularly engaged in the production of communications infrastructure components, including but not limited to, manholes, hand holes, and hardware.

2. Provide products from manufacturers whose products of similar types, capacities, and characteristics have been in satisfactory use in similar type projects for not less than five years.

B. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

C. Compaction density test: ASTM D1557.

D. Contractor will hire an independent soils laboratory to conduct in place moisture-density tests to ensure that all work complies with this specification.

1. Notify Construction Manager or Owner's representative at least 2 weeks prior to anticipated date of testing.
2. Contractor will pay additional cost if work is delayed due to his failure to notify Owner's agent as specified above.

E. Comply with all aspects of "Safety Rules & Regulations for Excavation: as promulgated by the state in which excavation will occur.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver equipment and components in factory-fabricated containers or wrappings, which properly protect equipment from damage.

B. Store conduit to avoid warping or deterioration with end caps.

C. Store plastic conduit on flat surface protected from direct rays of sun.

D. Handle equipment and components carefully to prevent damage. Do not install damaged units or components; replace with new.

1.6 SEQUENCING AND SCHEDULING

A. All work shall be reviewed and coordinated with the Construction Manager and/or General Contractor prior to commencing.

B. Coordinate installation with Civil, Structural, Electrical, and other trades to eliminate disruption and/or conflict with other systems (paving, curb and gutter, etc.).

1.7 PROJECT SITE CONDITIONS

A. Prior to submitting a proposal, the Contractor shall inspect the Contract Documents, and shall become fully informed as to laws, ordinances, and regulations affecting the project. The

Contractor shall immediately bring to the Owner, Architect, and Engineer's attention, in writing, any existing condition or statute that contradicts, is in conflict with, or negates the Contract Documents. Failure of the Contractor to become fully informed as to all above mentioned items shall in no way relieve the Contractor from any obligations with respect to their proposal.

B. The Technology Drawings depict equipment locations and conduit runs in a schematic manner. Field conditions and coordination with related trades may warrant relocations of field devices. No additional compensation will be allowed due to these revisions.

1.8 WARRANTY

A. The manufacturer shall provide a warranty with a minimum term of 25-years for all structures and components. This warranty shall cover all components including manholes, handholes, racking, etc. to maintain the specified performance, physical criteria, and applications assurance. Any such components shall be replaced by the Manufacturer at no cost to Owner during this period. The Contractor and Manufacturer shall submit all information and documentation on Warranty.

B. A one (1) year warranty on the Work and Compaction shall be provided by the Contractor. If, within one (1) year after the date of final acceptance of the installation or within such longer period of time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or provided by a manufacturer, any of the work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition. Such notice shall be provided by Owner representatives, to be identified, either verbally or in writing.

C. Nothing contained in the Contract Documents shall be construed to establish a shorter period of limitation with respect to any other obligation which the Contractor might have under the Contract Documents or any manufacturer's warranty. The establishment of the time period noted above, after the date of final acceptance or such longer period of time as may be prescribed by law or by the terms of any warranty required by the Contract Documents, relates only to the specific obligation of the Contractor to correct the work or equipment, and has no relationship to the time within which his obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to his obligations other than specifically to correct the work or equipment.

D. If system operation is not fully restored during the warranty period within two (2) business days, the Owner reserves the right to require the Contractor to provide on-site manufacturer's service technicians at no additional cost.

E. The Owner reserves the right to expand or add to the system during the warranty period using firm(s) other than the Contractor for such expansion without affecting the Contractor's responsibilities, provided that the expansion is done by a firm which is an authorized dealer or agent for the equipment of system being expanded.

1.9 SPECIFICATION RESPONSE

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

1.10 DEFINITIONS

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

PART 2 - PRODUCTS

2.1 DUCT SYSTEM

A. Duct System: Multiple and single, conduits completely encased in concrete.

1. Separators: Plastic or other non-metallic, non-decaying material.
2. Inner-Ducts: Provide (3) inner-ducts in each conduit as indicated on Technology Drawings.

B. Pull Wire: No. 9 galvanized iron, or heavy nylon cord, free of kinks and splices.

1. Marked with length every 10’.

C. Detectable Warning Tape:

1. Polyethylene plastic warning tape

a. Detectible warning tape can be used to provide tracer wire and warning tape only if conduits aren’t encased in a concrete duct way. Concrete ductway shall include tracer and non-detectible warning tape.
b. 6” width and 10mm thick
c. Integral wires, foil backing or other means of detection up to 3’ deep.
d. Tape to be orange in color and read “CAUTION, BURIED COMMUNICATIONS LINE BELOW” or as required by local code.

D. Non-detectable Warning Tape:

1. Polyethylene plastic warning tape

   a. 6” width and 10mm thick
   b. Tape to be orange in color and read “CAUTION, BURIED COMMUNICATIONS LINE BELOW” or as required by local code.

E. Tracer Wire:

1. #6 AWG bare copper wire.

2.2 HANDHOLES

A. Telecommunications Handholes: Sizes as indicated on drawings:

1. Concrete: 4500 PSI. Conform to Division 3 requirements.
2. HS-20 rated for traffic rated conditions.
3. Cover and frame: 36” diameter, gray cast iron with machine finished seat for perfect joint between cover and frame. “COMMUNICATIONS” to be stamped on cover.
4. Provide floor drain with grate.
5. Provide accessories per Telecommunication drawings.

B. Cable Pulling Irons: Galvanized, mounted on wall.

1. 7/8-inch diameter installed 3” to 9” above the floor and embedded in wall during construction.

C. Cable Racks: Galvanized, mounted on wall.

1. Provide minimum (3) cable racks on each long wall with minimum of 8 adjustable hooks; minimum 2 spare hooks on each rack.
2. Insulators: Best quality, high glazed porcelain; provide for each hook.
3. Space racks so each end of splices is supported horizontally.

D. Ladder: Galvanized.

1. Each manhole and handhole to contain its own ladder.

E. Sump Pit:

1. Provide 12” diameter by 24” deep sump recess with removable perforated grate. Refer to Division 31 for base course material.

F. Grounding:

1. Refer to Section 27 05 26 for requirements that shall be fulfilled as part of this specification section.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANDHOLES

A. Determine exact location of each manhole after careful consideration has been given to location of other utilities, grading, and paving.

1. Do not begin construction until location of each manhole has been reviewed by Architect/Engineer.

B. Construct manholes and/or handholes of type indicated in accord with applicable details.

1. Mix, place and cure concrete or set precast unit on non-expansive soil bed in accord with Division 3 and 31 requirements.

C. Set frames and cover:

1. Paint exterior with 2 coats asphaltic paint after inspection and before setting.
2. Set top of manhole and/or handhole minimum 12” below finished grade to allow for soil amendments and planting or roadway surface. Coordinate with Civil Engineer for roadway surface section depth.
3. In paved areas, set top of manhole covers flush with finished surface of paving.
4. In unpaved areas, set top of manhole covers approximately ½” above finished grade.
5. Where final grades are higher than top of manhole, install sufficient number of courses of grade rings between top of manhole and manhole frame to elevate manhole cover to final grade level.

D. Install cable racks, ladder and cable pulling irons.

E. Provide ground rods, bonding ribbon, and ground wires per Section 27 05 26.

3.2 DUCT BANK

A. Form all duct banks in square or rectangular fashion as shown. Install duct spacers per manufacturer’s requirements.

B. Pitch conduits a minimum 1:300 down towards manhole and/or handhole and away from building. Slope conduits from a highpoint midway between manholes.

C. Install tracer wire in top 2” of concrete encasement. Tracer wire shall be attached to the inside of the manhole near lid with sufficient slack to reach opening.

D. Install warning tape 12” above top of duct bank.

E. Adjust final slopes on-site to coordinate with utilities and structure.

F. Backfill and compaction requirements per Division 31 requirements.

G. After installation, clean and swab ducts.

H. Install galvanized steel pullwires in spare ducts. Cap empty ducts with screw covers.

I. Label conduit at stub-up and manhole penetrations in accordance with Section 27 05 00.

END OF SECTION 27 05 43

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:

1. This specification is intended to be performance based, with the expectation that an "end-to-end" solution is provided by one of the "pre-approved" manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish "benchmark" products from one or more of the "pre-approved manufacturers". The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Carlon
   b. Eastern Wire + Conduit
   c. Maxcell
   d. Oldcastle

Table 1 - Outside Plant Infrastructure			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	Manhole Concrete 24"W x 72"L x 48"D	Oldcastle	2x6x4 Comm Vault
		*Other	Submit for approval
2	Standard Inner-duct (OSP) HDPE Single Wall with Pull Rope (1" or 1-1/4" dia per drawings)	Carlon	CF4X1C (1" dia.) CG4X1C (1-1/4" dia.)
		Carlon	DF4X1C (1" dia.) DG4X1C (1-1/4" dia.)
		Eastern Wire + Conduit	Kortech PDCN1000F
3	Fabric Mesh Inner-duct (3-cell for 4" conduit) - Alternate for (3) 1" OSP in 4" conduit	Maxcell	MXE86383
		*Other	Submit for approval
4	HDPE Conduit – SCH-40 reel conduit 2", 3" 4"	Duraline	SCH 40 Smoothwall

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A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 27 11 00 - COMMUNICATIONS EQUIPMENT ROOM FIT-OUT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals, but are not intended to be an all-encompassing bill of materials.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Structural, Mechanical, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

F. Rough carpentry is specified in a Division 6 section.

PART 2 - SYSTEM REQUIREMENTS

2.1 COMMUNICATIONS ROOM FIT-OUT

A. Communications Entrance Cabling Pathways

1. Inner Duct

a. Provide (3) 1-1/4-inch (31mm) outside plant rated fiber optic inner ducts in one or more conduits as indicated on the site plan, for incoming Communications service cabling.

B. Communications Backboard

1. Plywood Backboard:

a. Provide ¾-inch (19mm) AC grade plywood back board mounted on communications walls as noted on drawings.
b. Plywood shall be mounted “A” side out, “C” side to the wall.

c. Shall conform to UL FR-S Plywood 1780 R-7003

1) Shall be fire retardant impregnated plywood OR
2) Plywood shall be painted with fire rated intumescent paint on all sides.

d. Shall be painted to match architectural finish (white minimum), fire rated plywood must be painted with intumescent paint to maintain rating.
e. Ensure that UL listing and Fire Rating stamp are left unpainted to allow inspector to verify the rating of the plywood.
f. If the UL stamp is on the "C" side of the plywood, contractor shall document via install and material progress photographs, delivery manifests and UL listing certifications to help satisfy potential inspector comments.

C. Communications Cabinets, Racks, Frames and Enclosures

1. General

a. Provide Equipment Cabinet and/or Rack types and sizes as shown on Technology Drawings. Refer to specific rack types described below for additional information.
b. Cabinets and/or racks shall be completely setup and installed all locations.
c. Cabinets and/or racks shall be vertically and horizontally level.
d. Cable distribution equipment cabinets and racks shall utilize 19-inch Standard / ETSI wide rack system. Cabinets (if applicable) post depths shall be adjustable.
e. Rack Rail Width: 3-inch (75mm).
f. Rack Units: 42U (minimum).
g. Rack Material: 6061-T6 Aluminum.
h. Enclosure and/or Rack Finish: Black Epoxy Powder Coat.
i. Rack Mounting Holes: Pre-drilled and Threaded Tap Holes (spacing and diameter) or 3/8-inch (9.5mm) Square Punch with Cage Nuts per TIA standard pattern.
j. Vertical Cable Managers: Yes, as described within this specification.
k. Horizontal Cable Managers: Yes, as described within this specification.
l. Power Strips: Yes, as described within this specification.
m. Bonding and Ground. Yes, all cabinets and racks shall be grounded as described within Technology Drawings and specifications.
n. Cabinet Enclosure Electric Fan: Include as applicable per specified enclosure.

2. Equipment Racks – 2-post Cable Distribution and Network Type:

a. Provide types and sizes as indicated on Technology Drawings.
b. Equipment Cabinet and Rack Specifications:

1) Enclosure: None.
2) Rack Type: 2-Post open frame rack, 19-inch TIA Standard.
3) Rack Size: 19" W x 84" H (42U) (483mm x 2100mm).
4) Loading: 1000-lb (450kg).
5) Mounting Type: Bolted to Floor with Neoprene Isolator.

D. Communications Termination Blocks and Patch Panels

1. All communications cables shall be terminated unless noted otherwise.
2. Cable terminations including wall fields, blocks, and patch panels are specified with in other sections.
3. Refer to 27 13 13 – Communications Copper Backbone Cabling, 27 13 23 – Communications Optical Fiber Backbone Cabling, and 27 15 01 – Communications Horizontal Cabling for additional requirements.

E. Communications Cable Management

1. General

a. Horizontal cable tray shall be mounted around room perimeter and above equipment racks as indicated on drawings. Tray sections shall be offset a minimum of 6-inches (150mm) clear from wall (unless otherwise noted) to allow passage of other systems up wall including risers, backbone, and other distribution.
b. Vertical ladder rack shall be placed on wall above riser conduit locations to support tie off of backbone cables.
c. Cable Tray sections shall be bonded together for electrical continuity (grounding) and system bonded to telecommunications ground bus (TGB) or electrical ground bus. Ladder rack, hardware, and components shall be UL classified.
d. Cable Tray drop-outs shall be provided above all equipment racks and/or cabinets to allow for cable transition to termination panels.

2. Cable Tray – Ladder Type

a. Cable racking in Communications Rooms shall be ladder rack with ASTM A513 and A570 structural tubular steel complete with all required mounting hardware and with all fittings and cables needed to form a bonded (grounded).

1) Width: Refer to Technology Drawings.
2) Side rails: 1½-inch x 3/8-inch (150mm x 9.5mm)
3) Rungs: 9-inches (225mm) on-center
4) Finish: Yellow zinc dichromate.

3. Wall Field Cable Managers:

a. Jumper troughs and cable managers shall be provided along each side and between wall fields or any other wall mounted cable terminals or patch panels. This is to provide adequate support of cables interconnecting wall fields or other wall mounted cable terminals.

4. D-Rings:

    a. D-Rings or equivalent means shall be provided as necessary on backboard to support any horizontal and vertical cables not supported by cable tray or other means.
    b. Spacing shall not exceed 24-inches (600mm) or cable manufacturer's recommendation, whichever is less.

F. Communication Rack Mounted Power Protection and Power Strips

1. Rack Mounted Uninterruptible Power Systems (UPS)

    a. A rack mounted UPS shall be provided by the project.
    b. The UPS including battery requirements, rack enclosure and power connections are specified within another section.

2. Vertical Power Strips

    a. One (1) equipment cabinet shall be installed with (2) different vertical power strips that have multiple power outlets to connect equipment within cabinet.
    b. Power strips shall have a cord with plug and shall be connected to specific receptacles on dedicated circuits; (1) L6-30P, (1) L5-20P.
    c. Power strips shall be connected to different power sources or UPS wherever possible.
    d. Provide mounting brackets per cabinet and/or power strip manufacturer recommendations to properly mount power strips within cabinet.
    e. There may be various power strip types and configurations used on this project. Refer to Technology Drawings and product list for additional requirements.

3. Horizontal Power Strips

    a. Five (5) equipment cabinets shall be installed with (2) different horizontal power strips that have multiple power outlets to connect equipment within cabinet.
    b. Power strips shall have a cord with a plug and shall be connected to specific receptacles on dedicated circuits; (1) L6-30P, (1) L5-20P.
    c. There may be various power strip types and configurations used on this project. Refer to drawings and product list for additional requirements.

G. Telecommunications Grounding Busbar (TGB)

1. Each Communications Room shall be installed with a dedicated telecommunications ground bus bar (TGB) and bonded to the telecommunications bonding backbone (TBB).
2. Each Equipment Cabinet, Equipment Rack, Ladder Rack or Wire Basket Tray, Conduit Sleeves, and other metallic components etc. shall be individually bonded and grounded to TGB. Overhead Ladder Rack or Basket Tray may have a single grounding connection to

the ground bus bar, but shall have grounding jumpers provided between each segment (as required) for tray that does not have connectors which are UL listed for grounding.

3. Refer to Section 27 05 26 – Telecommunications Grounding and Bonding for additional requirements.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Equipment Cabinet and/or Rack Installation:

1. Cabinets and racks shall be vertically and horizontally level.
2. Provide a junction plate at top of equipment rack and required cable runway to attach rack to cable runway around the perimeter of the Communications room. Junction plate must be fastened to frame without using "J" hooks so that no equipment space is lost.
3. The completed equipment rack will be affixed to the floor using drop-in anchors and 5/8-inch zinc-plated hex bolts, split and flat washers.
4. All equipment and components noted in this section and drawings shall be provided and completely setup and installed. This includes but not limited to Cabinets and Racks, Cable Management and Ladder Rack, Communication Wall Fields and Patch Panels, and Communications Rack Mounted Power Protection and Power Strips.
5. All equipment shall be generally installed per drawings and field coordinated with current conditions and other trades. The final locations shall be coordinated with Owner, Architect, and Engineer prior to installation. No additional cost submitted by contractor shall be incurred by Owner due to Contractor's failure to comply with this requirement.

C. Drip Pans:

1. Drip Pans: Where possible to run mechanical piping elsewhere, do not run mechanical piping directly above technology work which is sensitive to moisture. If no other options exist and after confirmation review with Engineer and Owner, provide drip pans under mechanical piping, sufficient to protect technology work from dripping.
2. Locate pan immediately below piping, and extend a minimum of 6" on each side of piping and lengthwise 18" beyond equipment being protected.
3. Fabricate pans 2" deep of reinforced sheet metal with rolled edges and soldered or welded seams; 22 gauge galvanized steel. Provide ¾" copper drainage piping from pan to nearest floor drain or similar suitable point of discharge, and terminate pipe as an open-sight drainage connection.
4. Coordinate work with MEP Contractor.
5. Insulate bottom of pan and drainage pipe as directed by Engineer.

D. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

END OF SECTION 27 11 00

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:

1. This specification is intended to be performance based, with the expectation that an "end-to-end" solution is provided by one of the "pre-approved" manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish "benchmark" products from one or more of the "pre-approved manufacturers". The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. APC
   b. Chatsworth-CPI
   c. CommScope
   d. Hoffman
   e. Middle Atlantic
   f. Ortronics
   g. Panduit

Table 1 - Equipment Cabinets, Racks, and Accessories

Item	Part Name/Description	Manufacturer	Part Number
1	45U - 2-post Equipment Rack (6-inch Channel)	Tripp Lite	SR2POST
		Chatsworth-CPI	66353-703
		CommScope	RK6-45A
2	Horizontal Power Distribution Unit (PDU) (L5-20P)	Tripp Lite	PDUMV20NETLX
3	Horizontal Power Distribution Unit (PDU) (L6-30P)	Tripp Lite	PDUMH30HVNET
4	Horizontal Cable Management	Panduit	WMPF1E

Table 2 - Raceway and Accessories			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	12-inch Ladder Rack Type Cable Tray (Black Powder Coat Finish)	Chatsworth-CPI	11252-712
		CommScope	CR-SLR-10L12W
		Legrand / Ortronics	TRT10-12B
2	Ladder Rack Triangular Support Bracket Aluminum 18-inch Wide (Black)	Chatsworth-CPI	11312-718
		CommScope	CRTWSBK-18W
		Legrand / Ortronics	P139540HB
3	Ladder Rack Suspended Mount Support Bracket Aluminum 12-inch Wide (Black)	Chatsworth-CPI	12362-712
		CommScope	CRCMK5-8TR
		Legrand / Ortronics	RCBK-6
4	Ladder Rack to Equipment Rack Support Brackets - Elevation Kit (Black)	Chatsworth-CPI	10595-712
		CommScope	CRR2RRMK
		Legrand / Ortronics	REK-4-6
5	12-inch Ladder Rack Radius Drop Out (Cross Member - Black)	Chatsworth-CPI	14304-702
		CommScope	CRDK-12W
		Legrand / Ortronics	TRP11-CM
6	12-inch Ladder Rack Radius Drop Out (Stringer Member - Black)	Chatsworth-CPI	14305-700
		CommScope	CRSMCRDK
		Legrand / Ortronics	TRP8-S

Table 2 - Raceway and Accessories			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
7	Ladder Rack Butt-Splice Kit (Black)	Chatsworth-CPI	11301-701
		CommScope	CRBSK
		Legrand / Ortronics	P820127H
8	Ladder Rack Junction Splice Kit (Black)	Chatsworth-CPI	11302-701
		CommScope	CRTJSK
		Legrand / Ortronics	P820147H
9	Equipment Grounding Components	Chatsworth-CPI	40164-001
		CommScope	CRGND
		Legrand / Ortronics	GS-8

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1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 27 13 13 - COMMUNICATIONS COPPER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals, but are not intended to be an all-encompassing bill of materials.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

F. Rough carpentry is specified in a Division 6 section.

PART 2 - SYSTEM REQUIREMENTS

2.1 COMMUNICATIONS COPPER CABLING SYSTEM

A. Topology:

1. The Communications Copper Backbone Cabling will be an industry standard physical star topology with high pair count copper cabling interconnecting each Intermediate Cross-connect (IC) to the Copper Main Cross-Connect (MC) location, unless noted otherwise.
2. For conditions where backbone cable is provided to non-communication room locations, all cabling topology shall follow the same requirements and originate from the MC unless noted otherwise.
3. All cable splices shall be coordinated with Owner, Architect, and Engineer. This includes those shown on drawings and/or proposed by Contractor.
4. Cable splices are only acceptable as noted on the drawings and must be approved by Owner, Architect, and Engineer.
5. Cable splices are only intended where differing cable types are joined and/or multiple smaller cables are joined to a larger backbone feeder cables.

6. Splices are not acceptable to extend cables of inadequate length.
7. Refer to drawings for additional requirements.

B. General Requirements

1. All cable and terminations shall meet the minimum Performance and Criteria listed in specification below and on drawings, in accordance with TIA-568-C.2.
2. Cable requirements including cable types, quantities and pair / strand counts are specified on the drawings.
3. All cables shall have the appropriate fire spread rating per building codes, industry standard, and Underwriters Laboratory (UL/cUL) including plenum (CMP/OFNP/OFCP), riser (CMR/OFNR/OFCR), etc. The contractor shall verify the appropriate cable is being used for application it is installed.
4. Any cable routed below grade shall utilize specific water block construction. Copper cables generally use gel-filled compound to achieve this rating. The contractor is required to submit a solution wherever this condition exists regardless of whether noted on drawings.
5. Underground rated cable that doesn't carry a suitable indoor building cable rating per building code and UL, shall not be routed more than 50-ft (15m) inside the building. Cable shall be spliced or terminated as appropriate and noted on drawings.
6. All armored and/or metallic cable sheaths shall be bonded to Telecommunications Ground Bus (TGB).

C. Performance and Criteria

1. General Copper Backbone Cabling Requirements: (as applicable per drawings)

   a. Cable Rating:

      1) Riser Rated

   b. Cable Construction:

      1) Construction: Unshielded Twisted Pair
      2) Medium: Solid Annealed Copper

   c. Length Limitations: 2600-feet (800m) for telecommunications
   d. Physical Specification:

      1) Standard Cable Sizes: 25, etc. per one-line drawings.
      2) Conductor Size: 24 AWG

   e. Compliances: Refer to respective cables types in section 2.2.

f. Electrical Specifications:

1) Characteristic Impedance: 100 Ohms
2) Cat.3 Frequency: 1-16 MHz

g. Temperature:

1) CMP Operating and storage: -4 to +140F (-10 to +60C)
2) OSP Operating and storage: -40 to 158F (-40 to +70C)

h. Pulling Tensions (max): 25-lb (11 kg).
i. Transmission Performance (min.)

1) Refer to tables below for each applicable cable type.

2. Category 3 Telecommunications

a. Transmission Performance (min.)

1) Permanent Link

CATEGORY 3 - PERMANENT LINK		
Frequency (MHz)	**Insertion Loss (dB)**	**NEXT (dB)**
1.0	3.5	40.1
4.0	6.2	30.7
8.0	8.9	25.9
10.0	9.9	24.3
16.0	13.0	21.0

2) Channel

CATEGORY 3 - CHANNEL		
Frequency (MHz)	**Insertion Loss (dB)**	**NEXT (dB)**
1.0	4.2	39.1
4.0	7.3	29.3
8.0	10.2	24.3
10.0	11.5	22.7
16.0	14.9	19.3

3) Connecting Hardware

CATEGORY 3 - CONNECTING HARDWARE		
Frequency (MHz)	Insertion Loss (dB)	NEXT (dB)
1.0	3.5	40.1
4.0	6.2	30.7
8.0	8.9	25.9
10.0	9.9	24.3
16.0	13.0	21.0

4) Assembled Patch Cord

a) Use Category 5E requirements if patch cords are used rather than cross-connect jumpers.

CATEGORY 5E – ASSEMBLED PATCH CORD				
Frequency (M Hz)	2 m Cord NEXT (dB)	5 m Cord NEXT (dB)	10 m Cord NEXT (dB)	Return Loss (dB)
1.0	65.0	65.0	65.0	19.8
4.0	62.3	61.5	60.4	21.6
8.0	56.4	55.6	54.7	22.5
10.0	54.5	53.7	52.8	22.8
16.0	50.4	49.8	48.9	23.4
20.0	48.6	47.9	47.1	23.7
25.0	46.7	46.0	45.3	24.0
31.25	44.8	44.2	43.6	23.0
62.5	39.0	38.5	38.1	20.0
100.0	35.1	34.8	34.6	18.0
Attenuation: per 100 meters (328-feet) @20 C=Horizontal UTP Cable Attenuation + 20%(due to Standard Conducts)				

2.2 CABLE REQUIREMENTS

A. General

1. The cables shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on TIA-568-C.2 equivalent cable rating.
2. Refer to Technology Drawings for all cable types, quantities and pair / strand counts.

B. Cat. 3 Riser Rated – Telecommunications Cables

1. Application: Building backbone and riser installation within duct, conduits or cable trays telecommunications backbone cable.

2. Construction:

    a. Insulation: Flame retardant semi-rigid PVC.
    b. Shield/Sheath: None.
    c. Filling Compound: None.
    d. Jacket: Flame retardant PVC.

3. Color: Gray.
4. Compliances: TIA-568-C.2, NEC/CEC Type CMR.

C. Cat. 3 Plenum Rated – Telecommunications Cables

2.3 TERMINATION REQUIREMENTS

A. General

1. Wiring terminals shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type, based on TIA-568-C.2 equivalent cable ratings.
2. Provide all necessary wiring terminals, jumper troughs, protector panel, ground wire and bonding to building ground, and plug in protectors (as applicable).
3. Temperature rating (unless noted otherwise):

    a. Operating: +14 to +140 OF (-10 to +60 OC).
    b. Storage: -40 to +158 ^{O}F (-40 to +70 ^{O}C).

B. Protector Panel and Building Entrance Terminal

1. General:

    a. All copper service entrance pairs serving the building shall be terminated on a Protector Panel and Building Entrance Terminal.
    b. All copper cable pairs routed to the exterior or routed to locations outside of building footprint shall be terminated on a Protector Panel at each end.

2. Type: 195-Type.
3. Mounting Configuration: Wall Mounted.
4. Protection: Ground Fault and Sneak Current.
5. Size: 100-Pair (and as required).
6. Cable Interface:

    a. Input: 110-Type Wiring Block or RJ21X Connector.
    b. Output: 110-Type Wiring Block or RJ21X Connector.

7. Protectors: Gas Discharge Tube (or Solid State) 5-Pin Plug In Protector (PIP).

8. Electrical Specifications:

    a. TIA: Category 3
    b. UL and cUL Listed
    c. FCC Part 68

C. 110-Type Wiring Blocks

1. Type: 110-Type w/ Legs.
2. Mounting Configuration: Wall Mounted (or 19-inch Rack).
3. Size: 100-Pair or 300-Pair (and provided as required to terminate all cable).
4. Cable Interface:

    a. Input: 110-Type Wiring Block.
    b. Output: 110-Type Wiring Block.

        1) 5-Pin Connector for feeder cables greater than 4-pairs.
        2) 4-Pin Connector for 4-pair cables.

5. Electrical Specifications:

    a. TIA: Category 5E
    b. Insulation Resistance: 500 MegaOhms (minimum).
    c. Current Rating: 1.5A @68 ^{O}F (20 ^{O}C).
    d. Dielectric Withstand Voltage: 1000 VAC RMS, 60Hz (minimum), contact-to-contact and 1,500 VAC RMS, 60Hz (minimum) to exposed conductive surface.
    e. UL and cUL Listed
    f. FCC Part 68

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Each cable, wiring block, patch panel, and termination shall be identified at the Main Cross-connect (MC), at the Intermediate Cross-connect (IC), and at each station termination.

3. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

C. Telecommunications Testing:

1. All communications copper backbone cabling and pairs shall be tested for electrical continuity and wire map.
2. All cabling will be test/certified for conformance to the TIA-568-C.2 Category 3 and Category 5 specifications (as applicable) using Level 2 test equipment in accordance with TIA-568-C.2.
3. Cable tests will be per industry standard and also include the following:

    a. Cable Length
    b. Attenuation
    c. NEXT
    d. Characteristic Impedance
    e. Mutual Capacitance
    f. Resistance
    g. Noise
    h. Wire Map

4. Electronic test results shall be submitted by the Contractor for approval by Owner, Architect, and Engineer.

END OF SECTION 27 13 13

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:

1. This specification is intended to be performance based, with the expectation that an "end-to-end" solution is provided by one of the "pre-approved" manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish "benchmark" products from one or more of the "pre-approved manufacturers". The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. Circa
   b. CommScope (Systimax)
   c. General / Panduit
   d. Superior Essex / Ortronics

Table 1 - Copper Backbone Cable / Connectivity Products			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	25-pair Category 3 - Riser Rated Cable	CommScope	1010A WH 25/24
		Superior Essex	18-025
		General Cable	2131505
2	50-pair Category 3 – M-Type 66-clip connecting block	Leviton	40066-M50
		Siemon	M4-12
		Ortronics	805003202

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 27 13 23 - COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals, but are not intended to be an all-encompassing bill of materials.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

F. Rough carpentry is specified in a Division 6 section.

PART 2 - SYSTEM REQUIREMENTS

2.1 COMMUNICATIONS OPTICAL FIBER BACKBONE CABLING SYSTEM

A. Topology:

1. The Optical Fiber Backbone Cabling will be an industry standard physical star topology with fiber optic cabling interconnecting each Intermediate Cross-connect (IC) to the Fiber Optic Main Cross-Connect (MC) location, unless noted otherwise.
2. For conditions where backbone cable is provided to non-communication room locations such as Remote Hub locations, all cabling topology shall follow the same requirements and originate from the MC unless noted otherwise.
3. All cable splices shall be coordinated with Owner, Architect, and Engineer. This includes those shown on drawings and/or proposed by Contractor.
4. Cable splices are only acceptable as noted on the drawings and must be approved by Owner, Architect, and Engineer.
5. Cable splices are only intended where differing cable types are joined and/or multiple smaller cables are joined to a larger backbone feeder cables.
6. Splices are not acceptable to extend cables of inadequate cable lengths.
7. Refer to drawings for additional requirements.

B. General Requirements:

1. All cable and terminations shall meet the minimum Performance and Criteria listed in specification below and on drawings, in accordance with TIA-568-C.3.
2. Cable requirements including cable types, quantities and pair / strand counts are specified on the drawings.
3. All cables shall have the appropriate fire spread rating per building codes, industry standard, and Underwriters Laboratory (UL/cUL) including plenum (CMP/OFNP/OFCP), riser (CMR/OFNR/OFCR), etc. The contractor shall verify the appropriate cable is being used for application it is installed.
4. Any cable routed below grade shall utilize specific water block construction. Fiber optic cables can use dry water block tape or gel-filled compound to achieve this rating. The contractor is required to submit a solution wherever this condition exists regardless of whether noted on drawings.
5. Underground rated cable that doesn't carry a suitable indoor building cable rating per building code and UL, shall not be routed more than 50-ft (15m) inside the building. Cable shall be spliced or terminated as appropriate and noted on drawings.
6. Approved splices shall be low attenuation fusion type.
7. All armored and/or metallic cable sheaths shall be bonded to Telecommunications Ground Bus (TGB).
8. Fiber terminations shall swap transmit/receive polarity on far end of cable per industry standards for all mated or duplex connectors. This requirement shall be coordinated with Owner and Facility Operator.
9. Service loops shall be provided at each end of cable at the termination point.
10. Provide breakout or fan-out kits for all loose type fiber optic cables for transitioning to tight buffered cable at termination points.

C. Performance and Criteria:

1. General Fiber Backbone Cabling Requirements: (as applicable per drawings)

    a. Cable Rating:

        1) Outside Plant / Underground w/ Water Block
        2) Riser Rated
        3) Plenum Rated
        4) Indoor / Outdoor

    b. Cable Construction:

        1) Construction: Interlocking Armored and/or Non-Armored

    c. Length Limitations: Refer to tables below.

d. Physical Specification:

1) Strand Counts: 24, 48 and 96.
2) Multi-mode Core Diameter: 50-Micron
3) Single-mode Core Diameter: 8-Micron
4) Cladding Diameter: 125-Micron

e. Compliances: Refer to respective cables types in section 2.2.
f. Temperature:

1) CMP Operating and storage: -4 to +140F (-10 to +60C)
2) OSP Operating and storage: -40 to 158F (-40 to +70C)

g. Bend Radius (Minimum):

1) Installation: 20X Outside Cable Diameter.
2) Operating: 10X Outside Cable Diameter.

h. Pulling Tensions (max): 25-lb (11 kg).
i. Transmission Performance (min.)

1) Refer to tables below for each applicable cable type.

2. 50.0 – Micron Multi-Mode 300 (OM3)

a. Transmission Performance:

50.0 - MICRON MULTI-MODE (OM3)						
Wavelength	Maximum Attenuation	Bandwidth (MHz-km)	Supported Ethernet Length			
			10 Mbps	100 Mbps	1 Gbps	10Gbps
850 nm	3.5 dB/km	2000 MHz-km	980-feet (300m)	980-feet (300m)	3280-feet (1000m)	980-feet (300m)
1300 nm	1.5 dB/km	500 MHz-km	6560-feet (2000m)	6560-feet (2000m)	1960-feet (600m)	980-feet (300m)

3. 50.0 – Micron Multi-Mode 550 (OM4)

a. Transmission Performance:

50.0 - MICRON MULTI-MODE (OM4)						
Wavelength	Maximum Attenuation	Bandwidth (MHz-km)	Supported Ethernet Length			
			10 Mbps	100 Mbps	1 Gbps	10Gbps
850 nm	3.5 dB/km	4700 MHz-km	980-feet (300m)	980-feet (300m)	3600-feet (1100m)	1800-feet (550m)
1300 nm	1.5 dB/km	500 MHz-km	6560-feet (2000m)	6560-feet (2000m)	1960-feet (600m)	980-feet (300m)

4. 8.3 – Micron Single-Mode (SM2/OS2)

a. Transmission Performance:

8.3 - MICRON SINGLE-MODE, (OS2)						
Wavelength	Maximum Attenuation	Bandwidth (MHz-km)	Supported Ethernet Length			
			10 Mbps	100 Mbps	1 Gbps	10Gbps
1310 nm	0.5 dB/km	100 TeraHz-km	9800-feet (3000m)	9800-feet (3000m)	9800-feet (3000m)	9800-feet (3000m)
1550 nm	0.5 dB/km	100 TeraHz-km	9800-feet (3000m)	9800-feet (3000m)	9800-feet (3000m)	9800-feet (3000m)

2.2 CABLING

A. General

1. This cable shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on ANSI/TIA/EIA-568-C.3 equivalent cable rating.
2. Refer to Technology Drawings for all cable types, quantities and pair / strand counts.

B. Interlocking Armored Building Cables

1. Riser Rated (CMR / OFCR)

a. Application:

1) Building Cable is intended for interior building backbone and riser distribution installation within duct, conduits, and/or cable tray.

b. Construction:

1) Jacket: Flame Retardant, Riser Rated, (CMR / OFNR)
2) Fiber Buffer: Tight Buffered, 900-micron.
3) Armor: Interlocking Aluminum.
4) Strength Member: Aramid Strength Yarn.
5) Water Block/Filling Compound: None.

c. Compliances:

1) ANSI/TIA/EIA-568-C.3
2) NEC/CEC Type CMR / OFCR.

C. Non-Armored Building Cables

1. Plenum Rated (CMP / OFNP)

a. Application:

1) Building Cable is intended for interior building backbone and riser distribution installation within duct, conduits, and/or cable tray. Requires installation within inner-duct to protect cable.

b. Construction:

1) Jacket: Flame Retardant, Plenum Rated, (CMP / OFNP)
2) Fiber Buffer: Tight Buffered, 900-micron.
3) Armor: None.
4) Strength Member: Aramid Strength Yarn.
5) Water Block/Filling Compound: None.

c. Compliances:

1) ANSI/TIA/EIA-568-C.3
2) NEC/CEC Type CMP / OFNP.

D. Indoor/Outdoor Interlocking Armored Building Cables

1. Riser Rated (CMR / OFCR)

a. Application:

1) Indoor/Outdoor Building Cable is intended for interior, exterior and outdoor building backbone and riser distribution installation within duct, conduits, and/or cable tray.

b. Construction:

1) Jacket: Flame Retardant, Riser Rated, (CMR / OFNR)
2) Fiber Buffer: Tight Buffered, 900-micron.
3) Armor: Interlocking Aluminum.
4) Strength Member: Aramid Strength Yarn.
5) Water Block/Filling Compound: Yes, Water Block Construction.

c. Compliances:

1) ANSI/TIA/EIA-568-C.3
2) NEC/CEC Type CMR / OFCR.

E. Outside Plant (OSP) Cables

1. Loose Tube Interlocking Armored OSP Cables

a. Application:

1) Underground duct
2) Trunk, distribution and feeder cable
3) Local loop, metro, long-haul and broadband network

b. Construction:

1) Jacket: UV resistant
2) Fiber Buffer: Loose Buffered
3) Armor: Corrugated steel interlocking
4) Strength Member: Central and dielectric water-blocking
5) Water Block/Filling Compound: Gel (PFM or generic)

c. Compliances:

1) Telcordia GR-20-CORE
2) RDUP PE-90 Designation MLT
3) ICEA S-87-640-2006
4) RoHS-compliant

2.3 TERMINATION EQUIPMENT

A. General

1. Fiber terminations shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type, based on ANSI/TIA/EIA-568-C.3 equivalent cable ratings.
2. Provide all necessary fiber enclosures, splice trays, and connectors (as applicable). Refer to Technology Drawings for additional information.

B. Termination Type Requirements

1. Pre-terminated fiber module with pigtail for fusion splicing, mounted within splice tray.

C. Connectors

1. General:

a. Ferrule: Ceramic
b. Fiber Buffer Size: 900-micron

c. Optical Specification:

1) Multi-mode
2) Single-mode
3) Insertion Loss (Typical / Max.): <0.3dB / <0.75dB

d. Plug Requirements:

1) Retention Force (Buffer): 2-lb (0.9kg)
2) Retention Force (Cordage): 10-lb (4.5kg)
3) Insertion Life: 500 minimum.

e. Temperature rating (operating): -40 to +167 ^{O}F (-40 to +75 ^{O}C).

2. LC-Type

a. Application / Fiber Type:

1) Multi-mode
2) Single-mode

b. Form Factor: Small Form Factor (SFF)
c. Adapter Type: Duplex
d. Form Factor: Small Form Factor (SFF)

3. SC-Type

a. Application / Fiber Type:

1) Single-mode

b. Adapter Type: Duplex
c. Form Factor: Small Form Factor (SFF)
d. Polish: Angled Polished Connectors (APC)

D. Enclosures

1. General:

a. Use: Enclosure or housing for consolidating connectors and/or splicing of high density optical fiber typically at communication distribution and equipment rooms.
b. Mounting Configuration: FACT Frame
c. Cable Managers:

1) Internal strand managers for service loops and strand management in back side.
2) Internal patch cord manager at front side.

3) Cable access on both sides at front and back sides. Access points should have integrated curved guards to support appropriate cable bends.

2. Element – Rack Mount Fiber Optic Housing

a. Application: Fiber Optic Rack mount fiber terminations.
b. Size: Element size 1E, 2E, 3E, 6E

E. Splice Trays

1. General:

a. Shall meet the minimum requirements noted in Performance and Criteria Section.
b. Dedicated splice trays may not be necessary as enclosures with built in splice trays may be acceptable, if submitted and accepted by Owner / Engineer.

2. Application:

a. Provide protection and slack management of heat shrink fusion spliced fibers.
b. Splice tray to be used with enclosures noted below.

3. Fiber Types supported:

a. Micron Multi-Mode (OM3, OM4)
b. Micron Single-Mode (OS1, SM2)

4. Related components to be provided (as necessary):

a. Mounting hardware kits
b. Heat shrink splice sleeve (40mm and/or 60mm lengths)

2.4 PATCH CORDS

A. General Requirements:

1. The patch cords shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on ANSI/TIA/EIA-568-C.3 equivalent cable rating.
2. Patch cords shall be provided as part of project at main cross-connects, intermediate cross-connects, and horizontal cross-connects (as applicable).
3. All fiber optic patch cords shall be from the same manufacturer as the fiber optic backbone and shall meet all performance requirements established in earlier sections of this specification.
4. Lengths and Colors: Refer to Technology Drawings (symbol legend) for additional requirements on various patch cord lengths and/or colors.

5. When provided by Contractor, patch cords to be provided for all fiber and connector types included in project, per sections 2.1, 2.2, and 2.3 of this specification section.
6. Refer to Technology Drawings (symbol legend) for additional requirements on various patch cord types, lengths and/or colors.

2.5 MISCELLANEOUS COMPONENTS

A. Grounding Components:

1. All fiber optic cabling with metallic sheath (i.e. Interlocking Armored Fiber) shall be grounded at each end, if cable exits the room.
2. Provide armored fiber jacket grounding straps grounded to telecom grounding busbar or ladder rack (not equipment rack), per manufacturer recommendations.

2.6 PATHWAYS

A. Inner-Duct:

1. Provide appropriately rated fiber optic inner-duct for incoming service conduits and any locations where non-armored fiber optic cable is installed. Refer to Technology Drawings for additional information, but inner-duct rating types used on this project may include:

    a. Outside Plant
    b. Interior Riser Rated

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Grounding:

1. All fiber optic cabling with metallic sheath (i.e. Interlocking Armored Fiber) shall be grounded at each end per manufacturer recommendations, if cable exits the room.
2. Refer to Telecommunications Grounding and Bonding specification section 27 05 26 for additional requirements.

C. Labeling:

1. The final labeling scheme shall be coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.

2. Each cable, termination panel, and termination shall be identified at the Main Cross-connect (MC), at the Intermediate Cross-connect (IC), and at each station termination.
3. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

D. Fiber Optic Testing/Certification (Passive)-EIA/TIA-526-14

1. Multi-mode Fiber:

a. All fiber optics will be tested for end-to-end attenuation at 850nm and 1300nm; using an optical power source and an optical power meter.
b. Tests will be performed after connectors have been installed, and will be from jumper side of hub(s) bulkhead connector to the jumper side of the bulkhead connectors at the MC/IC fiber interconnect panel.
c. Maximum loss will not exceed manufacturers' passive cable system attenuation; adjusted for cable length connector loss.
d. Maximum connector pair loss is .5dB. Splices are not acceptable in this system.
e. Test results, including OTDR printouts, will be included in the final documentation package.
f. Contractor shall complete a fiber optic post installation report at the time of testing containing meter readings at both 850 nm and 1300 nm from both directions on each fiber. Report shall include actual loss and other pertinent data regarding the cables tested, including model and serial number of test equipment, cable part number, installed fiber length, building span loss at 850 nm and 1300 nm and date tested.
g. Span loss calculations are required on the final test sheet for loss at 850 nm and 1300 nm for multimode.

$$(D \times L) + (C \times \#\ \text{connectors})$$

D = Length; L = Loss; C = Connector loss (Max 0.75 dB)

1 ft. = 0.0003048 km.

2. Single-mode Fiber:

a. All fiber Optics will be tested for end-to-end attenuation at both 1310nm and 1550nm; using an optical power source and an optical power meter.
b. Tests will be performed after connectors have been installed, and will be from jumper side of the hub(s) bulkhead connector to the jumper side of the bulkhead connectors at the MC/IC fiber interconnect panel.
c. Maximum loss will not exceed manufacturer's passive cable system attenuation; adjusted for cable length and connector loss.
d. Maximum connector pair loss is 0.5 dB. Splices are not acceptable in this system.
e. Test results including OTDR printouts will be included in the final documentation package.
f. Contractor shall complete a fiber optic post installation report at the time of testing containing meter readings at both 1310nm and 1550nm from both directions on

each fiber. Report shall include actual loss and other pertinent data regarding the cables tested, including model and serial number of test equipment, cable part number, installed fiber length, building span loss at 1310nm and 1550nm and date tested.

g. Span loss calculations are required on the final test sheet for loss at 1310nm and 1550nm for single-mode.

(D x L) + (C x # connectors)
D = Length; L = Loss; C = Connector loss (Max 0.75 dB)
1 ft. = 0.0003048 km.

END OF SECTION 27 13 23

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:

1. This specification is intended to be performance based, with the expectation that an "end-to-end" solution is provided by one of the "pre-approved" manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish "benchmark" products from one or more of the "pre-approved manufacturers". The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. CommScope (Systimax)
   b. Belden
   c. Superior Essex / Ortronics

Table 1 - Fiber Optic Cables

Item	Part Name/Description	Manufacturer	Part Number
1	OS2 (G657.A1) Single-mode (OFNP) Plenum Rated Premises Cable (Non-Armored)	CommScope	P-XXX-DS-8W-FSUYL
		Superior Essex	44XXXK
		Superior Essex	44XXXK1
		Belden	FISDxxxP9
2	OS2 (G657.A1) Single-mode (OFCR) Riser Rated Premises Cable (Armored)	CommScope	R-XXX-DZ-8W-FSUYL
		Superior Essex	L3XXXK
		Belden	FISDxxxF9
3	OS2 (G657.A1) Single-mode (OSP) Outside Plant Loose Tube Cable (Armored)	CommScope	D-XXX-LA-8W-F12NS
		Superior Essex	12xxxKD01
		Belden	FSSLxxx6D
4	12A Grounding Clamp (for Armored Fiber)	CommScope	GAK-FEC001
		Legrand / Ortronics	Submit for Approval

Table 2 - Fiber Optic Connectivity Products			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	High Density 1U modular cassette sliding Panel, accepts (4) G2 modules or MPO panels, providing up to 48 duplex LC ports, or up to 32 MPO ports	CommScope	760209940 HD-1U
2	G2 ULL Singlemode MPO-12 Distribution Module, 24LC to 2X12f MPOs unpinned, internal shutters	CommScope	760238083 DM12-24LC-SM-ULL
3	OS2 Single-mode Splice Cassette (LC-type) Pre-terminated with pigtails	CommScope	G2-SP-12LCG-PT

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 27 15 00 - COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Product Appendix: Refer to Appendix 1, Equipment Schedules, for specific product information on the benchmark products. These equipment schedules should be the baseline for product data submittals, but are not intended to be an all-encompassing bill of materials.

B. Refer to Section 27 05 00 (Part 1 and Part 3) for requirements that shall be fulfilled as part of this specification section.

C. General provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections.

D. Architectural, Electrical, and Technology Drawings. Other systems drawings may apply.

E. Division 26 Basic Electrical Materials and Methods sections apply to work of this section.

F. Rough carpentry is specified in a Division 6 section.

PART 2 - SYSTEM REQUIREMENTS

2.1 HORIZONTAL STRUCTURED CABLING SYSTEM

A. Topology

1. The Communications Horizontal Cabling will be an industry standard physical star topology with cabling routed to each communication device outlet location from the nearest Horizontal Cross-connect (HC) location, unless noted otherwise.
2. Communications horizontal cabling shall not exceed a total cable length of 295-feet (90m) for the permanent basic link. The channel length shall not exceed 325-feet (100m) when patch cords are installed.
3. Contractor(s) responsible for providing the communications horizontal raceway and/or cabling shall ensure that the pathway and cable to each device location does not exceed 295-feet (90m) length back to the nearest HC location. Contractor shall bring any distance concerns to the attention of the Architect and Engineer during the bid process and/or at a minimum during the shop drawing process, prior to installation.
4. Contractor shall immediately notify Owner, Architect, and Engineer of any cable segment that exceeds the length limitation.
5. Refer to drawings for additional requirements.

B. General Requirements

1. All cable and terminations shall meet the minimum Performance and Criteria listed in specification below and on drawings.
2. Cable requirements including cable quantities are specified on the drawings.
3. All cables shall have the appropriate fire spread rating per building codes, industry standard, and Underwriters Laboratory (UL/cUL) including plenum (CMP/OFNP/OFCP), riser (CMR/OFNR/OFCR), etc. The contractor shall verify the appropriate cable is being used for application it is installed.
4. Any cable routed outside and/or below grade shall utilize specific water block construction. Cables generally use gel-filled compound to achieve this rating for copper cable and dry water block paper for others. The contractor is required to submit an Outdoor Rated and/or Underground Rated solution wherever this condition exists regardless of whether noted on drawings.
5. Outdoor Rated and/or Underground Rated cable that doesn't carry a suitable building cable rating per building code and UL, shall not be routed more than 50-ft (15m) inside the building. Cable shall be spliced or terminated as appropriate and noted on drawings.
6. Cabling system shall be procured from a single manufacturer that offers a complete end-to-end certified and warranted system for the TIA-568-C.2 Category noted for each system. Additionally, all products provided shall be the newest products offered by the manufacturer for the product category specified.
7. Cable splices of any kind are not acceptable for communications horizontal cabling system.
8. Cables from different low voltage systems (ex. 70v Speaker, BMS, etc.) shall not be run in the same conduit pathways unless specifically noted on the drawings.

C. Performance and Criteria

1. General Horizontal Cabling Requirements:

   a. Cable Rating:

      1) Plenum Rated (CMP).
      2) Riser Rated (CMR) or General Rated (CM) when installed in continuous conduits or non-plenum spaces as determined by Authority Having Jurisdiction (AHJ).
      3) Outdoor Rated (all outdoor or below grade applications).

   b. Cable Construction:

      1) Type: Unshielded Twisted Pair.
      2) Medium: Solid Annealed Copper.

   c. Length Limitations:

      1) 295-feet (90m).

d. Physical Specification

1) Standard Cable Sizes: 4-pairs.
2) Conductor Size: 24 AWG.

e. Compliances:

1) TIA-568-C.2,
2) NEC/CEC Type CMP.

f. Electrical Specification

1) Characteristic Impedance: 100 Ohms.
2) Cat.6 Frequency: 1-250 MHz.

g. Temperature:

1) CMP Operating and storage: -4 to +140F (-10 to +60C)
2) OSP Operating and storage: -40 to 140F (-40 to +60C)

h. Pulling Tensions (max): 25-lb (11 kg).
i. Transmission Performance (min.)

1) Refer to tables below for each applicable cable type.

2. Category 6

a. Transmission Performance (min.)

1) Permanent Link

CATEGORY 6 – PERMANENT LINK						
Frequency (M Hz)	**Insertion Loss (dB)**	**NEXT (dB)**	**PSNEXT (dB)**	**ELFEXT (dB)**	**PSELFEXT (dB)**	**Return Loss (dB)**
1.0	1.9	65.0	62.0	64.2	61.2	19.1
4.0	3.5	64.1	61.8	52.1	49.1	21.0
8.0	5.0	59.4	57.0	46.1	43.1	21.0
10.0	5.5	57.8	55.5	44.2	41.2	21.0
16.0	7.0	54.6	52.2	40.1	37.1	20.0
20.0	7.9	53.1	50.7	38.2	35.2	19.5
25.0	8.9	51.5	49.1	36.2	33.2	19.0
31.25	10.0	50.0	47.5	34.3	31.3	18.5
62.5	14.4	45.1	42.7	28.3	25.3	16.0
100.0	18.6	41.8	39.3	24.2	21.2	14.0

CATEGORY 6 – PERMANENT LINK						
Frequency (M Hz)	**Insertion Loss (dB)**	**NEXT (dB)**	**PSNEXT (dB)**	**ELFEXT (dB)**	**PSELFEXT (dB)**	**Return Loss (dB)**
200.0	27.4	36.9	34.3	18.2	15.2	11.0
250.0	31.1	35.3	32.7	16.2	13.2	10.0
Minimum Link Propagation Delay: 498ns @10MHz Maximum Link Delay Skew: 44ns/100m @10MHz						

2) Channel

CATEGORY 6 – CHANNEL						
Frequency (M Hz)	**Insertion Loss (dB)**	**NEXT (dB)**	**PSNEXT (dB)**	**ELFEXT (dB)**	**PSELFEXT (dB)**	**Return Loss (dB)**
1.0	2.1	65.0	62.0	63.3	60.3	19.0
4.0	4.0	63.0	60.5	51.2	48.2	19.0
8.0	5.7	58.2	55.6	45.2	42.2	19.0
10.0	6.3	56.6	54.0	43.3	40.3	19.0
16.0	8.0	53.2	50.6	39.2	36.2	18.0
20.0	9.0	51.6	49.0	37.2	34.2	17.5
25.0	10.1	50.0	47.3	35.3	32.3	17.0
31.25	11.4	48.4	45.7	33.4	30.4	16.5
62.5	16.5	43.4	40.6	27.3	24.3	14.0
100.0	21.3	39.9	37.1	23.3	20.3	12.0
200.0	31.5	34.8	31.9	17.2	14.2	9.0
250.0	35.9	33.1	30.2	15.3	12.3	8.0
Minimum Link Propagation Delay: 555ns @10MHz Maximum Link Delay Skew: 50ns/100m @10MHz						

3) Connecting Hardware

CATEGORY 6 – CONNECTING HARDWARE				
Frequency (M Hz)	**Insertion Loss (dB)**	**NEXT (dB)**	**FEXT (dB)**	**Return Loss (dB)**
1.0	0.10	75.0	75.0	30.0
4.0	0.10	75.0	71.1	30.0
8.0	0.10	75.0	65.0	30.0
10.0	0.10	74.0	63.1	30.0
16.0	0.10	69.9	59.0	30.0
25.0	0.10	66.0	55.1	30.0
31.25	0.11	64.1	53.2	30.0

CATEGORY 6 – CONNECTING HARDWARE				
Frequency (M Hz)	**Insertion Loss (dB)**	**NEXT (dB)**	**FEXT (dB)**	**Return Loss (dB)**
62.5	0.16	58.1	47.2	28.1
100.0	0.20	54.0	43.1	24.0
200.0	0.28	48.0	37.1	18.0
250.0	0.32	46.0	35.1	16.0

4) Assembled Patch Cord

CATEGORY 6 – ASSEMBLED PATCH CORD				
Frequency (M Hz)	**2 m Cord NEXT (dB)**	**5 m Cord NEXT (dB)**	**10 m Cord NEXT (dB)**	**Return Loss (dB)**
1.0	65.0	65.0	65.0	19.8
4.0	65.0	65.0	65.0	21.6
8.0	65.0	65.0	64.8	22.5
10.0	65.0	64.5	62.9	22.8
16.0	62.0	60.5	59.0	23.4
20.0	60.1	59.6	57.2	23.7
25.0	58.1	56.8	55.4	24.0
31.3	56.2	54.9	53.6	23.0
62.5	50.4	49.2	48.1	20.0
100.0	46.4	45.3	44.4	18.0
125.0	44.5	43.5	42.7	17.0
150.0	43.0	42.1	41.4	16.2
175.0	41.8	40.9	40.2	15.6
200.0	40.6	39.8	39.3	15.0
225.0	39.7	38.9	38.4	14.5
250.0	38.8	38.1	37.6	14.0

2.2 CABLE REQUIREMENTS

A. General

1. The cables shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on TIA -568-C.2 equivalent cable rating.
2. Colors:

    a. Device outlets, patch panel termination labels, and patch cords may be colored to differentiate applications types. Horizontal voice/data cables do not require separate colors. Refer to Technology drawings (symbol legend) for additional requirements on color coding.

B. Category 6 Plenum Rated – Horizontal Cable

1. General:

   a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6.

2. Application: Primarily for communications horizontal cable installation within duct, conduits or cable trays. May also serve in the building backbone and riser applications.
3. Construction:

   a. Insulation: Flame retardant semi-rigid Fluoropolymer.
   b. Shield/Sheath: None.
   c. Filling Compound: None.
   d. Jacket: Flame retardant PVC.

C. Category 6 Outdoor Rated – Horizontal Cable

1. General:

   a. This cable shall meet the minimum requirements noted in Performance and Criteria Section for Category 6.

2. Application: Primarily for communications horizontal cable installation within duct or conduits in outdoor or underground locations.
3. Construction:

   a. Insulation: Polyethylene.
   b. Shield/Sheath: None.
   c. Filling Compound: Yes, water block filling compound.
   d. Jacket: Polyethylene.

2.3 TERMINATION REQUIREMENTS

A. General

1. All terminations shall meet the minimum requirements noted in Performance and Criteria Section for each respective cable type based on TIA -568-C.2 equivalent cable rating.
2. All terminations for copper cables located on the face of the building or at remote locations outside of the building footprint (i.e., IP security cameras, WLAN data, etc.) shall have surge protectors at the termination point within the communications room. Contractor shall comply with manufacturer recommendations.
3. Specific and dedicated patch panels shall be used when multiple TIA-568-C.2 cable categories are used on the same project.
4. Provide all necessary wiring terminals and horizontal cable managers.

5. Provide double-sided horizontal cable manager above and below each patch panels as indicated in 271100.
6. Terminate 4-pairs per RJ45 jack per T568B standard termination. Exact requirements shall be coordinated and approved with Owner, Architect, and Engineer prior to initiating any work.
7. Specific communication device outlet types shall be grouped together on patch panels. Additionally, 20% spare jacks shall be added within each grouping.

B. RJ45-Type Patch Panels

1. Type: RJ45-Type.
2. Pin Configuration: T568B.
3. Mounting Configuration: 19-inch Rack.
4. Size: 48-port (provide as required to terminate all cable).
5. Colors:

    a. Patch panel termination labels may require color coding to differentiate applications types. Refer to Technology drawings (symbol legend) for additional requirements on color coding.

6. Cable Interface:

    a. Input: 110-Type (back).
    b. Output: RJ45-Type (front).

7. Electrical Specifications:

    a. TIA-568-C.2:
    b. Insulation Resistance: 500 MegaOhms (minimum).
    c. Current Rating: 1.5A @68 ^{O}F (20 ^{O}C).
    d. Dielectric Withstand Voltage: 1000 VAC RMS, 60Hz (minimum), contact-to-contact and 1,500 VAC RMS, 60Hz (minimum) to exposed conductive surface.
    e. UL and cUL Listed
    f. FCC Part 68.

8. Plug Requirements:

    a. Retention Force: 30-lb (133N).
    b. Insertion Life: 750 minimum.
    c. Plug/Jack Contact Force: 0.22-lb (100g).

9. Temperature

    a. Operating: +14 to +140 ^{O}F (-10 to +60 ^{O}C).
    b. Storage: -40 to +158 ^{O}F (-40 to +70 ^{O}C).

C. RJ45-Type Device Outlet Jacks

1. Type: RJ45-Type
2. Pin Configuration: T568B.
3. Mounting Configuration: Faceplates, Trim Plates, and Modular Patch Panels.
4. Colors:

    a. Jacks and/or termination labels may require color coding to differentiate applications types. Refer to Technology drawings (symbol legend) for additional requirements on color coding.

5. Cable Interface:

    a. Input: 110-Type (back).
    b. Output: RJ45-Type (front).

6. Electrical Specifications:

    a. TIA-568-C.2:
    b. Insulation Resistance: 500 MegaOhms (minimum).
    c. Current Rating: 1.5A @68 ^{O}F (20 ^{O}C).
    d. Dielectric Withstand Voltage: 1000 VAC RMS, 60Hz (minimum), contact-to-contact and 1,500 VAC RMS, 60Hz (minimum) to exposed conductive surface.
    e. UL and cUL Listed
    f. FCC Part 68.

7. Plug Requirements:

    a. Retention Force: 30-lb (133N).
    b. Insertion Life: 750 minimum.
    c. Plug/Jack Contact Force: 0.22-lb (100g).

8. Temperature

    a. Operating: +14 to +140 ^{O}F (-10 to +60 ^{O}C).
    b. Storage: -40 to +158 ^{O}F (-40 to +70 ^{O}C).

D. Faceplates:

1. General:

    a. Faceplates and/or trim plates shall be provided at each communication device location as necessary to install jacks.
    b. No communication device cable and outlet jack shall be installed without a faceplate to tightly secure assembly.

c. All unused ports shall have a blank dust cover installed. The color of each dust cover shall match the faceplate color as closely as possible, unless otherwise indicated.
d. Faceplate and/or surface box shall be provided at modular furniture locations. Coordinate requirements with Owner, Architect, and Engineer prior to purchasing components and initiating installation.
e. Wall telephone locations shall use a modular faceplate with standard integrated mounting knobs for installing telephone handset to wall.
f. Coordinate faceplate requirements at specialty locations for floor boxes, surface raceway, surface mount boxes, and other locations accordingly.

2. Material: (Refer to Technology Drawing details for additional information.)

a. Wall Devices: Stainless Steel.

3. Type: RJ45 Standard Form Factor.

2.4 PATCH CORD REQUIREMENTS

A. General:

1. The patch cords shall meet the minimum requirements noted in Performance and Criteria Section for Category 5E, 6, and 6A as applicable based on TIA-568-C.2 equivalent cable rating.
2. Patch cords shall be provided as part of project at main cross-connects, intermediate cross-connects, horizontal cross-connects, and communication device outlet locations.
3. Exact patch cords requirements including TIA-568-C.2 category, quantity, and lengths shall be coordinated with Owner, Architect, and Engineer.
4. The sum of patch cord lengths when added the permanent basic link shall not exceed 325-feet (100m).
5. Construction: Unshielded Twisted Pair type.
6. Electrical Specifications:

a. TIA-568-C.2:
b. UL and cUL Listed CM Cordage
c. FCC Part 68.

7. Plug Requirements:

a. Retention Force: 30-lb (133N).
b. Insertion Life: 750 minimum.
c. Plug/Jack Contact Force: 0.22-lb (100g).

8. Temperature

    a. Operating: 14 to +140 ^{O}F (-10 to +60 ^{O}C).
    b. Storage: -4 to +140 ^{O}F (-20 to +60 ^{O}C).

9. Lengths: Refer to Technology drawings (symbol legend) for additional requirements on various patch cord lengths.
10. Colors:

    a. Patch cords shall be colored to differentiate applications types. Refer to Technology drawings (symbol legend) for additional requirements on color coding and quantities.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Refer to Section 27 05 00 for requirements that shall be fulfilled as part of this specification section.

B. Elevator Interface

1. Provide for Elevator Junction Box requirements, as follows:

    a. Low Voltage Cabling Contractor shall provide an elevator device junction box located within or outside of the Elevator Machine Room, for interface of elevator devices (elevator phones, IP security cameras, etc.) to be located within the elevator cab(s). This requirement complies with ANSI A17.1 code which prevents work within the Elevator Machine Room, other than specific elevator work.
    b. Elevator device J-box shall include a keyed lockable door. Additionally, J-box shall have proper terminal strips suitable for terminating all cables within the J-box.
    c. Coordinate exact location of elevator device junction box with the Elevator Contractor, Architect, and Engineer, prior to installation.
    d. Provide all cabling as required between the elevator device J-box and the IC-room for all elevator device interfaces.
    e. Provide all required interface points for connecting to elevator relays and travel cables.
    f. The Elevator Contractor shall provide all cables in conduit from the elevator machine room to the associated elevator device J-box.
    g. Cables entering the elevator device J-box shall be appropriately labeled by the Elevator Contractor, so that the Low Voltage Cabling Contractor can connect to the appropriate wires. Wires should be individually labeled to separate them from other

elevator functions and to assist the Low Voltage Cabling Contractor in making proper connection points.

C. Labeling:

1. The labeling scheme shall be provided by the Contractor and coordinated with Owner, Architect, and Engineer prior to finalizing and initiating any work. A sample scheme shall be submitted for approval.
2. Each cable, wiring block, patch panel, and termination shall be identified at the main cross-connect (MC), at the intermediate cross-connect (IC), and at each station termination.
3. Refer to Specification Section 27 05 00 for additional requirements that shall be fulfilled as part of this specification section.

D. Horizontal Systems Cable Testing:

1. All communications copper horizontal cabling and pairs shall be tested for electrical continuity and wire map.
2. Cable testing shall confirm to the cables TIA-568-C.2 rating.
3. All cabling will be test/certified for conformance to the TIA-568-C.2 Category Category 5E, Category 6, and Category 6A specifications using TSB-67 Level 4 time domain reflectometer (TDR) or approved equivalent test equipment.
4. Cable tests will be per industry standard and also include the following:

    a. Cable Length
    b. Attenuation
    c. NEXT
    d. Characteristic Impedance
    e. Mutual Capacitance
    f. Resistance
    g. Noise
    h. Wire Map

5. (5) Printed test results shall be submitted on disc and printed copies by the Contractor for approval by Owner, Architect, and Engineer.

END OF SECTION 27 15 00

APPENDIX 1 - EQUIPMENT SCHEDULE

General Notes:

1. This specification is intended to be performance based, with the expectation that an "end-to-end" solution is provided by one of the "pre-approved" manufacturers (or partnerships) listed below.
2. Products listed below are intended to establish "benchmark" products from one or more of the "pre-approved manufacturers". The listed benchmark products shall be used as a baseline when submitting products from a pre-approved manufacturer that does not have specific products listed.
3. Pre-approved manufacturers (listed in alphabetical order) include:
   a. CommScope (Systimax)
   b. Corning
   c. Berk-Tek / Leviton
   d. Belden
   e. General / Panduit
   f. Superior Essex / Ortronics

Table 1 - Horizontal Cable / Connectivity Products

Item	Part Name/Description	Manufacturer	Part Number
1	Category 6 Plenum Rated Cable	CommScope Systimax	2071E
		Superior Essex	77-###-yB
		Belden	2413
2	Category 6 OSP Rated Cable, Gel-filled	CommScope Systimax	1572A
		Superior Essex	04-001-68
		Belden	OSP6U
3	Category 6 Indoor/Outdoor Cable	CommScope	CS34P-IO
		Superior Essex	04-001-63
		Belden	2143A
4	Category 6 Information Outlet (XX = Color)	CommScope Systimax	MGS400-XX
		Leviton	61110-RX6
		Belden	AX101321

Table 1 - Horizontal Cable / Connectivity Products			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
5	24-port Patch Panel - Modular (Individual Jack Inserts)	CommScope Systimax	360-E-MOD-1U-24
		Leviton	49255-H24 - 1U
		Belden	AX103114
6	48-port Patch Panel - Modular (Individual Jack Inserts)	CommScope Systimax	360-E-MOD-2U-48
		Leviton	49255-H48 - 2U
		Belden	AX103115

Table 2 - Miscellaneous Connectivity Products			
Item	**Part Name/Description**	**Manufacturer**	**Part Number**
1	Surface Mount Box "Biscuit" (# = Number of Ports, XX = Color)	CommScope	M10#SMB-B-XX
		Leviton	41089-#XP
		Belden	AX105353
2	Blank Outlet Dust Covers (XX = Color)	CommScope	M20AP-XX
		Leviton	41084-0BX
		Belden	AX102262
3	Stainless Steel Faceplates (with label window) (# = Number of Ports)	CommScope	M1#SP-L
		Leviton	43080-1L#
		Belden	AX104231
4	Plastic Faceplates (with label window) (# = Number of Ports, XX = Color)	CommScope	M1#L-XX
		Leviton	42080-#XS
		Belden	AX102655

APPENDIX 2 - SPECIFICATION COMPLIANCE MATRIX TEMPLATE

Indicate compliance of the proposed equipment and/or services by the word "Comply" following each paragraph number. Indicate an exception to the requirement by the word "Exception" following the applicable paragraph number. Should the proposed equipment and/or services not entirely comply with the requirements specified, but ultimately achieve the intent, the Bidder shall explain fully the extent, or lack thereof, of compliance for the applicable equipment and/or services proposed. Instances where there is no indication of compliance or exception shall be considered non-compliant.

Contractor shall submit Compliance Matrix with the Bid Proposal AND at the time of Product Data submittal (as indicated previously in this specification) so that a complete system submittal reviewed can be performed. Contractor shall use the following template to create a full Compliance Matrix for each specification section.

	COMPLIANCE	**EXPLANATION**
PART 1		
1.1		
A	COMPLY	
B	EXCEPTION	Note clarifications and/or reason for exception here.
C	COMPLY	
1.2		
A.1	COMPLY	
A.2	COMPLY	
B	COMPLY	
C.1	COMPLY	
C.2	COMPLY	
D.1a	COMPLY	
D.1b	COMPLY	
D.2a	COMPLY	
xx	COMPLY	
xx	COMPLY	

SECTION 28 46 00 - ADDRESSABLE FIRE ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of contract, including General and Supplementary conditions and Division 1 specification sections, apply to work of this section.

B. Division 26, Basic Electrical Materials and Methods applies to work specified in this section.

C. Division 26 “Electrical Identification” applies to work in this section for labeling of conduit and equipment.

D. Related work specified in other divisions of these specifications.

1. Installation of duct type smoke detectors. Control wiring from Fire Alarm Control equipment to mechanical fans, dampers, control equipment both low voltage and line voltage and all other control wiring associated with mechanical equipment.

1.2 SUMMARY

A. Provide a complete and coordinated Class A wiring, fire alarm system in accordance with the contract documents. Audible intelligibility shall be provided throughout the building.

B. Contractor to include any and all hardware expansions and firmware updates to the existing Fire alarm system to be included in all renovated space.

C. Any fire alarm devices, wiring etc., not indicated on the drawings, but required by the local Building Department and Fire Department, shall be provided as part of this specification. Contractor shall adjust locations and quantities of fire alarm devices as required to comply with local codes. As minimum, an additional 5 audio/visual alarms, 5 smoke detectors, and 5 addressable interface devices shall be included for each building or interiors renovation project occurring at the base area for pricing, including labor.

D. Refer to Life Safety Report for additional requirements and fire alarm matrix.

E. Contractor shall assume all responsibilities for obtaining a fire alarm permit.

1. Contractor / Fire Alarm Installer shall develop a submittal including plan drawings, calculations, etc. to submit to the local jurisdictional authority in order to obtain a permit.
2. Contractor / Fire Alarm Installer shall provide and apply a seal / signature to fire alarm drawings as required by the authority having jurisdiction in order to obtain a permit.

3. Contractor is required to relist the Fire Alarm system as required to Steamboat Springs Fire Department.

1.3 SUBMITTALS

A. Procedure - prepare and make submittals listed in accordance with Division 1, “Submittals” as required by Local Department of Fire.

B. Product Data - submit manufacturer’s specifications, recommendations, and installation instruction for use intended. The data shall include but is not limited to the following:

1. Control panels
2. Cabinets
3. Manual stations
4. Batteries
5. Battery charger
6. Smoke sensors
7. Installer’s training history
8. Visual alarms
9. Audio/visual alarms
10. Addressable interface devices
11. Central processing unit
12. Wiring conductors
13. Wire connectors
14. Thermal sensors
15. Electromagnetic door hold-open devices
16. Two-way voice communication system
17. Manufacturer’s recommended calibrated test method for smoke sensors and smoke detectors.
18. Include Underwriters Laboratories or Factory Mutual listing cards for equipment provided.

C. Drawings

1. Detailed drawings for the fire alarm system shall consist of illustrations, schedules, performance charts, battery calculations, point lists, instructions, diagrams, and complete detailed drawings of the fire alarm system.
2. A descriptive index of drawings in the submittal with drawings listed in sequence by drawing number.
3. A legend sheet identifying device symbols, nomenclature, and conventions used in the package.
4. Floor plans drawn to a scale not less than 1/8 inch equals 1 foot which clearly show locations of devices, equipment, risers, panels, electrical power connections, approximate location of conduit runs, and other details required to clearly describe the proposed system.

5. A 1/4” scale plan view of the fire command center and security office with dimensioned layout of all equipment therein.
6. Location of control panels, detectors, supervisory switches, manual pull stations, visual/audible alarms and electrical devices. Clearly and completely indicate the function of the control panel and devices. Indicate conduit routing and sizes, and the number of conductors contained in each. Indicate points of connection and terminals used for electrical field connections in the system, with a wiring color code. Indicate termination points of devices and indicate the interconnection of modules required for proper operation of the system. Indicate interconnection between modules and devices. Control diagrams shall be supplemented with a narrative description of the system. Point-to-point wiring diagrams shall indicate control panel wiring and make and model of devices and equipment. Signal circuit diagrams shall show current draw and load by device and by circuit.

D. Design Data

1. Battery standby power requirements calculations.
2. Submit design calculations for the system substantiating battery standby power requirements, calculations showing battery capacity and supervisory and alarm power requirements.

E. Field Test Reports

1. Preliminary and acceptance tests.
2. Include the control panel and initiating and indicating devices, a unique identifier for each device with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include printer information.

F. Record Drawings

1. Upon completion, and before final acceptance of the work, submit a complete set of CADD generated as-built drawings for the fire alarm system, including components and any other associated appurtenances. Include as-built circuit diagrams complete with conductor color codes and a listing of initiating device locations and fixing voltage for each. Submit an electronic set of all documentation. Submit as-built drawings in addition to the record drawings required by Division 1, “Operation and Maintenance Data”.
2. List of FACP alphanumeric address names
3. Request for formal inspection and tests
4. When tests have been completed and corrections made, submit a signed, dated certificate with a request for formal inspection and tests.

G. Operation and Maintenance Manuals

1. Fire alarm control panel
2. Smoke and thermal sensors

3. Interface and control modules
4. Submit in accordance with Division 1, “Operation and Maintenance Data”. Include current unit prices and source of supply for parts list, and a list of parts recommended by the manufacturer to be replaced after one year and three years of service. Include in the fire alarm control panel, full and comprehensive manufacturer’s repair and service manuals.

1.4 QUALITY ASSURANCE

A. Qualifications the manufacturer’s authorized distributor must substantiate that within a 50-mile radius of the job site, there is an established agency which stocks a full complement of parts and offers full service during normal working hours on all equipment to be furnished and that the agency will supply parts without delay and at a reasonable cost.

B. Qualifications of Installer: Prior to installation, submit data for approval showing that the Contractor has successfully installed addressable, analog intelligent interior fire alarm systems of the same type as specified herein, or that the Contractor has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least two installations where the Contractor or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit names and phone numbers of points of contact at each site.

C. Codes and Standards: Except as modified by governing codes and where more stringent standards are specified by the contract documents, comply with the latest applicable provisions and the latest recommendations of the following:

1. National Fire Protection Association (NFPA): NFPA 70, “2020 National Electrical Code”: NFPA 72, “National Fire Alarm and Signaling Code”: NFPA 241, “Standard for Safeguarding Construction, Alteration and Demolition Operations”: NFPA 101, “Life Safety Code”.
2. Factory Mutual (FM): FM 37825, “1952 Approved Guide”.
3. Underwriters Laboratories (UL): UL FPED, “Fire Protection Equipment Directory; UL 268, “Smoke Detectors for Fire Protective Signaling Systems;” UL 164, “Control Units for Fire Protective Signaling Systems, UL 197/ANSI, “Codes applicable to Americans with Disabilities Act Compliance”, “Testing for Fire Resistive Cables” UL 2196, “Cables for Power-Limited Fire-Alarm Circuits” UL 1424.
4. Americans with Disabilities Act
5. Local and City Codes and Amendments.
6. International Building Code, IBC-2018.
7. International Fire Code, IFC-2018.

D. Federal Specifications Compliance: Comply with FED-STD-595, “Colors used in Government Procurement”.

E. Guarantee - all components, parts and assemblies supplied by the manufacturer shall be guaranteed against defects in materials and workmanship for a period of 12 months upon acceptance. Warranty service shall be provided by a trained specialist of the equipment manufacturer. The specialist shall be based in a fully-staffed branch office located within 50 miles from the job site.

F. Testing - conduct a total system test for Architect/Engineer and Local Fire Department. Tests shall include as a minimum.

1. Verify operation of all manual pull stations and detectors.
2. Verify line supervision of each initiating and indicating circuit.
3. Verify the Class A operation of each initiating circuit.
4. Verify operation of all indicating devices.
5. Verify operation of all alarm initiated function.
6. Perform smoke test(s) as directed by the Local Fire Department.

The Engineer, Owner and Architect shall be advised a minimum of five working days before each test.

G. All equipment provided as part of this section shall be the product of a single fire alarm equipment manufacturer. Interiors renovations scope shall match the base building fire alarm system to ensure interface between the rest of the building fire alarm systems.

H. Equipment and devices shall be from a manufacturer who has been manufacturing similar products for a minimum of 5 years. Furnish materials and equipment that are current products of one manufacturer regularly engaged in the production of such equipment.

I. Regulatory Requirements

1. Devices and equipment for fire alarm service shall be listed by Underwriters Laboratories, Inc. and listed in UL FPKD or approved by Factory Mutual and listed in FM P7825. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

J. Requirements for Fire Protection Service

1. Equipment and material shall have been tested by Underwriters Laboratories, Inc. and listed in UL FPKD or approved by Factory Mutual and listed in FM P7825. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement.

K. Standard Products

1. Materials and equipment shall be standard new products of a manufacturer regularly engaged in the manufacturer of such products. Select material from one manufacturer, and not a combination of manufacturers, for any particular classification of materials.

L. Modification of References

1. In NFPA publications referred to herein, consider advisory provisions to be mandatory, as though the word “shall” had been substituted for “should” wherever it appears; interpret reference to “Authority Having Jurisdiction”.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect equipment delivered and placed in storage from the weather, humidity and temperature variation, dirt and dust, and other contaminants.

1.6 SPARE PARTS

A. Spare parts shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, stamping or tagging. Furnish the following:

1. Four keys or tools for resetting manual systems.
2. Four keys for locks of control panels or cabinets.
3. Three (bases and heads) of each type smoke (area and duct) and thermal sensors.
4. Three of each type monitor module.
5. Three of each type control module.
6. Three fuses of each type provided. Spare fuses shall be mounted in the fuse holder located inside each control panel.
7. One of each type audio/visual device.
8. One of each type visual device.

PART 2 - PRODUCTS

2.1 SYSTEM DESIGN

A. Acceptable Manufacturers: Refer to Section 26 05 03.

B. Scope

1. The work covered by this section of the specifications includes the furnishing of all labor, equipment, materials, and performing all operations in connection with the installation of the multiplex addressable Fire Alarm System (Class A) as shown on the drawings, as hereinafter specified, and as directed by the architect/engineer.

2. The Fire Alarm System shall consist of all necessary hardware and software equipment to perform the following functions:

    a. Fire Alarm and Detection Operations.
    b. Two-way Supervised Voice Communication Operations.
    c. One-way Supervised Automatic Voice Alarm Operations.
    d. Remote Manual and Automatic Control of elevators and remote monitoring of sprinklers.
    e. Interface to the building network lighting control system.

3. Each item of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by the Underwriters' Laboratories, Inc. (UL), and shall bear the "U.L." label. The Control Equipment for all Systems shall be listed under UL category UOJZ as a Single Control Unit.
4. The complete installation shall conform to the applicable sections of NFPA-72, NEC 760, Life Safety Code 101, and Local Authorities Having Jurisdiction.
5. Nodes as defined for this specification shall be intelligent, microprocessor-based devices that connect to, and handle network communications.
6. By programmable selection at each node:

    a. The specific detail information of any point connected to any node in the network may be made accessible (declared public) to the network.
    b. Points within each node shall be able to be grouped by area, type of device, type of function, or any other user selectable category, and custom labeled as a point list. A point list shall be acted upon as though it was a point for purposes of interaction with the node custom control program. Detail information shall not burden the point list messages, only the quantity and type of status shall be broadcast into the network.

7. The fire alarm system shall be provided with the primary monitoring host computer system for alarms, trouble, and supervisory indication located as shown on the construction documents. This host shall be U.L. listed for use with the fire alarm system. The host system shall be connected to the fire alarm control panels utilizing an RS-485, BACnet Level II, or equivalent network protocol on a twisted pair communication bus network.
8. Survivability: When wiring connecting the FSCS to any remote-mounted controlling device exceeds 100 feet; the wire shall be 2-hour rated in addition to being in conduit.

C. Alarm System

1. Furnish and install a fully field programmable/addressable analog fire detection system. The System shall determine the number and types of modules installed, the number of analog addressable loops, and all installed devices. It shall determine the type of device and the device number. The System shall use Style 4 (Class A) signaling line circuits and Style Z (Class A) indicating appliance circuits with individual device supervision and annunciation, primary and secondary supervision. Include control panels, central

processing unit, microphone, signal zone selectors, manual pull stations, smoke sensors, thermal sensors, addressable input interface devices, control and isolation devices, analog/addressable loop modules, audio/visual devices, visual devices, wiring, connections to devices, outlet boxes, junction boxes, and other necessary material for a complete operating system. System shall allow for loading or editing special instructions and operation sequences as required. System shall be site programmable to accommodate and facilitate expansion or changes. System shall be capable of generating the programming necessary to establish a fully functional general alarm system upon initialization. Software operations are to be stored in a non-volatile programmable memory. Loss of primary and secondary power shall not erase the instructions stored in memory. Selective input/output control functions based on ANDing, Oring, NOTing, timing and special coded operations shall be incorporated in the resident software programming of the system.

D. Job Site Changes

1. To accommodate and facilitate job site changes, initiating and indicating circuits shall be individually configurable on site to provide either alarm/trouble operation, alarm only, trouble only, current limited alarm, no alarm, normally closed device monitoring, a non-latching circuit or an alarm verification circuit.

E. Operations - New Construction

1. Display

a. Under normal condition, front panel shall display a “SYSTEM NORMAL” or equivalent message and the current time and date.

2. Sequence of Operation

a. Operation of manual stations or activation of area smoke sensors and thermal sensors including any manual or automatic initiating device shall cause the following unless noted otherwise:

1) Annunciate device type, location by building, floor, circuit and time on FACP mounted alphanumeric annunciator and graphics panel.
2) Trip communications dialer to alert monitoring agent/Fire Department. (Response will be required to reset FACP.)
3) Building audio/visual devices to sound, except activation of a single smoke detector shall not sound devices until a second device of any type is activated, on devices programmed for Alarm Verification. Speakers and visual devices shall be activated in the area of alarm.
4) Operate prioritized outputs to release magnetically held smoke doors throughout the building and as indicated on the contract drawings. Any designated normally locked doors shall be unlocked via an interface to the security and access control system.

5) Operate prioritized outputs to signal the elevator recall functions.
6) Operate prioritized outputs to signal Building Automation Control system for controlling operation of dampers and fans for smoke evacuation and control, and integration of signal/control to all other systems.
7) Automatic Voice Evacuation Sequence shall perform as outlined below:

   The audio alarm signal shall consist of a "Slow Whoop" alarm tone for a maximum of 15 seconds followed by automatic pre-selected voice evacuation messages. At the end of each voice evacuation message, the "Slow Whoop" alarm tone shall resume. The alarm tones shall sound alternately until the signal silence switch at the FACP has been operated.

8) Refer to Appendix in this section for additional information on the Sequence of Operation.

3. Abnormal Conditions

   a. Panel shall display the following information relative to the abnormal condition of a point in the system:

      1) Alphanumeric custom location label (minimum of 30 alphanumeric characters.)
      2) Type of device.
      3) Point status.

4. Alarm or Trouble Condition

   a. Pressing the appropriate FACP acknowledge button shall acknowledge the alarm or trouble condition. After the points have been acknowledge, the LEDs shall glow steady and the panel audible signal will be silenced. Total number of alarms, supervisory and trouble conditions shall be displayed along with a prompt to review each list chronologically. End of the list shall be indicated.

5. System Reset

   a. "System Reset" button shall be used to return to its normal state after an alarm condition has been remedied. The display shall step the user through the reset process.
   b. Should an alarm condition continue to exist, system will remain in an abnormal state. System control relays shall not reset. The panel audible signal and the alarm LED shall be on. The display will indicate the total number of alarms and troubles present in the system along with a prompting to review the points.

6. History Logging

    a. The control panel shall have the ability to store multiple events in an event buffer. These events shall be stored in a battery-protected memory. Events shall also be printed to the alarm printer.

7. Access Levels

    a. There shall be a minimum of four access levels provided for operators and supervisors via user-defined pass codes. Changes to pass codes shall be made only by authorized personnel.
    b. Should an invalid code be entered the operator shall be notified with a message.
    c. Access to a level will only allow the operator to perform actions within that level and actions of lower levels, not higher levels.
    d. The following functions shall have access levels associated with them:

        1) System Reset
        2) Set Time/Date
        3) Manual Control
        4) On/Off/Auto Control
        5) Disable/Enable
        6) Clear Historical Log
        7) Change Alarm Verification
        8) Program Update

8. Detection Operation (Smoke Sensors)

    a. Smoke sensors shall be smoke density measuring devices having no self-contained alarm set point (fixed threshold.) The alarm decision for each sensor shall be determined by the fire alarm control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to the stored values.
    b. Control panel shall maintain a moving average of the sensors' smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. System shall automatically maintain a constant smoke obscuration sensitivity for each sensor (via the floating threshold) by compensating for environmental factors. Smoke obscuration sensitivity shall be adjustable at least twice a day and within UL 26B window (0.5 percent to 4.0 percent) to compensate for any environment.
    c. System shall automatically indicate when an individual sensor needs cleaning. When a sensor's percentage of compensation reaches a predetermined value, a "DIRTY SENSOR" trouble condition or similar display shall be audibly and visually indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. To prevent false alarms, these "DIRTY" conditions shall in no way decrease the amount of smoke obscuration necessary for system activation.

d. Control panel shall perform an automatic self-test routine on each sensor which will functionally check sensor sensitivity electronics and ensure the accuracy of the values being transmitted to the control panel. Sensors that fail this test shall indicate a trouble condition with the sensor location at the control panel.
e. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device:

1) Primary status
2) Device type
3) Present average value
4) Present sensitivity selected
5) Sensor range (normal, dirty, etc.)

f. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:

1) Alarm detection sensitivity values.
2) Enable or disable the point.
3) Control a sensor's relay driver output.

g. It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week (for example, to be more sensitive during unoccupied times and less sensitive during occupied periods.)
h. Control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a 3 percent sensor reaches a threshold of 2.5 percent smoke obscuration.
i. For increased smoke detection assurance, individually addressed smoke sensors shall be provided with field adjustable alarm verification. Only a verified alarm shall initiate the alarm sequence operation. System shall be initially set up with a 30-second verification period.

9. Detection Operation (Thermal Sensors)

a. Thermal sensors shall be combination rate-of-rise/fixed temperature sensing. The alarm decision for each sensor shall be determined by the fire alarm control panel. The control panel shall determine the condition of each sensor by comparing sensor value to stored values. Sensor shall have the ability from the control panel to adjust its temperature setting.
b. Control panel shall maintain a moving average of the sensors' heat sensing value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. System shall automatically maintain a constant heat sensing sensitivity for each sensor (via the floating threshold) by compensating for environmental factors.
c. System shall automatically indicate when an individual sensor needs cleaning. When a sensor's percentage of compensation reaches a predetermined value, a

"DIRTY SENSOR" trouble condition or similar display shall be audibly and visually indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. To prevent false alarms, these "DIRTY" conditions shall in no way decrease the amount of heat sensing necessary for system activation.

d. Control panel shall perform an automatic self-test routine on each sensor which will functionally check sensor sensitivity electronics and ensure the accuracy of the values being transmitted to the control panel. Any sensor that fails this test shall indicate a trouble condition with the sensor location at the control panel.

e. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device:

1) Primary status
2) Device type
3) Present average value
4) Present sensitivity selected
5) Sensor range (normal, dirty, etc.)

f. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:

1) Alarm detection sensitivity values.
2) Enable or disable the point.
3) Control a sensor's relay driver output.

F. Operations - Interiors Renovations

1. Sequence of Operation (Existing)
2. Abnormal Conditions (Existing to remain - include integration of new devices and new Fire Protection system)
3. Alarm or Trouble Condition (Existing to remain - include integration of new devices and new Fire Protection system)
4. History Logging (Existing to remain - include integration of new devices and new Fire Protection system)
5. Detection Operation (Smoke Sensors) (Existing to remain - include integration of new devices and new Fire Protection system)

a. Smoke sensors shall be smoke density measuring devices having no self-contained alarm set point (fixed threshold.) The alarm decision for each sensor shall be determined by the fire alarm control panel. The control panel shall determine the condition of each sensor by comparing the sensor value to the stored values.

b. Control panel shall maintain a moving average of the sensors' smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. System shall automatically maintain a constant smoke obscuration sensitivity for each sensor (via the floating threshold) by compensating for environmental factors. Smoke obscuration

sensitivity shall be adjustable at least twice a day and within UL 26B window (0.5 percent to 4.0 percent) to compensate for any environment.

c. System shall automatically indicate when an individual sensor needs cleaning. When a sensor's percentage of compensation reaches a predetermined value, a "DIRTY SENSOR" trouble condition or similar display shall be audibly and visually indicated at the control panel for the individual sensor. Additionally, the LED on the sensor base shall glow steady giving a visible indication at the sensor location. To prevent false alarms, these "DIRTY" conditions shall in no way decrease the amount of smoke obscuration necessary for system activation.

d. Control panel shall perform an automatic self-test routine on each sensor which will functionally check sensor sensitivity electronics and ensure the accuracy of the values being transmitted to the control panel. Sensors that fail this test shall indicate a trouble condition with the sensor location at the control panel.

e. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device:

1) Primary status
2) Device type
3) Present average value
4) Present sensitivity selected
5) Sensor range (normal, dirty, etc.)

f. An operator at the control panel, having a proper access level, shall have the capability to manually control the following for each sensor:

1) Alarm detection sensitivity values.
2) Enable or disable the point.
3) Control a sensor's relay driver output.

g. It shall be possible to program the control panel to automatically change the sensitivity settings of each sensor based on time-of-day and day-of-week (for example, to be more sensitive during unoccupied times and less sensitive during occupied periods.)

h. Control panel shall have the capability of being programmed for a pre-alarm or two-stage function. This function allows an indication to occur when, for example, a 3 percent sensor reaches a threshold of 2.5 percent smoke obscuration.

i. For increased smoke detection assurance, individually addressed smoke sensors shall be provided with field adjustable alarm verification. Only a verified alarm shall initiate the alarm sequence operation. System shall be initially set up with a 30-second verification period.

G. Primary Power

1. New Construction: Obtain primary power 120 VAC 60hz, at the emergency panel in the electrical room for new systems as indicated on plans. Primary power source shall be identified FIRE ALARM SYSTEM with a red and white engraved plastic sign

permanently affixed to the face of the switch. Install lock clips on circuit breakers in the "ON" position.

2. Interiors Renovations: (Existing to remain - include integration of new devices and new Fire Protection system)

H. Auxiliary Power (Secondary Power)

1. New Construction: Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.

a. Batteries

1) Provide rechargeable lead acid type with sufficient ampere-hour rating to operate the system under supervisory and trouble conditions, including audible trouble signal devices for 24 hours and audible and visual signal devices under alarm conditions for an additional 5 minutes. House batteries either within the control panel or in a separate substantial steel cabinet, and finish on inside and outside with enamel paint; equip with a non-corrosive base and cylinder lock keyed to match FACP. Separate cells to prevent contact between terminals of adjacent cells and between terminals and other metal parts. Locate cabinet to allow convenient viewing and servicing of the batteries. A separate cabinet shall have twice the volume of batteries it will contain. The battery cabinet, if provided, shall be identified FIRE ALARM SYSTEM BATTERY CABINET with a red and white engraved plastic sign permanently affixed to the face of the panel.

b. Battery Charger

1) Provide solid state automatic float type, capable of recharging completely discharged batteries to fully charged condition in 24 hours or less. Locate charger within the control panel or within the battery cabinet. Provide voltmeter and ammeter to indicate battery voltage and charging current.

2. Interiors Renovations: Existing to remain unless otherwise noted - include integration of new devices and new Fire Protection system.

I. Wiring

1. Conductors

a. Provide in accordance with NFPA 70 and NFPA 72. Conductors shall be copper. Conductors for 120/208-Volt circuits shall be No. 12 AWG minimum; single conductors for low-voltage D.C. circuits shall be a minimum No. 18 AWG twisted, shielded with drain wire minimum. Conductors shall be color-coded. Provide wiring in electrical metallic tubing conduit in dry locations not enclosed in concrete

or where not subject to mechanical damage. Conceal conduit in finished areas. Identify conductors within each enclosure where a tap, splice, or termination is made. Identify conductors by plastic-coated, self-sticking, printed markers or by heat-shrink type sleeves. Wire the alarm initiating and notification signal devices so that removal will cause the system trouble device to sound. Each conductor used for the same specific function shall be distinctively color-coded. Use two different color codes for each interior alarm circuit; one for each loop. Each circuit color code wire shall remain uniform throughout circuit. Plenum rated cable can be used where approved by engineer and is concealed but accessible.

2. Terminations

a. Connections, junctions and conductor terminations shall be made with screw terminals at risers only. Terminate strips everywhere except in control panels. Terminations with operating voltage of 50-Volts or more shall be provided with protective cover and shall be labeled with the voltage.

2.2 COMPONENT DESIGN

A. Colors

1. Provide finish colors under this section in accordance with FED-STD-595.

B. Fire Alarm Control Panel (FACP) – Only required in New Construction projects. Interiors Renovation scope will utilize the existing fire alarm control panel and new NAC/SLC circuits shall be routed to interface with the existing panel.

1. Requirements

a. FACP shall comply with the applicable requirements of UL 864 10th Edition. Panel shall be modular, installed in a surface-mounted steel cabinet with cylinder lock. The door shall be hinged to allow access for service. Control panel shall be a neat, compact assembly containing components and equipment required to provide the specified operating and supervisory functions of the system. Control panel switches shall be within the locked cabinet. A suitable means shall be provided for testing the control panel visual indicating devices (meter or lamps.) Meter and lamps shall be plainly visible when the cabinet of the control unit is closed. Each initiating circuit shall be powered and supervised so that a signal on one zone does not prevent the receipt of signals from other zones. Loss of power, including any batteries, shall not require the reloading of a program from any source. Upon restoration of power, start-up shall be immediate, automatic and shall not require manual operation. Loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Enclosures shall be provided with ample gutter space to allow proper clearance between the enclosure and live parts of the panel equipment.

b. Each FACP shall be intelligent, with its own microprocessor and memory. Each FACP shall be UL listed independently as a fire alarm control unit. Each FACP shall be capable of automatically updating the initial System Program to accommodate added or deleted devices on any analog circuit. Each FACP shall be capable of identifying and programming a General Alarm condition for all installed devices. The system shall be capable of identifying the number of analog addressable circuits, the number of devices on all circuits, the device type and location. The System shall be capable of incorporating all new devices into the System program. System shall display at the control panel, the sensitivity of remote addressable photoelectric or ionization smoke sensor devices and thermal heat sensor devices. The system shall be capable of displaying 160 characters of system and user text (4x40 alphanumeric display). Control panel shall automatically return the normal mode after a predetermined time (1 hour) after being in the service mode. Addressable devices shall be individually identified by the system, and any quantity of addressable devices shall be in alarm at any time up to the total number connected to the system. Control panel shall be capable of supporting non-addressable as well as addressable devices. The Control panel shall be capable of supporting conventional zones in addition to analog/addressable circuits. The Control Panel shall provide for addressable remote conventional zones that are hardwired to any device addressability as well as remote sensitivity measurement shall be performed on the same pair or wires. System shall be capable of having multiple addressable devices in alarm simultaneously. FACP shall have a service mode to permit the arming and disarming of individual detection or output devices as well as manually operating output devices. Status of these devices shall be displayed upon command from the FACP. Control panel shall automatically return to normal mode in the event the panel remains unattended in the service mode. Control panel shall be able to receive and process alarms even in the service mode. FACP shall be capable of:

1) Smart Start auto initialization.
2) Smart Start Program Update.
3) Program all functions from the FACP front panel.
4) Counting the number of addressable devices within a “circuit” which are in alarm.
5) Counting “circuits” which are in alarm.
6) Counting number of addressable devices which are in alarm on system.
7) Differentiating among types of addressable devices such as ionization smoke sensors, photoelectric smoke sensors, thermal heat sensors, control elements, collective zone interfaces, point identification devices, and manual stations.
8) Assigning priorities to type of detectors, circuits or groups of detectors.
9) Provide remote point lit graphic map for all remote annunciator locations.
10) Indicate on FACP alphanumeric display, as a minimum, the following: Building Number, Floor, Type of Device, and Device Address.
11) Supporting 1008 addressable devices.
12) Automatic evacuation voice message which operates as a two-channel system, allowing evacuation tones and voice messages be transmitted

simultaneously to different zones. Visual alarms shall operate in unison with voice alarm system.

2. Control Functions

    a. Control functions shall be assigned on the basis of system initiation patterns of devices such as “ANDing” groups and “ANDing” types of devices.

3. Supervision

    a. FACP shall supervise each individual device on an initiating circuit such that trouble supervisory, normal, pre-alarm and alarm thresholds are individually annunciated. Each device on an addressable initiating circuit shall be checked to include the following: Sensitivity, response, opens, shorts, ground faults, functionality and status.

4. Reporting a Failure

    a. FACP shall report the failure of a device’s transmitting components, open or shorted, on an addressable initiating circuit. Device shall be recognized and identified by location within the circuit to the specific devices, and other devices on the circuit shall continue to function properly.

5. Devices

    a. FACP shall report by specific device and address, any device which has been removed from an addressable initiating circuit, and shall not disrupt the operation of the remaining devices to function. The system shall be capable of sounding a Trouble if the device replaced is a different device type than the device removed.

6. Accessories

    a. FACP shall be completely equipped and be provided with 25 percent spare initiating and indicating circuits, including modules, enclosure space, terminal strips, internal electronic memory and other necessary accessories complete and ready to accept future circuits. The FACP shall be capable of automatically updating the System Program to adjust for such changes.

7. Power

    a. FACP shall provide power necessary for the devices connected to it, including relay and remote annunciators. Provide a green LED to indicate normal system power is functioning.

8. Hardware and Software

    a. Hardware and software which define system configuration and operation shall be provided. Memory data and operating system software shall be contained in a non-volatile memory.

9. Smoke Sensors

    a. Smoke sensors shall be provided with alarm verification with field-adjustable time from 0 to 60 seconds. System shall initially set up with a 30-second verification period.

10. Detector Sensitivity

    a. FACP shall be capable of measuring and adjusting the sensitivity of sensors. Provide an alphanumeric display to display custom messages and give readings of sensor sensitivity, sensor by sensor. It shall not be possible to change the sensor sensitivity from the FACP within maximum and minimum values as defined by the UL listing of the sensors. System shall be capable of listing sensor sensitivity settings on the printer for permanent record.

11. Smoke Obscuration Sensitivity

    a. Control panel shall maintain a moving average of the sensors' smoke chamber value to automatically compensate (move the threshold) for dust and dirty conditions that could affect detection operations. System shall automatically maintain a constant smoke obscuration sensitivity for each sensor (via the floating threshold) by compensating for environmental factors. The smoke obscuration sensitivity shall be adjustable within the UL 260 window (0.5 percent to 4.0 percent) to compensate for any environment.

12. Dirty Sensor Indication

    a. System shall automatically indicate when an individual sensor needs cleaning. When a sensor's percentage of compensation reaches a predetermined value, a "DIRTY SENSOR" or equivalent trouble condition shall be audibly and visually indicated at the control panel for the individual sensor. To prevent false alarms, these "DIRTY" conditions shall in no way decrease the amount of smoke obscuration necessary for system activation.

13. Self-Test Routine

    a. Control panel shall continuously perform an automatic self-test routine on each sensor which will functionally check sensor sensitivity and ensure the accuracy of the values being transmitted to the control panel. Any sensor that fails this test shall indicate a trouble condition with the sensor location at the control panel.

14. Resetting and Testing the System

    a. It shall be possible to test, reset and alarm silence from the FACP. New unacknowledged alarms and troubles shall be distinctively displayed on both the visual display and the printer and differentiated from previous alarm and troubles. System shall automatically indicate the total quantity of alarms and trouble which have occurred prior to reset at the control unit. No alarm or trouble indication shall be resettable until it has been acknowledged. It shall not be possible to reset the system until alarms have been acknowledged.

15. FACP Switches

    a. FACP switches shall allow authorized personnel to accomplish the following, independent of the main operating console:

        1) Trouble silencing switch which transfers trouble signals to an indicating lamp.
        2) Evacuation alarm silencing switch which, when activated during alarm, silences alarm devices and, upon clearing the alarm, causes operation of the system trouble signals until the switch is returned to the normal position. Upon activation of a second alarm while silenced, causes the evacuation alarm to re-sound. Operation of the switch when there is no evacuation alarm causes operation of the system trouble signals.
        3) Reset zones after initiating devices have been returned to normal.
        4) Perform a complete operation test of the microprocessor with a visual indication of satisfactory communications with each board.
        5) Test panel LEDs for proper operation without causing a change in the condition on any zone.

16. Field Programming Equipment

    a. Provide field programming equipment, software devices, software, computers and other equipment necessary, including interconnection cables to accommodate field software programming changes to be made by the owner to change device descriptions, sensitivity setting, control, device type and addition or deletion of devices.

17. Lockable Equipment

    a. Lockable equipment shall have a keyed lock. All devices and cabinets shall be keyed alike.

C. Manual Stations

1. Provide an addressable noncoded double action type with mechanical reset features. Locate stations as indicated. Stations shall be die cast aluminum semi-flush or

surface-mounted. Surface-mounted boxes shall be painted the same color as alarm station. Mount stations with the base at 4 feet above finished floor and no more than 5 feet from any door, measured horizontally, as shown. Provide each station with screw-type terminals of proper number and type to perform functions required. Break-glass-front stations will not be permitted; however, a pull-lever, break-glass-rod type is acceptable. The manual alarm station shall require a key to reset or test.

D. Smoke Sensors

1. Provide analog addressable smoke sensors of the photoelectric type which shall communicate actual smoke chamber values to the system fire alarm control panel. Detectors shall be uniquely identifiable to FACP.
2. Sensors shall be listed to UL 268 and shall be documented compatible with the control equipment to which they are connected. Sensors shall be listed for both ceiling and wall-mount applications.
3. Each sensor base shall contain a LED that, when the control panel determines that a sensor is in the alarm or trouble condition, the control panel shall command the LED on that sensor's base to turn on steady, indicating the abnormal condition.
4. Sensor's electronics shall be immune from false alarms caused by electromagnetic interference and radio frequency interference.
5. All sensor addressing information shall be stored in the fixed base. Addressing information that is stored in the removable sensor is not acceptable.

E. Duct Smoke Detectors

1. Detectors in duct shall be analog addressable photoelectric type and listed by UL or FM for duct installation. Duct detectors shall be provided with approved duct housing, mounted exterior to the duct, and shall be provided with perforated sampling tubes extending across the width of the duct. Activation of duct detectors shall cause actuation of the fire alarm control panel in the same manner as other alarm initiating devices and in addition, cause all air handling units to be deactivated. Detector head shall contain amplifier switching circuitry. The amplifier switching circuit shall be entirely solid-state and operate with a nominal detector line voltage of 24-Volts D.C. Detectors to be equipped with screw terminals. Detector to be provided with indicating lamp and test switch and in test position bypass fan shutdown feature.

F. Thermal Sensors

1. Provide analog addressable thermal sensors of the combination rate-of-rise and fixed temperature type which shall communicate actual heat values to the system fire alarm control panel. Detector temperature setting shall be accomplished via the FACP. Detectors shall be uniquely identifiable to FACP.
2. Sensors shall be listed to UL 521 and shall be documented compatible with the control equipment to which they are connected. Sensors shall be listed for ceiling applications.

3. Each sensor base shall contain an LED that, when the control panel determines that a sensor is in the alarm or trouble condition, the control panel shall command the LED on that sensor's base to turn on steady, indicating the abnormal condition.
4. Sensor's electronics shall be immune from false alarms caused by electromagnetic interference and radio frequency interference.
5. Detectors shall be nominal 24 Vdc powered by initiating circuit.

G. Addressable Point Identification Device

1. The Point Identification Device shall be provided to connect single supervised conventional initiating contact type device such as water flow switches, tamper switches, single detectors, and other such devices to any of the two-wire intelligent analog loop cards. The Point Identification Device shall mount in a 4-inch square, 2 1/8-inch-deep electrical box and shall be capable of (Class "A") supervised wiring to the initiating device. The Point Identification Device shall contain an integral LED that annunciates module activation. The Point Identification Device shall provide address setting means switches and store an internal identifying code which the control panel shall use to identify the type of device.

H. Addressable Collective Zone Interface

1. The Collective Zone Interface shall be provided to connect supervised conventional initiating device or zone of supervised conventional initiating devices such as water flow switches, tamper switches, detectors, and other such devices to any of the three -wire intelligent analog loop cards. The Collective Zone Interface shall mount in a 4 11/16-inch-square, 3-inch-deep electrical box and shall be capable of (Class "A") supervised wiring to the initiating device(s). The Collective Zone Interface shall contain an integral LED that annunciates module activation. The Collective Zone Interface shall provide address setting means switches and store an internal identifying code which the control panel shall use to identify the type of device.

I. Addressable Control Element

1. The Addressable Control Element shall be provided to connect and supervise, conventional indicating device or zone of indicating devices that required an external power supply, such as horns, strobes to any of the (2) wire intelligent analog loop cards. The Control Element shall be capable of operating as a relay (dry contact form C,) to control door holders, and other such devices. Control Elements shall mount in a 4 11/16-inch-square, 3-inch-deep electrical box and shall be capable of (Class "A") supervised wiring to the indicating or control device. Control Element shall contain an integral LED that annunciates module activation. Control Element shall provide address setting means switches and store an internal identifying code which control panel shall use to identify the type of device. The addressable Control element shall be capable of providing feedback to the FACP for positive confirmation of the controlled devices activity.

J. Audio/Visual Alarms

1. Provide recessed and surface-mounted approved combination audio/visual alarm devices consisting of an electronic horn for use in an electrically-supervised circuit and a top-mounted integral flashing strobe light. The alarm horn shall have a sound rating of at least 96 decibels at 10 feet. Provide lamps of the flashing stroboscopic type, powered from the control panel alarm circuit. Lamps shall produce a minimum of 75 candela and be designed for A.D.A. compliance. Lamps shall be protected by a polycarbonate lens and shall be labeled FIRE, and are to be mounted at 80 inches above the floor, unless noted otherwise on the drawings.
2. Visual alarms shall operate in unison with audio alarm system.

K. Visual Alarms

1. Provide flush and surface-mounted lamp assembly suitable for use in an electrically-supervised circuit. Provide lamps of the flashing stroboscopic type, powered from the control panel alarm circuit. Lamps shall produce a minimum of 75 candela and be designed for A.D.A. compliance. Lamps shall be protected by a polycarbonate lens and shall be labeled FIRE, and are to be mounted at 80 inches above the floor, unless noted otherwise on the drawings.
2. Visual alarms shall operate in unison with voice alarm system.

L. Electromagnetic Door Hold-Open Devices

1. Attach to the outlet boxes indicated. Device shall operate on power from the fire alarm control panel. Attach compatible magnetic component to the door. Under normal conditions, the magnets shall attract and hold the door open. Upon activation of the building fire alarm system, the devices shall be de-energized, thus releasing the doors on the circuit. Devices shall be designed for wall or floor mounting as required by location shown on drawings, complete with matching door plate, material and finish to match door hardware. Electromagnet operates from a 24 DC source, and requires no more than 0.070 watts to develop 25 lbs. holding force.

M. Fire Alarm Speakers - Medium Output

1. Speaker shall be a high efficiency, re-entrant type speaker suitable for voice and tone signals. Speaker shall be able to operate continuously without loss of signal for one hour in any ambient temperature environment from 150°F to -30°F. Speaker shall have a die cast housing and be resistant to water, corrosion, vibration and vermin and shall be impervious to damage from pointed objects. Speaker shall produce a sound pressure level of 87 dB measured at rated power (1 watt) ten (10) feet on axis at 1 Khz. Speakers shall have transformer taps of 2, 1, ½ and ¼ watts RMS audio power rating. Speaker shall be provided with pigtail leads for wiring terminations. Speaker shall be semi-flush mounted on a standard 4 x 4 electrical box with extension ring, or fully recessed as noted on the plans. All speakers in general space shall be medium output.

2. Where speakers are indicated to be installed flush mounted, provide with a white circular metal baffle with perforated holes meeting the Architect's approval.

N. Outdoor Fire Light and Horn

1. Outdoor fire lights and horn suitable for wet locations complete with high intensity flashing light and alarm horn as integral unit.
2. The electrical light source shall be sealed in silicone and protected by a Lexan lens. The word "fire" shall appear on the lens.
3. The minimum sound level shall be 95 dB at ten (10) feet.

O. Remote Indicator Lights

1. Remote indicator lights shall be lighted red when the associated device is in alarm. Light shall be mounted in a stainless-steel coverplate with the appropriate legend engraved thereon. Indicators shall be a highly visible red LED.

P. Nameplates

1. Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installations, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Major components include, but are not limited to, the following:

a. Fire Alarm Control Panels

1) Furnish to obtain approval by the Engineer/Fire Department before installation. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

Q. Wiring

1. Provide Wiring materials under this section as specified in division 26, "Wires and Cables", with the addition and modifications specified herein.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The work includes providing a new fully field programmable/addressable analog interior fire alarm and smoke detection system including associated equipment and appurtenances. Provide each system complete and ready for operation. Equipment, materials, installation, workmanship, inspection, and testing shall be in strict accordance with the required and advisory provisions of NFPA 70, NFPA 72 and NFPA 241, except as modified herein.

B. Provide intelligent, analog addressable type manual pull stations, smoke sensors, thermal sensors, and audio/visual devices, including a stand-alone fire alarm control panel as located on the drawings and required by the fire department.

C. Provide additional voice alarm speakers where sound level is not above 15dB above ambient noise level.

D. Pre-inspection - examine areas and conditions under which work of this section is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION CRITERIA

A. All fire alarm wiring shall be in conduit. All alarm and signal wiring shall be in accordance with the manufacturer's recommendations and installed in an approved raceway specified in Section 26 05 33.

B. The contractors shall fully coordinate with all other trades for the proper wiring and control of all systems.

C. VCS speakers shall be wired in parallel.

D. Control panel, annunciators, standby power module must be mounted with sufficient clearance for observation and testing. Final arrangement and location must be approved by the Architect/Engineer and Fire Department

E. Flexible connectors are to be used for all devices mounted in suspended lay-in ceiling panels. All conduit, mounting boxes, junction boxes and panels are to be securely hung and fastened with appropriate fittings to insure positive grounding throughout the entire system. No wiring other than that directly associated with fire alarm detection, alarm or auxiliary functions will be permitted in fire alarm raceways.

F. Conductors in cabinets must be carefully formed and harnessed so that each drops off directly opposite to its terminal. Cabinet terminals must be numbered and coded.

G. Wiring splices are to be avoided to the extent possible, and, if need, they must be made only in junction boxes which are to be painted fire-alarm red.

H. Color codes must be used throughout. Transposing or changing color coding of wire will not be permitted. Wire nut-type connections are not acceptable. All conductors in conduit pull boxes or cabinets containing more than one wire must be labeled on each end with "E-Z Markers" or equivalent.

I. Provide all necessary emergency power to the complete Fire Alarm System in accordance with the manufacturer's requirements.

3.3 PAINTING

A. Paint exposed electrical, fire alarm conduit and surface metal raceway to match adjacent finishes in exposed areas. Paint conduit and surface metal raceways red in unfinished areas and above finished ceilings.

3.4 FIELD QUALITY CONTROL

A. Preliminary Tests

1. Conduct the following tests during installation of wiring and system components. Correct any deficiencies pertaining to these requirements prior to formal functional and operational tests of the system.
2. Ground Resistance

    a. Measure the resistance of each connection to ground. Ground resistance shall not exceed 10 ohms.

3. Dielectric Strength and Insulation Resistance

    a. Test dielectric strength and the insulation resistance of system interconnecting wiring by means of an instrument capable of generating 500-Volts D.C. and equipped to indicate leakage current in 1000 mega-ohms. For the purpose of this test, instrument shall be connected between each conductor on the line and between each conductor and ground at control panel and of line, with the other extremity open circuited and series-connected devices shunted or in place. System shall withstand test without breakdown and indicate a resistance of not less than 500,000 ohms, the measurement being taken after an electrification of not more than 1.0 minute with a dc potential of not less than 100-Volts nor more than 550-Volts. Dielectric tests shall be witnessed by Engineer or their designee.

4. Smoke and Thermal Sensor Tests

    a. Prior to formal inspection and tests, clean and perform sensitivity tests on each smoke and thermal sensor. Clean the smoke and thermal sensors in accordance with the manufacturer’s recommended procedures. Perform voltage activation sensitivity test on each sensor and record the results. Remove sensors with a sensitivity level above or below the UL accepted sensitivity range for that sensor and replace with new sensors. Present recorded data at the formal inspection for verification. Approved copies shall become part of the operations and maintenance manual for the fire alarm system.

5. Field Inspection and Test

    a. Before final acceptance of the work, test each system to demonstrate compliance with the contract requirement. Each system shall be subjected, at minimum, to complete functional and operational tests including tests in place of each smoke sensor and detector, each thermal sensor, each manual station and visual and audio/visual device, tests of wiring supervision and tests of control panel functions. Preliminary tests shall be performed in accordance with manufacturer's published testing instructions and in accordance with NFPA 72. Furnish one extra Operations and Maintenance Manual with the formal request for final acceptance testing. The system shall be operational, with no trouble or alarm conditions, a minimum of 14 consecutive days prior to formal tests. Printer shall be operational during the preliminary tests and break-in period. Provide printer records with the request for formal inspection as evidence of completion of required preliminary test.

6. Formal Inspection and Test

    a. The Authority Having Jurisdiction will witness formal tests after receipt of written certification that preliminary tests have been completed and that the system is ready for final inspection. The system manufacturer's technical representative shall be present for the inspection and test. At minimum, preliminary tests shall be repeated and functional and operation tests conducted, as requested by the Architect/Engineer. Correct defects and conduct additional tests to demonstrate that the system conforms to contract specifications. Contractor shall provide two-way radios, personnel and test equipment required for conducting tests. Smoke detectors shall be tested using the manufacturer's calibrated test method. In addition, formal testing will require real smoke to be used to test smoke detectors. Canned smoke will not be permitted. Test equipment shall be turned over to the Authority Having Jurisdiction following test completion.

7. Manufacturer's Field Service

    a. Manufacturer's Representative

        1) Furnish the services of a factory-trained fire alarm system manufacturer's representative or technician, experienced in the installation and operation of the type of system being provided, to supervise the installation, testing, including formal testing, adjustment of the system, and instruction to the facility personnel. Furnish names and phone numbers of the factory-trained fire alarm system representatives or technicians.

B. Training

1. Equipment manufacturer shall provide 40 hours on site technical training to the owner or its representative (for two persons designated by Owner). Training shall allow for

individual hands on programming, trouble-shooting and diagnostics exercises. Training shall occur within 2 months of system acceptance.

2. Also provide a minimum of 40 classroom hours of factory training in programming and use of the system for each of two people (designated by Owner). Provide room and board for trainees' during this period if training facility is located more than 30 miles from the project. Provide this training no less than six months and no more than eighteen months after building acceptance, as scheduled by Owner.

C. Adjustments

1. Equipment manufacturer shall provide necessary subsequent custom reprogramming to modify and adjust operations and individual identification nomenclature to the owner satisfaction four months after final system acceptance and twelve months after system acceptance. Reprogramming is to be done at the job site and witnessed by the Authority Having Jurisdiction representative. Revision of as-built and record drawings shall be by the installing Contractor.

SYSTEM INPUTS	SYSTEM OUTPUTS	ACTIVATES FIRE ALARM SPEAKERS AND STROBES FOR ALL FLOORS	ACTIVATES ELEVATOR SHAFT RELIEF DAMPER.	RELEASE ELECTRIC LOCKS ON EXIT DOORS.	SHUT DOWN AFFECTED HVAC UNIT.	ACTIVATES EXTERIOR HORN/STROBE AT FIRE DEPARTMENT CONNECTION.	RELEASE MAGNETIC DOOR HOLDER CLOSING FIRE DOORS ON AFFECTED FLOOR.	RETURNS ELEVATORS TO PRIMARY RECALL LEVEL AS CURRENTLY OPERATED.	DISCONNECTS POWER TO AFFECTED ELEVATOR BANK.	RETURNS ELEVATORS TO ALTERNATE RECALL LEVEL AS CURRENTLY OPERATED	ANNUNCIATES AT FIRE ALARM CONTROL PANEL.	SENDS ALARM TO FIRE DEPARTMENT VIA MONITORING STATION CONNECTION	CLOSES LOCAL FIRE/SMOKE DAMPER	ACTIVATES SUPERVISORY ALARM AT FACP AND MONITOR STATION	ACTIVATE COMMON TROUBLE ALARM
FIRE PROTECTION															
-AUTOMATIC SPRINKLER WATERFLOW OTHER THAN GROUND FLOOR		X		X		X	X	X			X	X			
-AUTOMATIC SPRINKLER WATERFLOW GROUND FLOOR		X		X		X	X			X	X	X			
-MAIN FLOW SWITCH		X		X		X	X				X	X			
-SPRINKLER TAMPER SWITCH														X	
SMOKE DETECTION															
-HVAC (AT UNIT)					X									X	
-RETURN FAN														X	
-ELEVATOR HOISTWAYS, MACHINE ROOMS		X	X	X			X	X			X	X			
-SMOKE DAMPER DUCT DETECTORS				X									X	X	
-ALL FLOOR AREA DETECTORS OTHER THAN 1ST FLOOR		X		X		X	X	X			X	X			
-ALL FLOOR AREA DETECTORS 1ST FLOOR		X		X		X	X			X	X	X			
HEAT DETECTION															
-ELEVATOR HOISTWAY AND MACHINE ROOM		X		X			X		X		X	X			
-MECHANICAL ROOM AND FLOOR AREA HEAT DETECTORS		X		X			X				X	X			
MANUAL DEVICES															
-MANUAL PULL STATIONS 1ST FLOOR		X		X		X	X			X	X	X			

	SYSTEM OUTPUTS	ACTIVATES FIRE ALARM SPEAKERS AND STROBES FOR ALL FLOORS	ACTIVATES ELEVATOR SHAFT RELIEF DAMPER.	RELEASE ELECTRIC LOCKS ON EXIT DOORS.	SHUT DOWN AFFECTED HVAC UNIT.	ACTIVATES EXTERIOR HORN/STROBE AT FIRE DEPARTMENT CONNECTION.	RELEASE MAGNETIC DOOR HOLDER CLOSING FIRE DOORS ON AFFECTED FLOOR.	RETURNS ELEVATORS TO PRIMARY RECALL LEVEL AS CURRENTLY OPERATED.	DISCONNECTS POWER TO AFFECTED ELEVATOR BANK.	RETURNS ELEVATORS TO ALTERNATE RECALL LEVEL AS CURRENTLY OPERATED	ANNUNCIATES AT FIRE ALARM CONTROL PANEL.	SENDS ALARM TO FIRE DEPARTMENT VIA MONITORING STATION CONNECTION	CLOSES LOCAL FIRE/SMOKE DAMPER	ACTIVATES SUPERVISORY ALARM AT FACP AND MONITOR STATION	ACTIVATE COMMON TROUBLE ALARM
SYSTEM INPUTS															
-MANUAL PULL STATION OTHER THAN 1ST FLOOR		**X**		**X**		**X**	**X**	**X**			**X**	**X**			
SYSTEM															
-OPEN CIRCUIT, GROUND FAULT, SHORT															**X**
-FIRE ALARM LOW BATTERY															**X**
-FIRE ALARM AC POWER FAILURE														**X**	

END OF SECTION 28 46 00

SECTION 28 50 10 - AREA OF RESCUE ASSISTANCE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish, install, and wire all equipment associated with the installation of a digital Area of Rescue Assistance System designed for IBC-2015, NFPA -72 and ADA (Americans with Disabilities Act) requirements. This work shall include, but not limited to, a main control panel, remote control panels, remote call stations, power supply(s), outlet boxes, cables and wiring as shown on the drawings and as specified herein.

B. The Area of Rescue Assistance System shall include remote dialing that will automatically call an approved off-site monitoring company in the event there is no answer at the main control panel.

1.2 SUBMITTALS

A. General: Data sheets on all equipment being provided as well as recommended cable types. Internal control cabinet drawings showing internal block diagram connections shall be provided. Wiring diagrams showing typical field wiring connections as well as single line floor plan indicating equipment locations as well as cable routings and quantities.

B. Product Data: Submit product data, including manufacturer's product sheet, for specified products, including main control panel, call stations and cabling.

C. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including anchorage and accessories. Include cabling diagrams, wiring diagrams, station installation details, and equipment cabinet details.

D. Quality Assurance Submittals: Submit the following:

1. Test Reports: Certified test reports showing compliance with specified performance characteristics.
2. Manufacturer's Instructions: Manufacturer's installation instructions.
3. Manufacturer's Field Reports: Manufacturer's field reports specified herein.

E. Closeout Submittals: Submit the following:

1. Operation and Maintenance Data: Operation and maintenance data for installed products in accordance with Division 1 Closeout Submittals (Maintenance Data and Operation Data) Section.
2. Warranty: Warranty documents specified herein.

F. Project Closeout

1. A one-year maintenance contract offering continued factory authorized service of this system shall be provided as part of this contract.
2. The contractor shall furnish manufacturer's manuals of the completed system including individual specifications sheets, schematics, inter-panel and intra-panel wiring diagrams.

    a. All information necessary for the proper maintenance and operation of the system must be included.

3. As built drawings that include changes to wiring, wiring designations, junction box labeling, and other pertinent information shall be supplied upon completion of the project.
4. Provide a minimum of four (4) hours of in-service training with the system.

    a. These sessions shall be broken into segments that will facilitate the training of the system users in operating station equipment.
    b. Operating manuals and user’s guides shall be provided at the time of training.

1.3 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.

1. Warranty Period: Minimum three (3) years commencing on the Date of Substantial Completion.
2. All materials and installation shall be guaranteed to be free of defects in material and workmanship for one year after final acceptance of installation and tests.

1.4 INSTALLATION STANDARDS

A. The system shall be installed in accordance with the IBC-2015 and ADA (Americans with Disabilities Act) requirements.

B. The completed system shall be in compliance with state and local electrical codes.

C. All wiring shall test free from grounds and shorts.

D. Install according to the manufacturer’s wiring diagrams.

E. The Area of Rescue Assistance System requires installation by factory trained authorized dealers/distributors, in accordance with ANSI/NFPA 70 National Electrical Code and NFPA 72 Fire Alarm Code.

F. Properly trained personnel, familiar with Telecommunications Industry Associations 568 TIA/EIA standard, are required for proper installation. Failure to terminate the wiring correctly will cause damage to the system and void the warranty.

G. The Area of Rescue Assistance System shall be installed in a controlled, indoor dry environment, with temperatures maintained between 55°F and 95°F.

1.5 SYSTEM OPERATIONS

A. Furnish, install, and place into operation a Rescue Assistance System as indicated on the drawings and as specified herein.

B. A common control panel shall be provided adjacent to the existing fire alarm control panel and new fire alarm control panel located at Gondola Square as authorized by local authority or the fire department where shown on the drawings to indicate light and tone signals from multiple remote call stations and allow voice communication.

1. When the system is operational, a LED signals power on.
2. When the remote call station switch is activated, a one shot tone is made at the call station and a LED is lit that is steady. The call is displayed digitally on the control panel(s) with a tone along with a display of the call and its location on a 40-character LCD four line display.
3. When the alarm signal is answered by the control panel, the remote call station is signaled by the LED flashing that voice communication is initiated.
4. Voice communication with the remote call station can then be initiated from the control panel via a handset.
5. External modem connection to a public telephone system shall be provided after a programmable time delay.
6. The system shall supervise all the call stations, control panels and field switches on a continuous basis to identify line faults and defective equipment. Faults will be alerted and displayed at the control panel(s).

PART 2 - PRODUCTS

2.1 RESCUE ASSISTANCE-SYSTEM MANUFACTURER

A. Basis of Design: Rath, Inc.

B. Or approved equal. Equal to match Rath part numbers listed in this specification.

2.2 RESCUE ASSISTANCE SYSTEM AND COMPONENTS

A. Equipment

1. This system shall consist of multiple remote call stations, which will communicate with the main control panel and remote control panels as needed for a complete and operational system. The control panel(s) shall have access to a public telephone system for external alarm notification and two-way voice communication.
2. The system shall include a minimum of one control panel with the capacity to connect up to 255 call stations. Additional control panels shall be networked if additional call stations are required. In any given system there will be at least one Control Panel and between one and 255 Call Stations.
3. System wiring shall be provided per manufacturers requirements.
4. Provide signage as required by code.

B. Control Panel(s)

1. The Command Center (2500 series) shall include both the Base Station and Distribution Module. The Base Station must have a powder coated steel housing (surface or flush mount) or be desk mounted, include a black handset with coil cord and be powered from the Distribution Module.
2. The Command Center must include visual indicators to allow Rescue personnel to know which remote call station needs assistance. The Command Center must allow Rescue personnel to speak to each remote call station individual. The Command Center must include both a handset and speakerphone to communicate back to the remote call stations.
3. Distribution Module must be a surface mount enclosure, include connections for the Call Boxes and power both the Base Station and 2400 series remote call stations. The Distribution Module shall be powered from 120vac power with a battery backup that provides power for a minimum of 4 hours (Rath part # RP7700104 for 12-36 Zone or RP7700105 for 56-Up Zone).
4. The Command Center must provide an audible and visual indicator that a Remote call station has been activated.
5. The 120vac Power Supply Rath part # RP7700104 (12-36 Zone) or RP7700105 (56-Up Zone) must be capable of supplying power to the Distribution Module.
6. The power supply shall be connected to a dedicated 120V, 20A **emergency** circuit and shall include integral emergency battery backup.
7. The internal modem shall be provided to call to a designated location via a dedicated public telephone line to notify them of the alarm after a user programmed delay to allow for local response.
8. Command Center must include wording identifying the location of each Remote call station and light an LED when a particular Call Box has been activated.

C. Remote Call Station Boxes

1. The remote call station shall include a momentary switch, microphone, and loudspeaker.
2. The station shall have hands free voice communication with the control panel.
3. The station shall have silk-screened operating instructions.
4. The remote call station shall be Vandal Resistant. The standard two gang mounting plate can be flush or surface mounted and incorporates heavy-duty switches and speakers along with stainless-steel plates.
5. The station shall be an ADA compliant and vandal resistant speakerphone.
6. The station must be capable of being programmed and re-programmed on-site.
7. Provide protective covers as required on the Call Boxes per local municipal codes, use Rath 2400-XXXSSPC2.

D. Communication Sequence

1. The remote call station shall be hands-free and be a push-button-once to talk system. Once the button has been pushed, the remote call station will call the Base Station. If no answers at the Base Station, it will automatically call a pre-programmed emergency number. The remote call station must be capable of being programmed with up to 2 emergency numbers (either both off-site or Base Station and one off-site).
2. The remote call station shall have location message capability. Remote call station must have a minimum 18 second recordable message capability, programmable to play 1 or 2 times. Remote call station shall notify called party of the location of the call upon being received at the emergency dispatch center.
3. The remote call station shall be capable of allowing the called party to replay the location message, if necessary, to ensure an understanding of the caller location.
4. If system is not attended to 24 hours a day, the control panel must dial a secondary location outside the building to activate two-way off-site person to person voice communications.
5. Once a call has been made (button pushed), the call can only be terminated by the called party.
6. The station must have a red LED that will light up upon push of the button. The light shall be a solid color when the remote call station is activated, and will flash when call has been answered.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

3.2 EXAMINATION

A. 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.

3.3 INSTALLATION

A. Command Center

1. The Command Center is to be located at a central control point on the first floor or as determined by local Authority having jurisdiction.
2. The Command Center and remote call stations (2400 series) are to be powered by the Distribution Module.
3. Distribution Module shall be powered by the Rath part # RP7700104 or RP7700105 Power Supply. It shall require a dedicated 120 VAC power and provide battery backup capable of providing a minimum of 4 hours of electrical backup in case of building power failure.
4. The Base Station shall connect to the Distribution Module with single wire pair (12-16 zone), two wire pairs (28-56 zone) and three wire pairs (76-up zone).

B. Remote Call Stations

1. Provide remote call station in each area of rescue assistance or as required by the local AHJ that is above or below the exit discharge level.
2. The remote call stations must allow the programming of a specific location message of the unit. This allows rescue personnel to know the location of the activated Call Box.
3. The remote call stations are to be located no higher than 48” front reach, or 54” side reach to the center of the button above ground level to ensure conformance with the ADA requirements.
4. The remote call stations are to be flush mounted where in new walls. Surface mounted where mounted to existing walls.

C. Cabling Requirements

1. Wiring from the control panel to secondary control panels, field switches and the call stations shall be per manufacturer’s requirements.
2. Each Remote call station shall connect to the Distribution Module with a single wire pair. Wire pairs shall be shielded if near any power runs, otherwise standard pair is acceptable. Wiring shall be Rath Custom Communication Cable (part # RP7500094). If CI 2-hour fire-rated cable is required, use Rath Communication Cable (part # RP6600300M). For a UL Listed option use part # RPP66010002.
3. Provide monitoring of the system integrity as required per NFPA 72, use Rath Supervisor Board 2500-XXSPVSR.

4. Cabling for two-way communication system shall meet the applicable requirements for pathway survivability. Cabling installation shall consist of one or more of the following:

    a. 2-hour fire-rated circuit integrity (CI) cable
    b. 2-hour fire-rated cable system

D. Rescue Assistance Signal System - Audio/Visual Installation

1. Complete system shall be installed in strict accordance with manufacturer's recommendations.
2. Wiring shall be installed in raceways throughout the building, minimum ¾" conduit.

E. Rescue Assistance System Signage

1. System shall consist of a minimum of one 120/277 VAC edge light sign (part # 7050 or 7050E), a "location" and "instruction" sign (part # 7049) to clearly indicate location of designated area.
2. A tactile sign (part # 7043/7044 or 7087) with raised letter and Braille shall be located at entrance to area.
3. Command Center must include wording identifying the location of each Remote call station and light an LED when a particular remote call station has been activated.
4. The Remote call station wording must include "Emergency Phone", International Phone Symbol and raised Braille lettering.

3.4 FIELD QUALITY REQUIREMENTS

A. Site Tests (Post Installation Testing): Checkout final connections to the system shall be made by a factory technician authorized by the manufacturer of the products installed.

1. Factory authorized technicians shall demonstrate operation of the complete system and each major component to the staff.
2. System field wiring diagrams shall be provided to the subcontractor by the manufacturer prior to installation.

B. Inspection: Perform a complete functional test of the system upon completion of the installation and instruct the staff in the operation and maintenance of the system.

3.5 CLEANING

A. Cleaning: Repair or replace damaged installed products. Remove construction debris from project site and legally dispose of debris.

END OF SECTION 28 50 10

SECTION 28 50 20 - EMERGENCY RESPONDER RADIO SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Per IFC section 510, all new buildings shall have approved radio coverage for emergency responders within the building based upon the existing coverage levels of the public safety communications systems of the jurisdiction at the exterior of the building, with the following exceptions:

1. Where approved by the building official and the fire code official, a wired communication system may be permitted in lieu of an approved radio coverage system.
2. Where it is determined by the fire code official that the ERRS is not needed.
3. In facilities where the ERRS is required but the systems components could have a negative impact on the normal facility operations, the fire code official shall have the authority to accept an automatically activated ERRS.

B. Contractor shall provide turnkey Emergency Responder Radio System (ERRS) to provide coverage for emergency responder 2-way radio signals within the entire building, compliant with all adopted codes including, but not be limited to IBC-916, IFC-510 and NFPA-72. Note, this system may also be referenced as Emergency / First Responder DAS or Public Safety DAS.

C. Any reference to “DAS” within this specification section is for ERRS only. Cellular DAS (where applicable) is covered in another scope of work.

D. Provide RF site survey to establish benchmark signal level. Coordinate timing of site survey with Owner and General Contractor.

E. The following frequencies shall be supported and enhanced consistent with the results of the site survey and input from the local AHJ to confirm required frequencies. For pricing purposes, coverage for 700-800 MHz frequencies shall be considered the base / minimum requirement with alternate costs for adding 150 MHz and 450 MHz frequencies, where required.

1. 700 MHz
2. 800 MHz
3. VHF / 150 MHz
4. UHF / 450 MHz

F. Coverage and signal strength shall be provided per International Fire Code section 510, including requirements for radio signal strength, secondary power, installation and testing procedures.

G. The following design and installation scope is to be provided by the selected ERRS Contractor / Integrator, including but not limited to:

1. Donor antennas
2. Active DAS components (bi-directional amplifiers, head-end, remote units, etc.)
3. Passive DAS components (cabling, splitters, couplers, antennas, etc.)
4. Power supplies and 24 hours UPS battery back-up (to support active equipment)
5. Power circuits / outlets fed from base building electrical panels
6. Raceway (conduits, sleeves, j-hooks, etc.)
7. Penetrations (roof, floor, walls) and appropriate fireproofing and/or weather seals
8. Fire-wrap to satisfy 2-hour pathway survivability for riser coax (as necessary)
9. Fire alarm monitoring interface for 24/7 monitoring of system.

1.2 GENERAL REQUIREMENTS

A. The term “provide” used throughout this specification and drawings shall mean “furnish, install, test, and certify”.

B. Contractor shall fully coordinate with Authority Having Jurisdiction (AHJ) including all necessary system requirements, frequency allocations reviews and approvals with Building Department, Fire Department, Police Department, and/or other departments for determining system acceptance.

C. Contractor shall coordinate project schedule, installation schedule, phasing and any other requirements deemed necessary with Owner, CM, and all necessary Trades to ensure successful completion of work.

D. Contractor shall confirm if Union labor is required and include costs as applicable.

E. Contractor shall design, furnish, install, and configure turnkey DAS passive and active equipment, system management and monitoring software. Work shall include all necessary DAS system components and installation thereof required including raceway, penetrations (roof, floor, walls), fireproofing, weather-sealing, conduit 2-hour fire-wrapping (riser locations), cable, cable terminals, transceivers/media converters, amplifiers, equipment, power supplies, battery back-up, AC power circuits, fire alarm monitoring, drywall repair, etc. for a fully operational and functional DAS.

F. The DAS design shall be (virtually) developed, modeled and optimized using wireless computer software such as iBwave for establishing antenna locations based on electronic architectural drawings and various wireless frequency bands. Construction materials shall be inputted into the software program for structure, walls, floors, and ceilings.

G. The DAS wireless coverage and signal strength shall be field tested and verified, certified, and guaranteed upon installation, compliant with IFC-510 testing requirements.

H. The Contractor shall coordinate support systems requirements directly required by the DAS such as architectural, HVAC, electrical, and technology systems.

I. The installation of the DAS system shall comply with all local building codes, and applicable rules and regulations of the AHJ, FCC, BICSI, EIA, IEEE, NEC, TIA, UL, IFC, NFPA and other industry standards, codes, and methods.

J. All cabling shall comply with NFPA-72 pathway survivability requirements as adopted by the local AHJ. Specifically, Contractor shall confirm if AHJ considers building fully sprinkled and if there are any exceptions to the level-1 pathway survivability requirement. (Note: to comply with level-1 pathway survivability, all cabling shall be routed in metallic conduit, thus use of j-hooks or routing cable in cable tray is not allowed, unless specifically approved by the AHJ.)

K. All riser coax cables shall be routed within 2-hour rated enclosure to comply with NFPA-72 pathway survivability. Contractor shall confirm if Telecom and Electrical riser rooms are 2-hr rated or not. If riser rooms are not 2-hour rated spaces, all riser coax shall be installed in conduit that is wrapped with multiple layers of 3M (or equivalent manufacturer) fire wrap, as directed per manufacturer requirements. Additionally, splitters that tap off of riser coax shall be installed in pull-box that is also wrapped with fire wrap.

L. Plenum rated cable is required for all horizontal cable runs.

M. DAS head-end equipment and remote units shall be installed in NEMA-4X enclosures

1.3 SUBMITTALS

Product Data: The DAS Product Data Submittal shall be submitted for review and approval by AHJ prior to starting any work. Copies shall be provided to ME Engineers for reference only. Information shall include detailed parts list for all components and manufacturer's product data for each component to be installed.

A. Virtual Wireless Model: After project award, provide plan drawings based on architectural background or model indicating device and antenna placement based on wireless modeling computer software. Construction materials shall be inputted into the software program for structure, walls, floors, and ceilings as well as radio frequencies, zones, and capacity to help predict coverage and placement of antennas and associated coverage patterns. Information submitted shall include coverage drawing (heat map) as well as placement of antennas, equipment, cable and conduit routing, reflected ceiling plan layer, etc. Models shall be developed using iBwave or equivalent industry recognized software. Drawings shall be submitted for review and approval by AHJ prior to starting any work. Copies shall be provided to ME Engineers for reference only.

B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements of installed systems as well as acceptance by AHJ.

C. Commissioning: The Contractor shall complete commissioning of the system and issue a final report. Commissioning shall be performed upon completion of system, and after its testing and retuning. Report shall be completed and finalized by the Contractor prior to system acceptance by the Owner.

D. Warranties: The Contractor shall provide a warranty on all parts, components, and labor Warranty period shall start based on acceptance by Owner upon completion of all installation, testing and optimization.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: The installation supervisor for both installation and maintenance of units required for this Project must be an experienced installer who is an authorized representative of the DAS Vendor.

1. Contractors shall have at least five (5) years of successful installation experience with projects utilizing wireless systems including DAS.
2. The company shall be a certified installer of the DAS manufacturer, and shall provide a 1-year warranty on installation/applications.

B. Electrical Components, Devices, and Accessories: These shall be listed and labeled as defined in NFPA 70, NEC, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use. All materials shall be Underwriters Laboratories (UL) Listed unless otherwise noted or required by AHJ.

1.5 CODES AND STANDARDS

A. All work including materials and installation shall conform to all applicable sections of currently adopted editions of the codes and standards listed below or the codes, standards and specifications published by the organizations listed below:

1. All applicable / adopted national, state and local codes.
2. ANSI: American National Standards Institute (ANSI).
3. ANSI/EIA/TIA standards as applicable to DAS.
4. ASTM: American Society for Testing and Materials
5. BICSI TDM Telecommunications Distribution Methods Manual (current edition).
6. BICSI Wireless Design Reference Manual (current).
7. Emergency Responder Requirements as determined by AHJ, Fire Department, Police Department, and Ambulance/EMS.
8. ICEA: Insulated Cable Engineers Association
9. IEEE: Applicable requirements and recommended installation practices of IEEE Standards 80, 81, 141 and 142 pertaining to grounding and bonding of systems, circuits and equipment.

10. IEEE-1100-1999: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.
11. International Fire Code
12. National Electrical Code
13. NESC: National Electrical Safety Code
14. NEMA: Applicable requirements of NEMA Standards/Pub No.'s OS1, OS2 and PUB 250 pertaining to raceways, outlet and device boxes, covers, and box supports.
15. NFPA-70/NEC: National Electrical Code.
16. NFPA-70B: "Recommended Practice for Electrical Equipment Maintenance" pertaining to installation of cable tray systems.
17. NFPA-72: National Fire Alarm and Signaling Code
18. UL Compliance: Applicable requirements of UL 50, UL 514-series, and UL 886 pertaining to electrical boxes and fittings.
19. UL Compliance: Applicable requirements of UL Standards No.'s 467, Electrical Grounding and Bonding Equipment", and 869 "Electrical Service Equipment", pertaining to grounding and bonding of systems, circuits and equipment. In addition, comply with UL Standard 486A, "Wire Connectors and soldering Lugs for Use with Copper Conductors." Provide grounding and bonding products which are UL-listed and labeled for their intended usage.

1.6 SEQUENCING AND HANDLING

A. All work shall be reviewed and coordinated with the Owner and/or Construction Manager prior to commencing.

B. DAS, infrastructure, and equipment are sensitive to environmental conditions including but not limited to temperature, dirt, dust, and water. The contractor shall ensure the storage and installation of all system components are sequenced and scheduled accordingly to prevent any damage, loss of performance, and warranty voiding.

C. Installation shall be coordinated with all Ceilings, Structural, Electrical, HVAC, Plumbing, Fire Protection, and other trades to eliminate disruption and/or conflict with other systems.

1.7 WARRANTY

A. Warranty periods shall be provided on the components noted below and as listed within this section. Contractor shall submit all standard manufacturer product warranty information, including warranty length for each major component, including but not limited to passive devices (antennas, splitters, couplers, etc.), cabling (coaxial, fiber, and power), active components (remote radios, head-end equipment, etc.) and power supplies (power plants, rectifiers, batteries, etc.).

B. A warranty on the Work shall be provided by the Contractor. If, within warranty time period after the date of final acceptance by Owner of the installation or within such longer period of

time as may be prescribed by law or by the terms of any applicable special warranty required by the Contract Documents or provided by a manufacturer, any of the work or equipment is found to be defective or not in accordance with the Contract Documents, the Contractor shall correct it promptly including all parts and labor after receipt of notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This obligation shall survive termination of the contract. The Owner shall give such notice promptly after discovery of the condition. Such notice shall be provided by Owner representatives, to be identified, either verbally or in writing. Warranty period shall start based on acceptance by Owner upon completion, testing and acceptance of the installation by the Wireless Carriers.

C. The cabling Manufacturer shall provide a warranty for all cable infrastructure components. This warranty shall cover all components including cable, terminations, patch panels, and wiring panels, etc. to maintain the specified performance and physical criteria. Any such components, link, or channel shall be replaced by the Manufacturer at no cost to Owner during this period. The Contractor and Manufacturer shall submit all information and documentation on Warranty.

1.8 INSTALLATION

A. General:

1. The Contractor shall examine areas and conditions under which DAS infrastructure is to be installed. Notify Owner, Architect, and Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
2. The Contractor shall be knowledgeable of work to be performed by other trades and take necessary steps to integrate and coordinate their work with other trades.
3. The Contractor shall verify space requirements and locations before starting cable installations and terminations. Inappropriate conditions shall be immediately reported to Construction Manager, Owner, Architect, and Engineer prior to initiating installation.
4. All DAS communications infrastructure shall be installed for optimal performance.
5. All DAS and communications infrastructure shall be installed to allow for easy additions, moves, and other changes in the future.
6. Final labeling scheme for all DAS and communications components shall be coordinated with the Owner and Engineer, prior to initiating work. Labeling scheme shall include but not be limited to communications rooms, cabinets, racks, cable terminal blocks and patch panels, antennas, outlets, cables, etc.
7. The Contractor is required to coordinate their efforts with the other trades and sub-contractor who may be working within the same vicinity to avoid conflict and lost time.
8. The Contractor shall supply all necessary tools, equipment, accessories, safety equipment, protective clothing, etc., as customary for the craft and necessary for the installation.
9. The contractor shall not install any component in a manner or condition that will void manufacturer and/or contractor warranty. Any such conditions that prevent an acceptable install shall be immediately reported to Construction Manager or General Contractor,

Owner, Architect, and Engineer prior to initiating installation. All mis-installed components will be removed and replaced with new, appropriate components at the Contractor's expense. No additional cost will be submitted to Owner.

10. All equipment shall be installed in a neat and workmanlike manner, arranged for convenient operation, testing and future maintenance.

B. Raceway Installation:

1. Contractor shall comply with all industry codes and standards for DAS raceway installation, including but not limited to, appropriate conduit size, fill ratio, bend radii, number of bends and/or distance between pull-boxes, etc.
2. Fire seal all raceway penetration and openings to maintain fire rating after communications cables are installed.
3. Provide labels on all communications pull-boxes and junction-boxes.
4. Identify conduits at cable tray end by architectural room number.

C. Cable Installation: The following procedures shall apply to cable installation:

1. All distribution cable, backbone cable, horizontal cable, and antenna cable must be plenum rated.
2. All DAS and communications cables routed within Telecom Rooms shall be bundled and combed to provide a neat and organized appearance, per industry standards.
3. Install cables concealed in accessible ceilings. Install cables according to manufacturer's recommended installation practices using approved hangers at a maximum spacing of every 48 inches (1.2m), where deemed acceptable by AHJ.
4. Cable bends shall not be less than that recommended by the manufacturer of the cable. Do not exceed manufacturer's minimum bending radii and other cable requirements.
5. The contractor shall not install any cable in conduits that does not have the appropriate protect bushings on conduit ends.
6. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
7. All exposed conduit routing shall be coordinated with the Architect prior to installation. Contractor shall not route any cable exposed to view. Exposed cable (when allowed by AHJ) shall only be routed in cable trays or in j-hooks above accessible ceiling.
8. Care shall be taken so as not to damage cable during the installation process and that the manufacturer's and industry standard's pull tension specification is not exceeded.

D. Antenna Installation: The following procedures shall apply to antenna installation:

1. All antenna locations shall be coordinated with ME Engineers prior to initiating any work.
2. Install antennas per manufacturer's requirements.
3. Contractor shall install antennas with all necessary supports to ensure safe installation and support to prevent falling.
4. Antennas shall be rated accordingly and as applicable for the installation type, location, condition, and application supported.

E. Equipment Installation: The following procedures shall apply to equipment installation:

1. Install surge suppressors where ac-power-operated devices are not protected against voltage transients by integral surge suppressors specified in UL1449. Install surge suppressors at the devices' power-line terminals. Comply with Division 26 Section "Transient Voltage Suppression."
2. Mount electronic equipment in the types of cabinets recommended by manufacturer. Group related items in methodical sequence.
3. Arrange equipment to facilitate access for maintenance and to preserve headroom and passage space.
4. Interface DAS equipment with all base station equipment as required during installation period of DAS.
5. Label all equipment and interfaces.

F. System Management and Monitoring Software Installation: The following procedures shall apply to system management and monitoring software installation:

1. Coordinate all work with fire alarm contractor for interface to FACP for monitoring.
2. The system management and monitoring software shall be fully set up, programmed, and configured.

G. Design Coordination: All components proposed by the Contractor shall be coordinated with the Owner and Architect.

H. Record documentation shall be submitted to the Owner by the Contractor at the completion of the DAS installation. The contractor shall submit all information necessary to operate and maintain the system including but not limited to the following:

1. As-Built Documents
2. Operations and Maintenance Manuals
3. Maintenance Schedule (with Company Contact Information)
4. Troubleshooting Guide
5. Product Data and Manufacturer Cut-Sheets
6. Warranty Information and Contact
7. Manufacturer’s Product and Installation Certificate
8. Log (troubleshooting, replacement, expansion, and replacements)
9. Labeling Scheme

END OF SECTION 28 50 20

APPENDIX A
Fixture Cuts

STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

me engineers

Job Number:	Issue Description:	Issue Date:
DV20131	BP4C - KVC IFC & PERMIT	6/4/2021

LED Fixtures

LITHONIA LIGHTING

Catalog Number	
Notes	
Type	

LED Linear

CLX

24", 36", 48" and 96" Lengths

Flat Diffuse Lens

Round Diffuse Lens

Wide Diffuse Lens

FEATURES & SPECIFICATIONS

INTENDED USE — The CLX is a linear lighting solution that is available in multiple lengths, lumen packages and distributions. Designed for versatility, the CLX can address virtually any indoor lighting need. The CLX is also offered in standard and high efficacy configurations and capable of being continuous row mounted or installed as a stand-alone fixture. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** Click here for Acrylic Polycarbonate Compatibility table for suitable uses.

CONSTRUCTION — Channel and cover are formed from code-gauge cold-rolled steel. Housing and lens endcaps are injection-molded plastic to provide a more architectural look and feel. The endcaps come standard with a 7/8" knock out for continuous mounting but can be ordered without.

Finish: Paint options include high-gloss, baked white polyester (WH), galvanized (GALV), matte black (MBL) and smoke gray (SKGY). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Offered with acrylic lens and less lens configurations. Provides a choice of optical distributions including, wide, narrow, and axile.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications. (See PLR_ ordering information on page 14.) Electronic LED driver is multi-volt input and 0-10V dimming standard (see Operational Data on page 12 for actual wattage consumption). This fixture is designed to withstand a maximum line surge of 2.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

L70>100,000 hours at 25°C.

LEDs provide nominal 80 CRI or 90 CRI at 3000 K, 3500 K, 4000 K, or 5000 K.

Lumen output up to 2,500 lumens per foot.

INSTALLATION — Fixture may be ceiling or wall mounted (with or without THCLX hanger or angle mounted with CLXANGBRT), pendant or stem mounted with appropriate mounting options.

WARNING — Removing the lens and opening the fixture during installation exposes the LEDs, putting them at risk for damage.

If you plan to surface mount the fixture, we recommend using the THCLX. This eliminates the need to open the fixture.

If you plan to continuous row mount, we recommend using the PLR wiring harness option. This eliminates the need to open the fixture.

Damage to the LEDs caused during installation will not be covered under the warranty.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 104°F (40°C). Optional High Ambient (HA) ranging to 122°F(50°C) available on certain lumen packages (See ambient temperature chart for additional information).
DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at:
www.acuitybrands.com/support/warranty/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Stock configurations are offered for shorter lead times:

Stock Part Number	UPC	DLC QPL Product ID	DLC Premium
CLX L48 3000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525816	PAMKZR4	Yes
CLX L48 3000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525885	PKW32VRL	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525939	P778Z20	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525908	P84QC1H	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525861	PPFTGR8V	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525915	PW6250TE	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525922	PYRDC7EW	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525830	PKYPL35K	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525960	PAMKZR4	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525892	PKW32VRL	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525854	P778Z20	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525946	P84QC1H	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525878	PPFTGR8V	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525823	PD0SSJRD	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525953	PYRDC7EW	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525847	PKYPL35K	Yes

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or XPoint™ Wireless control networks marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

CLX LED Linear

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example:** CLX L48 5000LM SEF WDL MVOLT GZ10 40K 80CRI WH

Series	Length	Nominal lumens	Performance package	Louver	Lens
CLX LED linear	L24 24" [1,2]	1500LM 1,500 lumens 2000LM 2,000 lumens 2500LM 2,500 lumens 3500LM 3,500 lumens 4500LM 4,500 lumens 5000LM 5,000 lumens [3,4]	SEF Standard efficiency[2] HEF Premium efficiency	(Blank) Less louver SBLW Straight blade louver, white[6] SBLMB Straight blade louver, matte black[6] SBLGV Straight blade louver, galvanized[6] SBLSBGY Straight blade louver, smoke gray[6]	L/Lens Less lens FDL Flat diffuse [7,8] RDL Round diffuse [7,8] WDL Wide diffuse [7,8]
	L36 36" [2]	2250LM 2,250 lumens 3000LM 3,000 lumens 3750LM 3,750 lumens 5250LM 5,250 lumens 6750LM 6,750 lumens 7500LM 7,500 lumens [3,4]			
	L48 48"	3000LM 3,000 lumens 4000LM 4,000 lumens 5000LM 5,000 lumens 7000LM 7,000 lumens[1] 9000LM 9,000 lumens[2] 10000LM 10,000 lumens [3,4]			
	L96 96"	6000LM 6,000 lumens 8000LM 8,000 lumens 10000LM 10,000 lumens 14000LM 14,000 lumens [3,4] 18000LM 18,000 lumens [3,4] 20000LM 20,000 lumens [3,4]			

Distribution	Voltage		Driver[14]	Color temperature	Coloring rendering index
(Blank) General ND Narrow[8,9] WD Wide[8,9] AD2 Aisle, 24" off center[8,9]	MVOLT 120-277V[10] 120 120V 208 208V[11] 240 240V[11]	277 277V 347 347V[12,13] 480 480V[12,13]	GZ10 0-10V dimming[15] EZ1 Dimming to 1%[15]	30K 3000 K 35K 3500 K 40K 4000 K 50K 5000 K	80CRI 80 CRI 90CRI 90 CRI

Options

PS1050	Emergency battery pack, 10W, CA Title 20 Noncompliant [17,18,19,27]
E10WLCP	Emergency battery pack, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS [17,19,20,27]
BGTD	Generator transfer device, not available with PS1050 [17,18,19]
OCS	5', 18/3 Reloc selectable One Pass cable[26]
HA	High ambient, for use in ambient temperatures up to 50°C [1]
EPMOD	Decorative endplate, no knock out[28]
OUTCTR	Wiring leads pulled through back center of fixture[29]
OUTEND	Wiring leads pulled through end of fixture[3]
Cord Sets:	
CS7W	Staight blade plug, 120V [6,26]
CS3W	NEMA twist-lock plug, 120V [6,26]
CS7W	Staight blade plug, 277V [6,26]
CS11W	NEMA twist-lock plug, 277V [6,26]
CS25W	NEMA twist-lock plug, 347V [6,26]
CS97W	NEMA twist-lock plug, 480V [6,26]
CS99W	600V SEOOW white cord, no plug (no voltage required)
CS6WC16S10WDSD	6' white cord, 16/5, no plug, includes low voltage dimming wires (no voltage required) [3]
PLR___	Plug-in wiring, see page 16 for ordering information
PLR1LVG	Plug-in wiring, low voltage dimming[32]
RRL___	RELOC®-ready luminaire. See page 15 for ordering information
SPD	Surge protection device, provides up to 6kV protection[30]
USPOM	Assembled in the United States

nLight® Wireless: [21,24]

NLTAIR2 RES7	nLight® Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell
NLTAIR2 RES7POT	nLight AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell
NLTAIR2 R10	No sensor control

nLight® Wired: [21,25]

N100	nLight® without lumen management
NES7	nLight® nES 7 PIR integral occupancy sensor[26]
NESPOT7	nLight® nES POT 7 dual technology integral occupancy control[26]
NES7ADCX	nLight® nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell[26]
NESPOT7ADCX	nLight® nES POT 7 dual technology integral occupancy sensor with automatic dimming photocell[26]

Individual controls: [21,25]

MSD7	PIR integral occupancy sensor
MSDPDT7	PDT 7 dual technology integral occupancy control
MSD7ADC	PIR integral occupancy sensor with automatic dimming control photocell
MSDPDT7ADC	PDT integral occupancy sensor with automatic dimming control photocell

Finish

WH	White
GALVW	Galvanized with white lens end caps
GALVB	Galvanized with black lens end caps
MB	Matte black
SBGYW	Smoke gray with white lens end caps
SBGYB	Smoke gray with black lens end caps

See Accessories and footnotes on next page

Accessories: *Order as separate catalog number.*

Mounting:

ZACVH M100	Adjustable 10' aircraft cable with Y hanger (1 pair)
ZAC120	One adjustable aircraft cable with canopy 120° [17]
ZACFP120	One adjustable aircraft cable with feed (3 conductor) and canopy, 120° [17]
ZACFPD120	One adjustable aircraft cable with feed (5 conductor) and canopy 120° [17]
ZAC240	One adjustable aircraft cable with canopy 240° [17]
ZACFP240	One adjustable aircraft cable with feed (3 conductor) and canopy, 240° [17]
ZACFPD240	One adjustable aircraft cable with feed (5 conductor) and canopy 240° [17]
SQ__	Swivel stem hanger (specify length in 2" increments up to 48") [17]
THCLX___	Tong hanger (Must specify color) (one pair) [28]
CLXANGBKT____	Angle bracket, (Must specify color) (one pair) [28]
HC39 M12	Hanger chain, 36" (1 pair)

Sensors & Controls:

LSXR	Sensor Switch * LSXR occupancy sensor [29]
NPP16D	nLight® switching/dimming module
NPP16DER	nLight® switching/dimming module with emergency relay
rPP20D	nLight® air dimming/switching module
XPA CMRB0	XPoint™ Wireless 0-10V relay, external, 55°C max ambient

Reflectors:

CLXRW24___	Wide decorative 24" reflector, (Must specify color) [31]
CLXRW36___	Wide decorative 36" reflector, (Must specify color) [31]
CLXRW48___	Wide decorative 48" reflector, (Must specify color) [31]
CLXRW96___	Two wide decorative 48" reflectors, (Must specify color) [31]
CLXRWU24___	Wide decorative 24" reflector with uplight, (Must specify color) [31]
CLXRWU36___	Wide decorative 36" reflector with uplight, (Must specify color) [31]
CLXRWU48___	Wide decorative 48" reflector with uplight, (Must specify color) [31]
CLXRWU96___	Two wide decorative 48" reflectors with uplight, (Must specify color) [31]
CLXRN24	Narrow 24" reflector, (Must specify color) [31]
CLXRN36	Narrow 36" reflector, (Must specify color) [31]
CLXRN48	Narrow 48" reflector, (Must specify color) [31]
CLXRN96___	Two narrow 48" reflectors, (Must specify color) [31]

Wireguards:

WGCLX24___	24" wireguard, (Must specify color) [32]
WGCLX36___	36" wireguard, (Must specify color) [32]
WGCLX48___	48" wireguard, (CX, (Must specify color) 96" fixture requires two [32]

Notes

1. Not available with OBTCTR option.
2. Not available with HA option.
3. Not available with SBF when ordered in combination with EZ1.
4. Not available with NLTAIRE2 RES7, NLTAIRE2 RES7PDT, or NLTAIR2 RID.
5. Not available with EZ1 when ordered with L24 with 5000LM or L36 with 7500LM.
6. When ordered with L24 only available with 1500LM or 2000LM in combination with GZ10 driver. Not for use with THCLX, CLXANGBKT, CLX reflectors or RWGCLR accessories. Not available with RDL lens options.
7. Only available with general distribution.
8. Not available with CLXRN accessories.
9. Available L/LENS only.
10. Not available with PS1050, E10WLCP, or BGTD.
11. Not available with BGTD option.
12. Voltage selected utilizes a step-down transformer. Not available with L24 when ordered with N100. Not available with PS1050, E10WLCP or BGTD option.
13. Requires SPD option.
14. When continuous row mounting, fixtures must all have the same driver selection.
15. Not available with individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
16. Must specify voltage.
17. Not available with L24 or L36. Not available with L48 in combination with N100.
18. Available with L48 or L96 only. 20 Not available with PS1050 or E10WLCP options. Not available with 208 or 240V. Not available Individual controls, NLight Wired, or NLight Wireless options.
19. Not available DUTINO.
20. Required with PS1050, E10WLCP, BGTD, RAD, or XADJ24.
21. Not available with PLR options.
22. Not available with XPoint, Individual controls, NLight Wired, or NLight Wireless options.
23. Sensor housing will be the same color as lens end caps.
24. Not available with L24 in combination with 5000LM, nor available with L36 in combination with 7500LM, not available with L48 in combination with 10000LM, and not available with L96 in combination with 14000LM, 18000LM, or 20000LM. Not available with PLRs containing low voltage dimming wires.
25. Not available with any other control option. Requires EZ1.
26. Requires N100 option.
27. Ships standard as white.
28. Not available with louver, wireguards, wide reflectors.
29. More configurations on LSXR Specification Sheet.
30. L24 reflector is 22.65", L36 reflector is 34.07", L48 reflector is 46.86", L96 comes with two L48 reflectors.
31. For use with L/LENS fixtures only. L24 reflector is 22.75", L36 reflector is 34.20", L48 reflector is 46.85", L96 comes with two L48 reflectors.
32. Not for use with CLX wide reflector accessories.

OPTIONS AND ACCESSORIES

Narrow reflector
Ships separately from fixture.
Order as:
CLXRN24___
CLXRN36___
CLXRN48___
CLXRN96___

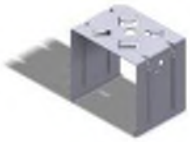
Wide decorative reflector
Ships separately from fixture.
Order as:
CLXRW24___
CLXRW36___
CLXRW48___
CLXRW96___

Wireguard
Ships separately from fixture.
96" fixture requires two WGCLX48.
Order as:
WGCLX24___
WGCLX36___
WGCLX48___

Aircraft Cable with Canopy
Available in 120° or 240°
Order as:
ZAC120
ZAC240

HANGER CHAIN
36" chain with Y hanger. ships as a pair
Order as:
HC36

ZACVH HANGER
10' Aircraft cable with Y hanger.
Order as:
ZACVH



Tong hanger
Ships as a pair
Order As:
THCLX___

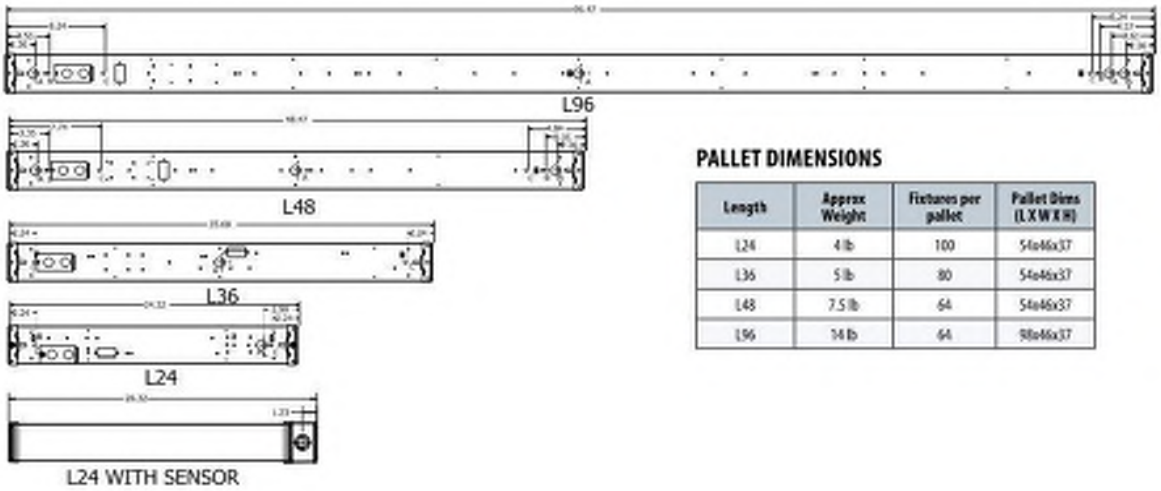
CLX LED Linear

DIMENSIONS

All dimensions are in inches (centimeters) unless otherwise indicated.
Dimensions may vary with options or accessories.

INTEGRATED SENSOR ADDS 2.0 INCHES TO STANDALONE FIXTURE LENGTH
HOUSING END CAP ADDS 0.236 INCHES TO FIXTURE LENGTH PER SIDE. DIMENSIONS BELOW INCLUDE ENDCAPS.

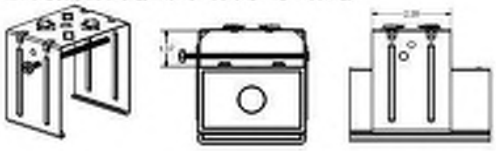
A - 7/8" KNOCK OUT
B - 0.5" by 0.16" SLOT
C - 0.3" DIA HOLE



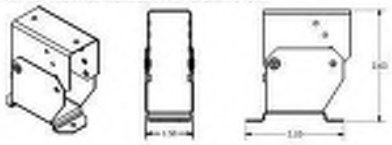
PALLET DIMENSIONS

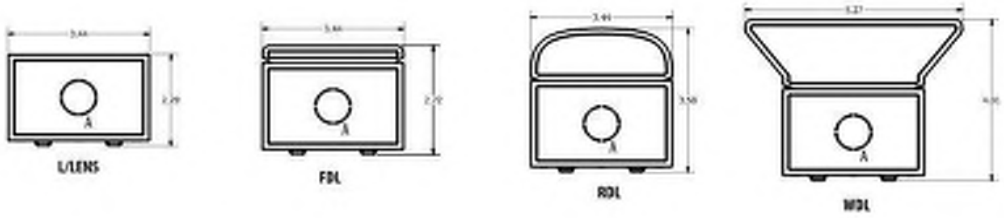
Length	Approx Weight	Fixtures per pallet	Pallet Dims (LXWXH)
L24	4 lb	100	54x46x37
L36	5 lb	80	54x46x37
L48	7.5 lb	64	54x46x37
L96	14 lb	64	98x46x37

THCLX - SHIPS TWO PER ORDER.
UTILIZES A #8 HEX HEAD SCREW AND NUT
FIXTURE SITS 1.3 INCHES FROM STRUCTURE WHEN MOUNTED



CLXANGBKT - SHIPS TWO PER ORDER
HOLES TO MOUNTING STRUCTURE ARE 0.175" DIA, 2.5" APART
FIXTURE SITS APPROXIMATELY 3.5" FROM STRUCTURE
WHEN MOUNTED HORIZONTAL TO STRUCTURE





PHOTOMETRICS

See www.lithonia.com.

POWER SENTRY EMERGENCY BATTERY PACKS

		SEF Emergency Lumens	HEF Emergency Lumens
PS1050	Factory installable	1400	1500
E10WLCP	Factory installable	1400	1500
PS1555LCP	Field installable, remote mount only	2000	2100

Note: For emergency lumen output of specific model, please consult factory. One board will be illuminated during emergency operation.

CLX CHARACTERISTICS

Nominal Lumen Package	Length	Wattage								Length	Width	Depth	Comparable Light Source
		Standard efficiency				High efficiency							
		120V	277V	347V	480V	120V	277V	347V	480V	Dimensions are shown in inches			
2500LM	24"	19.9	19.9	25.9	25.9	18.5	18.5	24.5	24.5	24	3.5	3.75	1-lamp 32WT8, 1-lamp 54WT5HO, 50W HID
5000LM	24"	41.9	41.9	47.9	47.9	37.9	37.9	43.9	43.9	24	3.5	3.75	2-lamp 32WT8, 1-lamp 54WT5HO, 70W HID
3750LM	36"	28.1	28.1	34.1	34.1	27.0	27.0	33.0	33.0	36	3.5	3.75	1-lamp 32WT8, 1-lamp 54WT5HO, 50W HID
7500LM	36"	62.9	62.9	68.9	68.9	56.8	56.8	62.8	62.8	36	3.5	3.75	2-lamp 32WT8, 1-lamp 54WT5HO, 70W HID
5000LM	48"	35.4	35.4	41.4	41.4	32.9	32.9	38.9	38.9	48	3.5	3.75	2-lamp 32WT8, 1-lamp 54WT5HO, 70W HID
10000LM	48"	77.1	77.1	83.1	83.1	70.4	70.4	76.4	76.4	48	3.5	3.75	3 -lamp 32WT8, 2-lamp 54WT5HO, 100W HID
10000LM	96"	70.8	70.8	76.8	76.8	65.8	65.8	71.8	71.8	96	3.5	3.75	3 -lamp 32WT8, 2-lamp 54WT5HO, 100W HID
20000LM	96"	154.2	154.2	160.2	160.2	140.8	140.8	146.8	146.8	96	3.5	3.75	6 - lamp 32WT8, 4 -lamp 54T5HO, 200W HID

AMBIENT TEMPERATURE RATINGS

Driver Package		GZ10			EZ1			Any Driver	
Length	Lumen package	Direct Surface	THCLX/ Suspended	HA Option (Direct or Suspended)	Direct Surface	THCLX	Suspended 18"	Xpoint/ BGTD Direct Surface	PS1050 Suspended
L24	1500LM	40C°	40C°	N/A	35C°	35C°	35C°	N/A	N/A
	2000LM	40C°	40C°		35C°	35C°	35C°		
	2500LM	40C°	40C°		35C°	35C°	35C°		
	3500LM	40C°	40C°		40C°	40C°	40C°		
	4500LM	40C°	40C°		35C°	35C°	40C°		
	5000LM	40C°	40C°		25C°	30C°	35C°		
L36	2250LM	40C°	40C°		40C°	40C°	40C°		
	3000LM	40C°	40C°		40C°	40C°	40C°		
	3750LM	40C°	40C°		40C°	40C°	40C°		
	5250LM	40C°	40C°		35C°	35C°	40C°		
	6750LM	30C°	40C°		35C°	35C°	40C°		
	7500LM	30C°	40C°		25C°	30C°	35C°		
L48	3000LM	40C°	40C°	50C°	40C°	40C°	40C°	35C°	25C°
	4000LM	40C°	40C°	50C°	40C°	40C°	40C°		
	5000LM	40C°	40C°	50C°	35C°	35C°	40C°		
	7000LM	30C°	40C°	N/A	35C°	35C°	40C°		
	9000LM	30C°	40C°		25C°	30C°	35C°		
	10000LM	30C°	40C°		25C°	30C°	35C°		
L96	6000LM	40C°	40C°	50C°	35C°	35C°	40C°		
	8000LM	30C°	40C°	50C°	35C°	35C°	40C°		
	10000LM	30C°	40C°	50C°	25C°	30C°	35C°		
	14000LM	40C°	40C°	N/A	35C°	35C°	40C°		
	18000LM	30C°	40C°		25C°	30C°	35C°		
	20000LM	30C°	40C°		25C°	30C°	35C°		

CLX OPERATIONAL DATA

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L24	1500LM	SEF	80	1497	1540	1582	1619	10.85
				90	1305	1333	1371	1441	10.85
			HEF	80	1493	1514	1582	1586	10.39
				90	1220	1237	1301	1301	10.39
		2000LM	SEF	80	2066	2125	2183	2235	14.48
				90	1801	1840	1892	1989	14.48
			HEF	80	2060	2089	2183	2189	13.46
				90	1684	1708	1796	1796	13.46
		2500LM	SEF	80	2616	2689	2763	2829	18.41
				90	2279	2329	2394	2517	18.41
			HEF	80	2607	2644	2763	2771	17.42
				90	2132	2161	2273	2273	17.42
		3500LM	SEF	80	3518	3617	3716	3804	25.83
				90	3065	3132	3220	3385	25.83
			HEF	80	3506	3556	3716	3726	25.04
				90	2867	2907	3057	3057	25.04
		4500LM	SEF	80	5048	5182	5325	5451	38.7
				90	4392	4487	4614	4851	38.7
			HEF	80	5024	5096	5325	5339	34.8
				90	4108	4165	4380	4380	34.8
		5000LM	SEF	80	5355	5506	5657	5791	41.48
				90	4667	4767	4902	5153	41.48
			HEF	80	5338	5414	5657	5672	38.11
				90	4364	4425	4653	4653	38.11
	L36	2250LM	SEF	80	2411	2547	2101	2207	16.36
				90	2479	2607	2146	2320	16.36
			HEF	80	2437	2554	1965	2095	15.47
				90	2547	2403	1992	2095	15.47
		3000LM	SEF	80	3221	3388	2790	2868	20.8
				90	3310	3133	2789	3015	20.8
			HEF	80	3167	3319	2553	2722	19.98
				90	3310	3123	2589	2722	19.98
		3750LM	SEF	80	4123	4337	3495	3671	26.47
				90	4236	4010	3570	3859	26.47
			HEF	80	4054	4248	3268	3485	25.09
				90	4236	3997	3314	3485	25.09
		5250LM	SEF	80	5545	5833	4700	4937	39.9
				90	5698	5393	4801	5190	39.9
			HEF	80	5452	5713	4396	4687	34.3
				90	5698	5376	4457	4687	34.3
		6750LM	SEF	80	7081	7448	6001	6303	54.85
				90	7275	6886	6131	6627	54.85
			HEF	80	6962	7294	5613	5984	47.97
				90	7275	6864	5691	5984	47.97
		7500LM	SEF	80	7756	8158	6574	6905	62.6
				90	7969	7543	6716	7260	62.6
			HEF	80	7626	7991	6148	6555	54.02
				90	7969	7519	6234	6555	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L48	3000LM	SEF	80	3019	3134	3190	3265	20.32
				90	2631	2688	2764	2906	20.32
			HEF	80	3010	3052	3190	3198	19.01
				90	2461	2495	2634	2624	19.01
		4000LM	SEF	80	4034	4148	4262	4363	27.58
				90	3515	3591	3693	3882	27.58
			HEF	80	4021	4078	4262	4273	24.75
				90	3288	3334	3505	3505	24.75
		5000LM	SEF	80	5047	5189	5332	5458	34.8
				90	4398	4493	4620	4857	34.8
			HEF	80	5031	5102	5332	5346	31.77
				90	4113	4171	4386	4386	31.77
		7000LM	SEF	80	7311	7517	7724	7907	49.05
				90	6371	6509	6682	7036	49.05
			HEF	80	7288	7391	7724	7744	44.67
				90	5959	6042	6353	6353	44.67
		9000LM	SEF	80	9215	9475	9735	9967	63.99
				90	8031	8204	8435	8869	63.99
			HEF	80	9186	9317	9735	9762	58.58
				90	7511	7615	8008	8008	58.58
		10000LM	SEF	80	10299	10590	10880	11139	73.37
				90	8975	9169	9427	9912	73.37
			HEF	80	10266	10412	10880	10910	66.27
				90	8394	8511	8950	8950	66.27
	L96	6000LM	SEF	80	5942	6110	6278	6427	38.15
				90	5178	5290	5439	5719	38.15
			HEF	80	5923	6008	6278	6294	35.54
				90	4843	4911	5164	5164	35.54
		8000LM	SEF	80	7929	8153	8376	8575	52.32
				90	6910	7059	7258	7631	52.32
			HEF	80	7903	8016	8376	8399	48.5
				90	6462	6552	6890	6890	48.5
		10000LM	SEF	80	9808	10085	10362	10608	66.47
				90	8548	8732	8978	9439	66.47
			HEF	80	9777	9916	10362	10390	60.89
				90	7994	8106	8523	8523	60.89
		14000LM	SEF	80	14323	14727	15131	15491	94.78
				90	12482	12752	13111	13784	94.78
			HEF	80	14277	14480	15131	15172	85.96
				90	11674	11836	12447	12447	85.96
		18000LM	SEF	80	18458	18979	19500	19963	128.98
				90	16086	16433	16896	17764	128.98
			HEF	80	18399	18661	19500	19552	116.92
				90	15044	15254	16040	16040	116.92
		20000LM	SEF	80	20386	20962	21537	22048	146.83
				90	17766	18150	18661	19619	146.83
			HEF	80	20321	20610	21537	21595	131.6
				90	16616	16847	17716	17716	131.6

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L24	1500LM	SEF	80	1359	1397	1436	1470	10.85
				90	1184	1210	1244	1308	10.85
			HEF	80	1355	1374	1436	1439	10.39
				90	1107	1123	1181	1181	10.39
		2000LM	SEF	80	1875	1928	1981	2028	14.48
				90	1634	1670	1717	1805	14.48
			HEF	80	1869	1896	1981	1987	13.46
				90	1528	1550	1630	1630	13.46
		2500LM	SEF	80	2374	2441	2508	2567	18.41
				90	2069	2113	2173	2284	18.41
			HEF	80	2366	2400	2508	2514	17.42
				90	1935	1962	2063	2063	17.42
		3500LM	SEF	80	3792	3282	3372	3452	25.83
				90	2782	2842	2922	3072	25.83
			HEF	80	3182	3227	3372	3381	25.04
				90	2602	2638	2774	2774	25.04
		4500LM	SEF	80	4574	4703	4832	4947	38.7
				90	3986	4072	4187	4402	38.7
			HEF	80	4560	4624	4832	4845	34.8
				90	3728	3780	3975	3975	34.8
		5000LM	SEF	80	4860	4997	5134	5256	41.48
				90	4235	4327	4448	4677	41.48
			HEF	80	4844	4913	5134	5148	38.11
				90	3961	4016	4223	4223	38.11
	L36	2250LM	SEF	80	2388	2250	2311	2366	16.36
				90	1907	1948	2003	2106	16.36
			HEF	80	2181	2212	2311	2318	15.47
				90	1783	1808	1901	1901	15.47
		3000LM	SEF	80	2843	2924	3004	3075	20.8
				90	2478	2531	2603	2736	20.8
			HEF	80	2834	2875	3004	3012	19.98
				90	2317	2350	2471	2471	19.98
		3750LM	SEF	80	3639	3742	3845	3936	26.47
				90	3171	3240	3331	3502	26.47
			HEF	80	3628	3679	3845	3855	25.09
				90	2966	3007	3162	3162	25.09
		5250LM	SEF	80	4895	5033	5171	5294	39.9
				90	4265	4357	4480	4710	39.9
			HEF	80	4879	4948	5171	5185	34.3
				90	3989	4045	4253	4253	34.3
		6750LM	SEF	80	6250	6426	6602	6759	54.85
				90	5446	5564	5721	6014	54.85
			HEF	80	6230	6318	6602	6620	47.97
				90	5094	5165	5431	5431	47.97
		7500LM	SEF	80	6846	7039	7232	7404	62.6
				90	5966	6095	6266	6588	62.6
			HEF	80	6824	6921	7232	7252	54.02
				90	5580	5657	5949	5949	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L48	3000LM	SEF	80	2740	2817	2895	2963	20.32
				90	2388	2439	2508	2637	20.32
			HEF	80	2731	2770	2895	2902	19.01
				90	2233	2264	2381	2381	19.01
		4000LM	SEF	80	3661	3764	3868	3959	27.58
				90	3190	3259	3351	3523	27.58
			HEF	80	3649	3701	3868	3878	24.75
				90	2984	3025	3181	3181	24.75
		5000LM	SEF	80	4580	4710	4839	4954	34.8
				90	3992	4078	4193	4408	34.8
			HEF	80	4566	4631	4839	4852	31.77
				90	3733	3785	3980	3980	31.77
		7000LM	SEF	80	6615	6822	7009	7136	49.05
				90	5782	5907	6073	6385	49.05
			HEF	80	6614	6708	7009	7028	44.67
				90	5408	5483	5766	5766	44.67
		9000LM	SEF	80	8363	8599	8835	9045	63.99
				90	7288	7446	7655	8049	63.99
			HEF	80	8336	8455	8835	8859	58.58
				90	6816	6911	7268	7268	58.58
		10000LM	SEF	80	9347	9611	9874	10109	73.37
				90	8145	8321	8556	8995	73.37
			HEF	80	9317	9450	9874	9901	66.27
				90	7618	7724	8122	8122	66.27
	L96	6000LM	SEF	80	5393	5545	5687	5832	38.15
				90	4700	4801	4936	5190	38.15
			HEF	80	5375	5452	5687	5712	35.54
				90	4395	4457	4686	4686	35.54
		8000LM	SEF	80	7196	7399	7602	7782	52.32
				90	6271	6406	6587	6925	52.32
			HEF	80	7173	7275	7602	7622	48.5
				90	5865	5946	6253	6253	48.5
		10000LM	SEF	80	8902	9153	9404	9627	66.47
				90	7757	7925	8148	8567	66.47
			HEF	80	8873	8999	9404	9429	60.89
				90	7255	7356	7735	7735	60.89
		14000LM	SEF	80	12999	13366	13732	14058	94.78
				90	11328	11573	11899	12510	94.78
			HEF	80	12957	13142	13732	13769	85.96
				90	10594	10742	11296	11296	85.96
		18000LM	SEF	80	16751	17224	17687	18117	128.98
				90	14598	14913	15334	16121	128.98
			HEF	80	16698	16936	17687	17744	116.92
				90	13653	13843	14557	14557	116.92
		20000LM	SEF	80	18501	19023	19545	20009	146.83
				90	16123	16471	16935	17805	146.83
			HEF	80	18442	18705	19545	19598	131.6
				90	16079	15290	16078	16078	131.6

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L24	1500LM	SEF	80	1320	1358	1395	1428	10.85
				90	1151	1175	1208	1271	10.85
			HEF	80	1316	1335	1395	1399	10.39
				90	1076	1091	1147	1147	10.39
		2000LM	SEF	80	1822	1874	1925	1971	14.48
				90	1588	1622	1668	1754	14.48
			HEF	80	1816	1842	1925	1930	13.46
				90	1485	1506	1583	1583	13.46
		2500LM	SEF	80	2306	2371	2436	2494	18.41
				90	2010	2053	2111	2219	18.41
			HEF	80	2299	2332	2436	2443	17.42
				90	1880	1906	2004	2004	17.42
		3500LM	SEF	80	3302	3189	3277	3354	25.83
				90	2703	2761	2839	2985	25.83
			HEF	80	3092	3136	3277	3285	25.04
				90	2528	2563	2695	2695	25.04
		4500LM	SEF	80	4444	4570	4695	4807	38.7
				90	3873	3957	4068	4277	38.7
			HEF	80	4430	4493	4695	4708	34.8
				90	3622	3673	3862	3862	34.8
		5000LM	SEF	80	4722	4855	4988	5107	41.48
				90	4115	4204	4322	4544	41.48
			HEF	80	4707	4774	4988	5002	38.11
				90	3848	3902	4103	4103	38.11
	L36	2250LM	SEF	80	2126	2186	2246	2299	16.36
				90	1852	1892	1946	2046	16.36
			HEF	80	2119	2149	2246	2252	15.47
				90	1732	1757	1847	1847	15.47
		3000LM	SEF	80	2762	2840	2918	2988	20.8
				90	2407	2459	2529	2659	20.8
			HEF	80	2754	2793	2918	2926	19.98
				90	2251	2283	2401	2401	19.98
		3750LM	SEF	80	3536	3636	3735	3824	26.47
				90	3081	3148	3237	3408	26.47
			HEF	80	3525	3575	3735	3745	25.09
				90	2882	2922	3073	3073	25.09
		5250LM	SEF	80	4755	4890	5024	5143	39.9
				90	4144	4234	4353	4577	39.9
			HEF	80	4740	4808	5024	5037	34.3
				90	3876	3930	4132	4132	34.3
		6750LM	SEF	80	6072	6243	6415	6567	54.85
				90	5292	5406	5558	5844	54.85
			HEF	80	6053	6139	6415	6432	47.97
				90	4949	5018	5276	5276	47.97
		7500LM	SEF	80	6651	6839	7027	7194	62.6
				90	5796	5922	6088	6401	62.6
			HEF	80	6630	6725	7027	7046	54.02
				90	5421	5497	5780	5780	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L48	3000LM	SEF	80	2662	2737	2812	2879	20.32
				90	2320	2370	2437	2562	20.32
			HEF	80	2654	2691	2812	2820	19.01
				90	2170	2200	2313	2313	19.01
		4000LM	SEF	80	3557	3657	3758	3847	27.58
				90	3100	3167	3256	3423	27.58
			HEF	80	3546	3596	3758	3768	24.75
				90	2899	2939	3091	3091	24.75
		5000LM	SEF	80	4450	4576	4701	4813	34.8
				90	3878	3962	4073	4283	34.8
			HEF	80	4436	4499	4701	4714	31.77
				90	3627	3678	3867	3867	31.77
		7000LM	SEF	80	6446	6628	6810	6972	49.05
				90	5618	5759	5901	6204	49.05
			HEF	80	6426	6517	6810	6829	44.67
				90	5254	5327	5602	5602	44.67
		9000LM	SEF	80	8126	8355	8584	8788	63.99
				90	7081	7234	7438	7820	63.99
			HEF	80	8100	8215	8584	8667	58.58
				90	6623	6715	7061	7061	58.58
		10000LM	SEF	80	9081	9338	9594	9822	73.37
				90	7914	8085	8313	8740	73.37
			HEF	80	9052	9181	9594	9620	66.27
				90	7402	7505	7892	7892	66.27
	L96	6000LM	SEF	80	5240	5387	5535	5667	38.15
				90	4566	4665	4796	5042	38.15
			HEF	80	5223	5297	5535	5550	35.54
				90	4270	4330	4553	4553	35.54
		8000LM	SEF	80	6991	7189	7386	7561	52.32
				90	6093	6224	6400	6728	52.32
			HEF	80	6969	7068	7386	7406	48.5
				90	5698	5778	6075	6075	48.5
		10000LM	SEF	80	8649	8893	9137	9354	66.47
				90	7537	7700	7917	8323	66.47
			HEF	80	8621	8744	9137	9161	60.89
				90	7049	7147	7516	7516	60.89
		14000LM	SEF	80	12630	12986	13342	13659	94.78
				90	11006	11244	11561	12154	94.78
			HEF	80	12589	12768	13342	13378	85.96
				90	10293	10437	10975	10975	85.96
		18000LM	SEF	80	16276	16735	17194	17602	128.98
				90	14184	14490	14888	15663	128.98
			HEF	80	16223	16454	17194	17240	116.92
				90	13265	13450	14143	14143	116.92
		20000LM	SEF	80	17976	18483	18990	19441	146.83
				90	15665	16004	16454	17300	146.83
			HEF	80	17918	18173	18990	19041	131.6
				90	14651	14855	15621	15621	131.6

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L24	1500LM	SEF	80	1377	1415	1454	1489	10.85
				90	1200	1226	1260	1325	10.85
			HEF	80	1372	1392	1454	1458	10.39
				90	1122	1138	1196	1196	10.39
		2000LM	SEF	80	1900	1953	2007	2055	14.48
				90	1656	1691	1739	1828	14.48
			HEF	80	1894	1921	2007	2012	13.46
				90	1548	1570	1651	1651	13.46
		2500LM	SEF	80	2405	2472	2540	2601	18.41
				90	2095	2141	2201	2314	18.41
			HEF	80	2397	2431	2540	2547	17.42
				90	1960	1987	2090	2090	17.42
		3500LM	SEF	80	3214	3325	3416	3497	25.83
				90	2818	2879	2960	3112	25.83
			HEF	80	3223	3269	3416	3426	25.04
				90	2636	2672	2810	2810	25.04
		4500LM	SEF	80	4634	4765	4895	5012	38.7
				90	4038	4125	4242	4459	38.7
			HEF	80	4619	4685	4895	4908	34.8
				90	3777	3829	4027	4027	34.8
		5000LM	SEF	80	4823	5062	5201	5324	41.48
				90	4290	4383	4586	4738	41.48
			HEF	80	4907	4977	5201	5215	38.11
				90	4012	4068	4278	4278	38.11
	L36	2250LM	SEF	80	2216	2279	2341	2397	16.36
				90	1931	1973	2029	2133	16.36
			HEF	80	2209	2241	2341	2348	15.47
				90	1806	1832	1926	1926	15.47
		3000LM	SEF	80	2880	2962	3043	3115	20.8
				90	2510	2564	2636	2772	20.8
			HEF	80	2871	2912	3043	3051	19.98
				90	2347	2380	2503	2503	19.98
		3750LM	SEF	80	3687	3791	3895	3987	26.47
				90	3213	3282	3375	3548	26.47
			HEF	80	3675	3727	3895	3905	25.09
				90	3005	3047	3204	3204	25.09
		5250LM	SEF	80	4958	5098	5238	5362	39.9
				90	4321	4414	4539	4772	39.9
			HEF	80	4942	5013	5238	5252	34.3
				90	4041	4097	4309	4309	34.3
		6750LM	SEF	80	6331	6510	6688	6847	54.85
				90	5517	5636	5795	6093	54.85
			HEF	80	6311	6401	6688	6706	47.97
				90	5160	5232	5502	5502	47.97
		7500LM	SEF	80	6935	7131	7326	7500	62.6
				90	6044	6174	6348	6674	62.6
			HEF	80	6913	7011	7326	7346	54.02
				90	5652	5731	6027	6027	54.02

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L48	3000LM	SEF	80	2776	2854	2932	3002	20.32
				90	2419	2471	2541	2671	20.32
			HEF	80	2767	2806	2932	2940	19.01
				90	2262	2294	2412	2412	19.01
		4000LM	SEF	80	3709	3813	3938	4011	27.58
				90	3232	3302	3395	3569	27.58
			HEF	80	3697	3749	3938	3929	24.75
				90	3023	3065	3223	3223	24.75
		5000LM	SEF	80	4640	4771	4902	5018	34.8
				90	4044	4131	4247	4465	34.8
			HEF	80	4625	4691	4902	4915	31.77
				90	3782	3834	4032	4032	31.77
		7000LM	SEF	80	6721	6911	7101	7269	49.05
				90	5857	5984	6152	6469	49.05
			HEF	80	6700	6795	7101	7129	44.67
				90	5478	5554	5841	5841	44.67
		9000LM	SEF	80	8472	8711	8950	9163	63.99
				90	7383	7543	7755	8154	63.99
			HEF	80	8445	8565	8950	8974	58.58
				90	6905	7001	7362	7362	58.58
		10000LM	SEF	80	9469	9736	10003	10240	73.37
				90	8252	8430	8667	9112	73.37
			HEF	80	9438	9571	10003	10030	66.27
				90	7717	7825	8228	8228	66.27
	L96	6000LM	SEF	80	5463	5617	5771	5908	38.15
				90	4761	4864	5001	5258	38.15
			HEF	80	5445	5523	5771	5787	35.54
				90	4452	4515	4747	4747	35.54
		8000LM	SEF	80	7289	7495	7701	7884	52.32
				90	6353	6490	6672	7015	52.32
			HEF	80	7266	7370	7701	7722	48.5
				90	5941	6024	6334	6334	48.5
		10000LM	SEF	80	9017	9272	9526	9752	66.47
				90	7858	8028	8254	8678	66.47
			HEF	80	8888	9117	9526	9552	60.89
				90	7349	7452	7836	7836	60.89
		14000LM	SEF	80	13168	13540	13911	14241	94.78
				90	11476	11723	12054	12673	94.78
			HEF	80	13126	13313	13911	13949	85.96
				90	10732	10882	11443	11443	85.96
		18000LM	SEF	80	16870	17448	17927	18353	128.98
				90	14788	15108	15533	16331	128.98
			HEF	80	16915	17156	17927	17975	116.92
				90	13831	14024	14746	14746	116.92
		20000LM	SEF	80	18742	19271	19800	20270	146.83
				90	16333	16686	17156	18037	146.83
			HEF	80	18682	18948	19800	19853	131.6
				90	15276	15489	16287	16287	131.6

RRL - RELOC®-Ready Luminaire

- RRL connectors can be used with Quick-Flex®, System 820 and OnePass® systems.
- Load side of connector factory installed to luminaire.
- 4-pole mating connector with push-in terminations allows for simple installation.
- Touch-safe design on both halves meets UL/CSA requirement.
- Wiping contact design allows safe disconnect under load.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example:** RRLA

Series		Wiring instructions	
RRL	RELOC®-ready luminaire	A	Hot conductor wired to position #1 (phase A)
		B	Hot conductor wired to position #2 (phase B)
		C	Hot conductor wired to position #3 (phase C) [1]

Compatible RELOC® Cables for Industrial Luminaires (ordered and shipped separately)

QCS QCII QD RC PT

Notes

1 C, ABE, and C125 options are not used with Quick Flex QFC, QSFC, QPT, and QD.

PRODUCT INFORMATION

Advanced plug-in system with two-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. 1, 2, 3 and 4-lamp fixtures. PLR22 (2-circuit) and crossover harness switches host circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G-ground required.

Note: Specifications subject to change without notice.

Wiring

PLR

Advanced 1 or 2-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires		Branch circuits		Emergency circuit connected		Dimming		Ground	
PLR	(blank)	Not required for 22	Circuits to which ballast is connected		Emergency circuit connected		LV	Low-voltage dimming	G	Ground
PLR22	1	Black	(blank)	Not required for 22	(blank)	No emergency circuit				
	2	Black and red	A	Black wire	ELA	Emergency circuit wired to black wire				
			B	Red wire	ELB	Emergency circuit wired to red wire				

Typical Applications

- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits and 2-circuit (PLR 22)
- Multiple-circuit with night-lights located along row as desired

LITHONIA LIGHTING

DIGITAL NAVIGATION

Ordering Tree | nLight Platform | Sensor Switch JOT | Photometrics | Performance Data

FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available - curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight® controls make each luminaire addressable - allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless R90, RES7 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intuitive mobile app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR — Integrated sensor (individual control): Sensor Switch MSD7ADCX ()Passive infrared (PIR) or MSDPDT7ADCX ()PIR/Microphonics Dual Tech (PDT)) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or MultiPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated.
DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Catalog Number	
Notes	
Type	

BLT Series LED

2BLT4

ADP Diffuser Option

2' x 4' LED

Ribbed Reflector Option

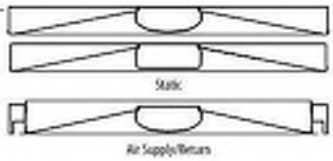
eldoLED

nLIGHT

JOT JUST ONE TOUCH

Specifications

Length: 47-3/4 (121.2)
Width: 23-3/4 (60.3)
Depth: 2-3/8 (6.0)
Depth with Air supply/return: 2-3/4 (6.9)
All dimensions are inches (centimeters) unless otherwise specified.



Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

2BLT Volumetric Recessed Lighting 2'x4'

A– Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT4 40L ADP EZ1 LP840

2BLT4

Series	Fixture Style	Air function	Lumens ‡	Diffuser	Voltage	Driver	Color temperature
2BLT4 2x4 BLT	(blank) Smooth Reflector RB Ribbed Reflector	(blank) Static A Air supply/ return ‡	**Standard efficiency (>100 LPW)** 30L 3000 40L 4000 48L 4800 60L 6000 72L 7200 85L 8500 100L 10000 120L 12000 **High efficiency ‡ (>130 LPW)** 30LHE 3000 40LHE 4000 48LHE 4800 60LHE 6000 72LHE 7200 85LHE 8500	ADP Curved, ribbed ADSM Curved, smooth SDP Square, ribbed SDSM Square, smooth **Includes trim rings to match sensored version** ADPT Curved, ribbed ADSMT Curved, smooth SDPT Square, ribbed SDSMT Square, smooth	(blank) MVOLT 120 120V 277 277V 347 347V ‡	EZ1 eldoLED dims to 1% (0-10 volt dimming) GZ1 Dims to 1% (0-10V dimming) ‡ GZ10 Dims to 10% (0-10V dimming) ‡ SLD Step-level dimming ‡	LP830 82CRI, 3000 K LP835 82CRI, 3500 K LP840 82CRI, 4000 K LP850 82CRI, 5000 K LP930 90CRI, 3000K LP935 90CRI, 3500K LP940 90CRI, 4000K LP950 90CRI, 5000K

nLight Interface

nLight Wired

(blank)	no nLight ® interface
N80	nLight with 80% lumen management
N80EMG	nLight with 80% lumen management For use with generator supply EM power ‡
N100	nLight without lumen management
N100EMG	nLight without lumen management For use with generator supply EM power ‡

nLight Wireless

(blank)	no nLight ® interface
NLTAIR2	nLight AIR Generation 2 enabled ‡

Control ‡

nLight Wired ‡

(blank)	No sensor control
NES7	nLight™ nES 7 PIR integral occupancy sensor
NESPDT7	nLight™ nES PDT 7 dual technology integral occupancy control
NES7ADCX	nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell
NESPDT7ADCX	nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell

nLight Wireless

REST	nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities
RESTPDT	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell
RIO	nLight AIR radio module without sensor
RESTEM	nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RESTPDTEM	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RIOEM	nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡

Individual Control

MSDVADCX	PIR integral occupancy sensor with automatic dimming control photocell ‡
MSDPDT7ADCX	PDT integral occupancy sensor with automatic dimming control photocell ‡
JOI	Wireless room control with "Just One Touch" pairing ‡
JOIVDX15	Wireless occupancy sensor with "Just One Touch" pairing ‡

Standby Mode

NOC	NOC Occupancy sensor disabled ‡

Options

BDP Disconnect Plug

EL7L	700 lumen battery pack (Noncompliant with CA T20) ‡
EL14L	1400 lumen battery pack (Noncompliant with CA T20) ‡
EL14LSD	1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡
E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡

CP	Chicago plenum ‡
BGTD	Bodine Generator Transfer Device ‡
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit
PWS1846 PWSLV	Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡
PWS1856LV	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡

GLR	Fast-blowing fuse ‡
GMF	Slow-blowing fuse ‡
NPLT	Narrow pallet
RRL_	RELOC®-ready luminaire ‡
LATC	Earthquake clip
DWHM	Anti-Microbial paint
JP14	Job packaging ‡
JP18	Job packaging ‡
IPSX	Gasketed diffuser compartment to meet IPSX rating ‡

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

me engineers
14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L3

2BLT Volumetric Recessed Lighting 2'x4'

Option Value Ordering Restrictions	
Option value	**Restriction**
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with TD, JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Controls	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JOT & JOTVTX15
EL14LSD, E10WLCP, EL7L, EL14L	When using pre-wire option, use PWS1846 or PWS1846 PWSELK. For more information, please see the PSSD2 specification sheet.
FAO	EZ1 driver required. Not available with USPDM, FAO or lumen packages > 6000LM. FAO restricts use of external Dimming controls. See chart on page 3 for additional details.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
IPSX	Not available with air supply/return or Wired Networking (NES_) and Individual Control (NSD_) sensors.
JOT, JOTVTX15	Not available with standard efficiency 85L, 100L or 120L lumen options. Not available with SLD, nLight, NLTAIR2, NDC, or BGTD options.
JP14	Only available on fixtures with NES7, NESPDT7, NESPDT7ADCX, MSDT7ADCX, MSDPDT7ADCX, RES7, RES7PDT, R80, JOT,JOTVTX15. Not available when air supply/return function and sensor options are combined.
JP18	Not available with option: NES7, NESPDT7, NESPDT7ADCX, MSDT7ADCX, MSDPDT7ADCX, RES7, RES7PDT, R80, JOT, JOTVTX15.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com. Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSDT7ADCX, MSDPDT7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver. Not available with 85L, 100L, or 120L options.
NDC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
RES7EM, RES7PDTEM, R80EM	See UL924 Sequence of Operation chart on page 4. Not available with 72L, 72LHE, or 85LHE lumen packages.
RRL_	For ordering logic consult: RRL_2013.
SLD	Not available with with any nLight Interface or Control options.

Multiple Diffuser Options

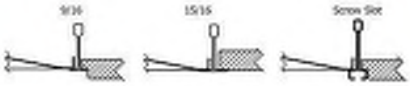
2BLT Volumetric Recessed Lighting 2'x4'

Non-Configurable BLT

Non-Configurable BLT								
Stock/MTO	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT4 40L ADP LP835	00190887470789	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP LP840	00190887470765	4063	31.69	128.23	4000K/82CRI	120-277	28
	2BLT4 46L ADP LP835	00190887468656	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP LP840	00190887468649	5039.18	38	132.58	4000K/82CRI	120-277	28
	2BLT4 40L ADP EL14L LP835	00190887470925	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP EL14L LP840	00190887470918	4063	31.69	128.23	4000K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP835	00190887468670	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP840	00190887468663	5039.18	38	132.58	4000K/82 CRI	120-277	28

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	Appropriate Trim Type
Exposed grid tee (1" and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:

- Digital dimming is commanded to high-end trim level.
- Device ignores wireless lighting control commands.

Accessories & Replacement Parts

Accessories: *Order as separate catalog number.*	
DGA24	Drywall grid adapter for 2x4 recessed fixture
2845MKSHP PAF	Surface Mount Troffer Kit Post Paint
RK88DP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1
RK88DP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1
RK88DP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10
RK88DP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40

Replacement Parts: *Order as separate catalog number.*		
*249P2N	2DBLT48 ADP LENS ASSEMBLY	4 ft. replacement lens
*249P2T	2DBLT48 SDP LENS ASSEMBLY	4 ft. replacement lens
*249P30	2DBLT48 ADSM LENS ASSEMBLY	4 ft. replacement lens
*249P33	2DBLT48 SDSM LENS ASSEMBLY	4 ft. replacement lens
*237LT2	2DBLT48 ADPT LENS ASSEMBLY	4 ft. replacement lens
*237LT4	2DBLT48 SDPT LENS ASSEMBLY	4 ft. replacement lens
*237LT6	2DBLT48 ADSMT LENS ASSEMBLY	4 ft. replacement lens
*237LT8	2DBLT48 SDSMT LENS ASSEMBLY	4 ft. replacement lens
*237LTA	2DBLT48 ADPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237MS2	2DBLT48 SDPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237MSA	2DBLT48 ADSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237MSL	2DBLT48 SDSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens

JOT Wireless

JOT

Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

1. Power: Install JOT enabled fixtures and controls as instructed.
2. Pair: Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
3. Play: Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.

LITHONIA LIGHTING®

BLT-2X4

COMMERCIAL INDOOR One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

 Rev. 01/21/21

2BLT Volumetric Recessed Lighting 2'x4'

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time-of-Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

nLight Wired Networking

Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

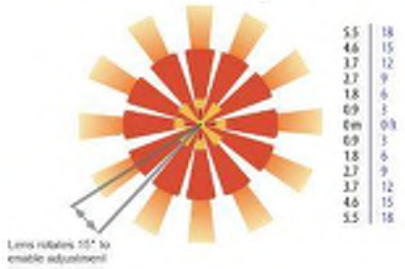
2BLT Volumetric Recessed Lighting 2'x4'

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSDTADCX	X	X			
MSDPDT7ADCX	X		X		
NTS7		X		X	
NES7ADCX	X	X		X	
NESPDT7			X	X	
NESPDT7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	X	X	X		X

Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSDTADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nES7ADCX includes an integrated photocell, which enables daylight harvesting controls.

For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)

*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)

*The presetting on the automatic dimming photocell is 5fc (NES7) and 10fc (RES7).

2BLT Volumetric Recessed Lighting 2'x4'

Controls Accessories

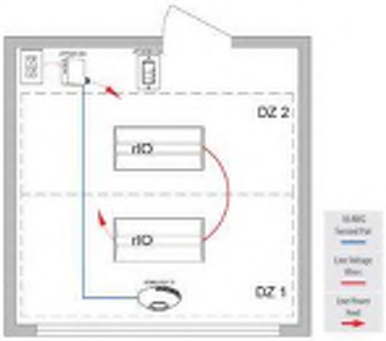
nLight® Wired Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM 10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD 10BOH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT /1
		30' cable	CAT5 30FT /1

nLight® AIR Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

2BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS[1] — Example: RCMS PDT 10 AR G2

Series / Detection	Power Supply[1]	Occupancy Detection	Lens (Required)	Operating Mode	Generation
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately PS 150 Standard 150 mA Power Supply	[blank] PIR Detection PDT Dual Tech PIR/ Microphonics	10 Large Motion/ Extended Range 360° 9 Small Motion/ Extended Range 360° 6 High Bay 360° Lens	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility

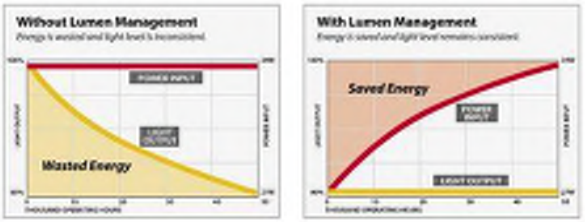
Notes
1 RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.

Sensor Switch WSX | nLight WIRED NPOD 10BTOUCH | nLight WIRED nPODMA DX | nLight AIR rPODBA | 2BLT with rIO | rPODBA | RCMS

2BLT Volumetric Recessed Lighting 2'x4'

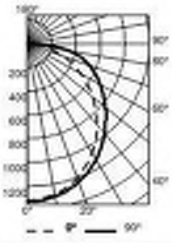
Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system's life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.



PHOTOMETRICS

2BLT4 40L ADP LP835, 4000 delivered lumens, test no. ISF36900P109, tested in accordance to IESNA LM-79



CP Summary

	C°	90
0°	1325	1325
5°	1309	1325
15°	1259	1278
25°	1136	1192
35°	981	1058
45°	797	909
55°	601	761
65°	406	621
75°	212	460
85°	48	197
90	1	17

Coefficients of Utilization

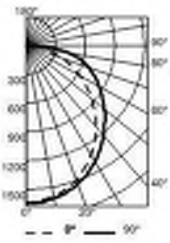
ρf	20%								
ρc	80%			70%			50%		
ρw	70%	50%	30%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	108	102	97	100	96	92	96	92	89
2	97	88	81	86	80	74	83	77	72
3	88	77	69	76	68	61	72	66	60
4	81	68	59	67	58	52	64	57	51
5	74	61	51	60	51	44	57	50	44
6	68	55	45	54	45	39	52	44	38
7	63	50	40	49	40	34	47	39	34
8	59	45	36	44	36	30	43	36	30
9	55	41	33	41	33	27	40	32	27
10	52	38	30	38	30	25	37	30	25

RCR

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1324	25.6	25.6
0° - 40°	1569	41.7	41.7
0° - 60°	2960	74.0	74.0
0° - 90°	3998	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4000	100.0	100.0

2BLT4 48L ADP LP835, 4960 delivered lumens, test no. ISF 36900P117, tested in accordance to IESNA LM-79



CP Summary

	C°	90
0°	1643	1643
5°	1623	1644
15°	1559	1585
25°	1409	1472
35°	1217	1312
45°	988	1127
55°	745	943
65°	505	769
75°	263	571
85°	59	244
90	1	21

Coefficients of Utilization

ρf	20%								
ρc	80%			70%			50%		
ρw	70%	50%	30%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	108	102	97	100	96	92	96	92	89
2	97	88	81	86	80	74	83	77	72
3	88	77	69	76	68	61	72	66	60
4	81	68	59	67	58	52	64	57	51
5	74	61	51	60	51	44	57	50	44
6	68	55	45	54	45	39	52	44	38
7	63	50	40	49	40	34	47	39	34
8	59	45	36	44	36	30	43	36	30
9	55	41	33	41	33	27	40	32	27
10	52	38	30	38	30	25	37	30	25

RCR

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1270	25.6	25.6
0° - 40°	2070	41.7	41.7
0° - 60°	3671	74.0	74.0
0° - 90°	4957	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4960	100.0	100.0

2BLT Volumetric Recessed Lighting 2'x4'

Performance Data

Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT4 30L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	2962	127.31	23.26	Premium	PWTDEMHS
2BLT4 30L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	3009.28	129.34	23.26	Premium	P1B5GLD
2BLT4 30L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	2969.16	127.62	23.26	Premium	P3MB2QSG
2BLT4 40L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4000	126.22	31.69	Premium	P0WKYXFD
2BLT4 40L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4061.86	128.23	31.69	Premium	PEYXAZWD
2BLT4 40L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	3946.66	124.53	31.69	Premium	PS63CPK6
2BLT4 40L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4029.67	126.52	31.69	Premium	PK79UR9W
2BLT4 48L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4960	130.5	38	Premium	PJ9CB6C1
2BLT4 48L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	5039.18	132.58	38	Premium	P9W2B5AK
2BLT4 48L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	4893.86	128.76	38	Premium	PYYKZ33U
2BLT4 48L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4971.99	130.82	38	Premium	PC89MCH9
2BLT4 60L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	6016	126.39	47.59	Premium	PS66QE9M
2BLT4 60L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	6112.04	128.4	47.59	Premium	PV3QXPUV
2BLT4 60L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	5955.78	125.7	47.59	Premium	PHT84BW4
2BLT4 60L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	6030.55	126.69	47.59	Premium	P8VS5BC8
2BLT4 72L ADP EZ1 (GZ10) LP840 (All Options)	7360.66	125.3	58.74	Premium	P5CZ22CB
2BLT4 72L ADP GZ1 LP835 (All Options)	7345	119.87	60.84	standard	P1SHTCTS
2BLT4 72L ADP GZ1 LP840 (All Options)	7360.66	120.97	60.84	standard	PBEERALG7
2BLT4 72L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	7148.4	117.48	60.84	standard	PDQS3CYK
2BLT4 72L ADPT EZ1 (GZ10) LP840 (All Options)	7262.52	123.63	58.74	Premium	PZKKMMVN
2BLT4 72L ADPT GZ1 LP840 (All Options)	7262.52	119.36	60.84	standard	P10DUPC0
2BLT4 85L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	8567	116.43	73.58	standard	PYD2G06V
2BLT4 85L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	8703.77	118.28	73.58	standard	P8ZMVKX
2BLT4 85L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	8452.77	114.87	73.58	standard	PTZEW9DM
2BLT4 85L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	8587.72	116.71	73.58	standard	P0YDMJE9
2BLT4 100L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	9837	103.14	95.36	standard	PGDE52QR
2BLT4 100L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	9994.84	104.79	95.36	standard	P0C7CHGX
2BLT4 100L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	9705.84	101.77	95.36	standard	PSZUQY7M
2BLT4 100L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	9860.79	103.39	95.36	standard	P6V9X6HY
2BLT4 120L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	11709	118.18	99.07	standard	PGM4Y7DP
2BLT4 120L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	11895.9	120.07	99.07	standard	P0DD0CG2
2BLT4 120L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	11552.9	116.61	99.07	standard	PXM0F5D9
2BLT4 120L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	11737.3	118.47	99.07	standard	P34GEBZM

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

HE Performance Data

Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT4 30LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	3107	135.17	22.98	Premium	P7XEDCN9
2BLT4 30LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	3156.6	137.33	22.98	Premium	P9DM066BK
2BLT4 30LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	3065.57	133.37	22.98	Premium	P7P2AJQZ
2BLT4 30LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	3114.51	135.5	22.98	Premium	P20J3E8P
2BLT4 40LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4085	138.56	29.48	Premium	PETP655F
2BLT4 40LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4150.21	140.77	29.48	Premium	P99JQD66
2BLT4 40LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	4030.53	136.71	29.48	Premium	PC1SDQEC
2BLT4 40LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4094.88	138.89	29.48	Premium	PGRESJJT
2BLT4 48LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4770	138.16	34.52	Premium	PX8UBGN8
2BLT4 48LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4846.15	140.37	34.52	Premium	P5PQ58RX
2BLT4 48LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	4706.4	136.32	34.52	Premium	P2MK2H33
2BLT4 48LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4781.53	138.5	34.52	Premium	PKBC1321
2BLT4 60LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	5894	135.12	43.61	Premium	PQZN0368
2BLT4 60LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	5988.89	137.28	43.61	Premium	PG5CYUUC
2BLT4 60LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	5815.41	133.32	43.61	Premium	P272TAWM
2BLT4 60LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	5908.25	135.45	43.61	Premium	PRC4W72B
2BLT4 72LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	7149	135.94	52.58	Premium	PUB386EQ
2BLT4 72LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	7263.33	138.11	52.58	Premium	P7GDHZTN
2BLT4 72LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	7053.68	134.12	52.58	Premium	PSCC2VKX
2BLT4 72LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	7166.29	136.26	52.58	Premium	PHP1BKDM
2BLT4 85LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	8158	128.96	63.25	Premium	PRTW6KXW
2BLT4 85LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	8288.24	131.02	63.25	Premium	P6HYV2D6
2BLT4 85LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	8049.22	127.24	63.25	Premium	PYWE6TA3
2BLT4 85LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	8177.73	129.27	63.25	Premium	PNSBRJ6E

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLD.

How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Delivered Lumens = 1.25 x P x LPW
P = Ouput power of emergency driver, P = 10W for E10WJCP option.
LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

LITHONIA LIGHTING

DIGITAL NAVIGATION

Ordering Tree | nLight Platform | Sensor Switch JOT | Photometrics | Performance Data

FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available - curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight®controls make each luminaire addressable - allowing them to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless r80 and rES7 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intuitive model app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows systems to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR — Integrated sensor (individual control): Sensor Switch WSD7ADCX ()Passive infrared (PIR) or MSDPDT7ADCX ()PIR/Microphonics Dual Tech (PDT)) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The rES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated.

DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Catalog Number	
Notes	
Type	

BLT Series LED

2BLT2

AOP Diffuser Option

2' x 2'
LED

Ribbed Reflector Option

eldoLED

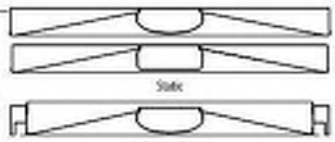
nLIGHT

JOT

Specifications

Length: 23-3/4 (60.3)
Width: 23-3/4 (60.3)
Depth: 2-3/8 (6.0)
Depth with Air supply/return: 2-3/4 (6.9)

All dimensions are inches (centimeters) unless otherwise specified.



Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L3A

2BLT Volumetric Recessed Lighting 2'x2'

A– Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT2 33L ADP EZ1 LP835

2BLT2

Series	Fixture Style	Air function	Lumens ‡	Diffuser	Voltage	Driver	Color temperature
2BLT2 2X2 BLT	(blank) Smooth Reflector RB Ribbed Reflector	(blank) Static A Air supply/ return ‡	**Standard efficiency ‡ (>125 LPW)** 20L 2000 33L 3300 40L 4000 48L 4800 **High efficiency ‡ (>130 LPW)** 20LHE 2000 33LHE 3300 40LHE 4000 48LHE 4800	ADP Curved, ribbed ADSM Curved, smooth SDP Square, ribbed SDSM Square, smooth **Includes trim rings to match sensored version** ADPT Curved, ribbed ADSMT Curved, smooth SDPT Square, ribbed SDSMT Square, smooth	(blank) MVOLT 120 120V 277 277V 347 347V ‡	EZ1 eldoLED dims to 1% (0-10 volt dimming) GZ1 Dims to 1% (0-10V dimming) ‡ GZ10 Dims to 10% (0-10V dimming) ‡ SLD Step-level dimming ‡	LP830 82CRI, 3000 K LP835 82CRI, 3500 K LP840 82CRI, 4000 K LP850 82CRI, 5000 K LP930 90CRI, 3000K LP935 90CRI, 3500K LP940 90CRI, 4000K LP950 90CRI, 5000K

nLight Interface

nLight Wired

(blank)	no nLight ® interface
N80	nLight with 80% lumen management
N80EMG	nLight with 80% lumen management For use with generator supply EM power ‡
N100	nLight without lumen management
N100EMG	nLight without lumen management For use with generator supply EM power ‡

nLight Wireless

(blank)	no nLight ® interface
NLTAIR2	nLight AIR Generation 2 enabled ‡

Control ‡

nLight Wired

(blank)	No sensor control
NES7	nLight™ nES 7 PIR integral occupancy sensor ‡
NESPOT7	nLight™ nES POT 7 dual technology integral occupancy control ‡
NES7ADCX	nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ‡
NESPOT7ADCX	nLight™ nES POT 7 dual technology integral occupancy sensor with automatic dimming photocell ‡

nLight Wireless

RES7	nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities
RES7POT	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell
RIO	nLight AIR radio module without sensor
RES7EM	nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RES7POTEM	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RIOEM	nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡

Individual Control

MSDTADCX	PIR integral occupancy sensor with automatic dimming control photocell ‡
MSDPDT7ADCX	PDT integral occupancy sensor with automatic dimming control photocell ‡
JOE	Wireless room control with "Just One Touch" pairing ‡
JOEVTX15	Wireless occupancy sensor with "Just One Touch" pairing ‡

Standby Mode

NOC	NOC Occupancy sensor disabled ‡

Options

BDP Disconnect Plug

EL7L	700 lumen battery pack (Noncompliant with CA T20) ‡
EL14L	1400 lumen battery pack (Noncompliant with CA T20) ‡
EL14LSD	1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡
E10WLCP	Ebt Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡

CP	Chicago plenum ‡
BGTD	Bodine Generator Transfer Device ‡
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit
PWS1846 PWSLV	Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡
PWS1856LV	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡

GLR	Fast-blowing fuse ‡
GMF	Slow-blowing fuse ‡
NPLT	Narrow pallet
RRL_	RELOC®-ready luminaire ‡
LATC	Earthquake clip
DWHM	Anti-Microbial paint
JP28	Job packaging ‡
JP36	Job packaging
IP5X	Gasketed diffuser compartment to meet IP5X rating ‡

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L3A

2BLT Volumetric Recessed Lighting 2'x2'

‡ Option Value Ordering Restrictions	
Option value	**Restriction**
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with JDT, JDTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Control	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JDT & JDTVTX15
EL7L, EL14L, EL14LSD, E10WLCP	When using pre-wire option, use PWS1846 or PWS1846 PWSLV. For more information on the EL14LSD, please see the PSSD2 specification sheet.
GLR, GMF	Must specify voltage: 120 or 277, with GLR and GMF fusing.
IPSX	Not available with air supply/return or Wired Networking (NES_) and Individual Control (NSD_) sensors.
JDT, JDTVTX15	Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP28	Only available with options: NES7, NESPDT7, NES7ADCX, NESPDT7ADCX, MSD7ADCX, MSDPDT7ADCX, RES7, RES7PDT, R80. Not available when sensor options combined with air supply return option.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com. Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSD7ADCX, MSDPDT7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
PWS1846 PWSLV, PWS1856LV	Not available with nLIGHT wired network or individual controls
RES7EM, RES7PDTEM, R80EM	See UL924 Sequence of Operation chart on page 3.
RRL	For ordering logic consult: RRL_2013.
SLD	Not available with with any nLight Interface or Control options.

Multiple Diffuser Options

Non-Configurable BLT

Stock/MTO	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT2 33L ADP LP835	190887529708	3332	26.67	124.92	3500K/82 CRI	120-277	56
	2BLT2 33L ADP LP840	190887529739	3385	26.67	126.91	4000K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP835	190887529890	3332	26.67	124.92	3500K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP840	190887529937	3385	26.67	126.91	4000K/82CRI	120-277	56

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	**Appropriate Trim Type**
Exposed grid tee (1" and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*

*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

UL924 Sequence of Operation
For 90 minutes following any complete AC power interruption >200 ms:
• Digital dimming is commanded to high-end trim level.
• Device ignores wireless lighting control commands.

2BLT Volumetric Recessed Lighting 2'x2'

Accessories & Replacement Parts

Accessories: Order as separate catalog number.	
DGA22	Drywall grid adapter for 2x2 recessed fixture
ZK2SMKSHP PAF	Surface Mount Troffer Kit Post Paint
RK88DP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1
RK88DP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1
RK88DP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10
RK88DP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40

Replacement Parts: Order as separate catalog number.		
*247WJV	2DBLT24 ADP LENS ASSEMBLY	2 ft. replacement lens
*249P2P	2DBLT24 SDP LENS ASSEMBLY	2 ft. replacement lens
*249P2W	2DBLT24 ADSM LENS ASSEMBLY	2 ft. replacement lens
*249P3J	2DBLT24 SDSM LENS ASSEMBLY	2 ft. replacement lens
*237LT1	2DBLT24 ADPT LENS ASSEMBLY	2 ft. replacement lens
*237LT3	2DBLT24 SDPT LENS ASSEMBLY	2 ft. replacement lens
*237LT5	2DBLT24 ADSMT LENS ASSEMBLY	2 ft. replacement lens
*237LT7	2DBLT24 SDSMT LENS ASSEMBLY	2 ft. replacement lens
*237LT9	2DBLT24 ADPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237R4Y	2DBLT24 SDPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237R5Y	2DBLT24 ADSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*237R5H	2DBLT24 SDSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens

JOT Wireless

JOT

Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

1. **Power:** Install JOT enabled fixtures and controls as instructed.
2. **Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
3. **Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.

2BLT Volumetric Recessed Lighting 2'x2'

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

nLight Wired Networking

Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

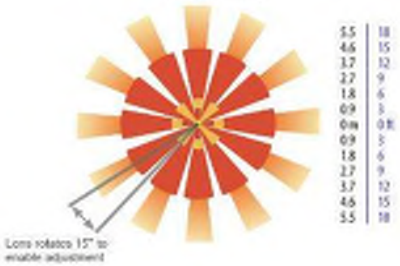
2BLT Volumetric Recessed Lighting 2'x2'

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSDTADCII	II	X			
MSDPDT7NDCII	II		X		
NES7		X		X	
NES7ADCX	II	X		X	
NESPDT7			X	X	
NESPDT7ADCX	II		X	X	
RES7	II	X			X
RESPDT7	II	X	X		X

Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSDTADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

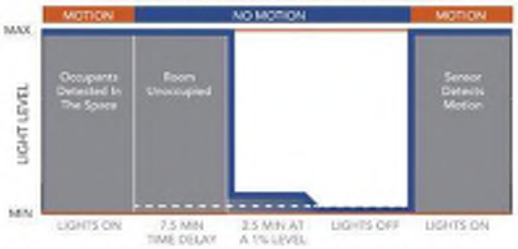
The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nES7NDCX includes an integrated photocell, which enables daylight harvesting controls.

For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7NDCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)

*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)



*The presetting on the automatic dimming photocell is 5fc (NES7) and 10fc (RES7).

COMMERCIAL INDOOR: One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com

Rev. 01/21/21

2BLT Volumetric Recessed Lighting 2'x2'

Controls Accessories

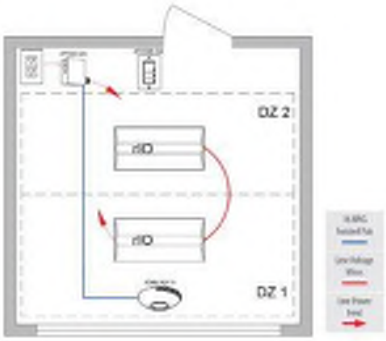
nLight® Wired Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM 10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1

nLight® AIR Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS[1] — Example: RCMS PDT 10 AR G2

Series / Detection	Power Supply[1]	Occupancy Detection	Lens (Required)	Operating Mode	Generation
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately PS 150 Standard 150 mA Power Supply	[blank] PIR Detection PDT Dual Tech PIR/ Microphonics	10 Large Motion/ Extended Range 360° 9 Small Motion/ Extended Range 360° 6 High Bay 360° Lens	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility

Notes
1 RCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.

Sensor Switch WSX | nLight WIRED NPOD UNITDOCK | nLight WIRED nPODMA DX | nLight AIR rPODBA | BLT with rIO | rPODBA | RCMS

LITHONIA LIGHTING® BLT-2X2

COMMERCIAL INDOOR One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com Rev. 01/21/21

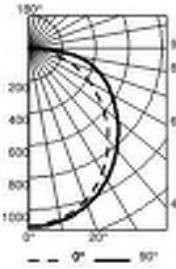
2BLT Volumetric Recessed Lighting 2'x2'

Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.

PHOTOMETRICS

2BLT2 33L ADP LP835, 3332 delivered lumens, test no. ISF36900P19, tested in accordance to IESNA LM-79



CP Summary

	0°	90°
0°	1103	1103
5°	1090	1104
15°	1042	1064
25°	946	989
35°	817	881
45°	664	757
55°	500	634
65°	340	517
75°	177	383
85°	43	164
90	1	14

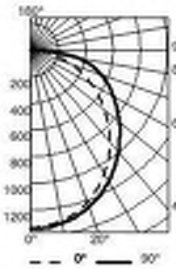
Coefficients of Utilization

RCR	pf/pc/pw	80% 70%/60%/30%	70% 50%/30%/10%	50% 50%/30%/10%
0		119 119 119	116 116 116	111 111 111
1		108 102 97	100 96 92	96 92 89
2		97 88 81	86 80 74	83 77 72
3		88 77 69	76 68 61	72 66 60
4		81 68 59	67 58 52	64 57 51
5		74 61 51	60 51 44	57 50 44
6		68 55 45	54 45 39	52 44 38
7		63 50 40	49 40 34	47 39 34
8		59 45 36	44 36 30	43 36 30
9		55 41 33	41 33 27	40 32 27
10		52 38 30	38 30 25	37 30 25

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	853	25.6	25.6
0° - 40°	1390	41.7	41.7
0° - 60°	2466	74.0	74.0
0° - 90°	3330	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	3332	100.0	100.0

2BLT2 40L ADP LP835, 4041 delivered lumens, test no. ISF36900P35, tested in accordance to IESNA LM-79



CP Summary

	0°	90°
0°	1338	1338
5°	1322	1339
15°	1263	1291
25°	1148	1199
35°	991	1069
45°	805	918
55°	607	769
65°	412	627
75°	214	465
85°	48	199
90	1	17

Coefficients of Utilization

RCR	pf/pc/pw	80% 70%/60%/30%	70% 50%/30%/10%	50% 50%/30%/10%
0		119 119 119	116 116 116	111 111 111
1		108 102 97	100 96 92	96 92 89
2		97 88 81	86 80 74	83 77 72
3		88 77 69	76 68 61	72 66 60
4		81 68 59	67 58 52	64 57 51
5		74 61 51	60 51 44	57 50 44
6		68 55 45	54 45 39	52 44 38
7		63 50 40	49 40 34	47 39 34
8		59 45 36	44 36 30	43 36 30
9		55 41 33	41 33 27	40 32 27
10		52 38 30	38 30 25	37 30 25

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1035	25.6	25.6
0° - 40°	1686	41.7	41.7
0° - 60°	2991	74.0	74.0
0° - 90°	4039	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4041	100.0	100.0

2BLT Volumetric Recessed Lighting 2'x2'

Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT2 20L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	2665.45	124.06	16.64	Premium	PMR2196A
2BLT2 20L ADP EZ1 (GZ10) LP835 [All Options]	2653	126.58	16.06	Premium	P644SUVD
2BLT2 20L ADP GZ1 LP835 [All Options]	2653	122.11	16.64	standard	P1M6M3B
2BLT2 20L ADPT EZ1 (GZ10) LP840 [All Options]	2637.91	126.89	16.06	Premium	PY3150EQ
2BLT2 20L ADPT GZ1 LP835 [All Options]	2805.89	120.49	16.64	standard	P40HDGLB
2BLT2 20L ADPT GZ1 LP840 [All Options]	2637.91	122.41	16.64	standard	P83HB9AK
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3332	124.92	26.67	Premium	PHS0HB8F
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3385.19	126.91	26.67	Premium	PD18DXD8
2BLT2 33L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3348.05	125.22	26.67	Premium	PF98CZ2H
2BLT2 33L ADPT EZ1 (GZ10) LP835 [All Options]	3387.57	125.14	26.27	Premium	PTKZR9WQ
2BLT2 33L ADPT GZ1 LP835 [All Options]	3387.57	123.25	26.67	standard	PTN502JN
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4041	127.35	31.73	Premium	P19WW9GV
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4105.51	129.38	31.73	Premium	PHCQ2C0F
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3987.12	125.65	31.73	Premium	PW6RMMJ4
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4058.77	127.65	31.73	Premium	PSYYDAA8
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4800	109.9	43.67	standard	P5RHYR1G
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4876.63	111.66	43.67	standard	P8G9YYDK
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4736	108.44	43.67	standard	PJTU9N6X
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4811.61	110.17	43.67	standard	PSR2R3T6

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLO.

HE Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	1948	130.59	14.91	Premium	PJQCZWQ1
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	1979.1	132.67	14.91	Premium	PJCZRW21
2BLT2 20LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	1952.71	130.9	14.91	Premium	PLC4RF4L
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	3392	137.3	24.7	Premium	P3XXZV0PH
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	3446.15	139.5	24.7	Premium	PKPJYYBF
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	3346.77	135.47	24.7	Premium	PZC8BZS5
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	3400.2	137.64	24.7	Premium	PM5G8AFU
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4118	133.71	30.79	Premium	PJ5XHFFP
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4183.74	135.85	30.79	Premium	PEGFHPZD
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4063.09	131.93	30.79	Premium	PBE16E9B
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4127.96	134.04	30.79	Premium	PFR5S5VG
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP835 [All Options]	4845	128	37.85	Premium	P5S8HJZP
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP840 [All Options]	4922.35	130.04	37.85	Premium	P1B63H56
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP835 [All Options]	4780.4	126.29	37.85	Premium	PHPT65M8
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP840 [All Options]	4856.71	128.31	37.85	Premium	P8RX954Z

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLO.

How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Delivered Lumens = 1.25 x P x LPW
P = Ouput power of emergency driver. P = 10W for E10WLCP option.
LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumens per watt rating of the luminaire. LPW information available in Performance Data section.

LITHONIA LIGHTING

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — The T Series LED combines digital lighting and control technologies with a high-performance optical system to deliver general ambient lighting for many applications such as schools, offices and hospitals.

High efficacy light engine delivers long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.

CONSTRUCTION — Housing formed from cold-rolled steel. Housing is painted after fabrication for superior finish.

Smooth hemmed sides and smooth inward-formed end flanges, for easy handling.

Standard extruded aluminum door frame has superior structural integrity with premium appearance and mitered corners. Powder-painted rotary cam latches provide easy, secure door closure. Integral T-bar clips are standard. Acrylic shielding material is 100% UV stabilized.

OPTICS — Standard pattern #19 lens, 0.156" thick with highly transmissive overlay, is standard for superior brightness control. Overlay is 0.040" thick. Other lenses are available.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior level and quality of illumination for extended service life. 90% LED lumen maintenance at 60,000 hours (L90/60,000).

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI. Optional nLight® embedded controls continuously monitor system performance, allow for constant lumen management/compensation function, facilitate simple "plug-and-play" network and controls upgrading via Cat-5 cable.

Driver disconnect is provided where required to comply with U.S. and Canadian codes.

INSTALLATION — Drivers and internal components are accessible from floor. LED boards include plug-in connectors for easy replacement or servicing. Suitable for direct insulation contact. Suitable for damp location.

LISTINGS — CSA certified to U.S. and Canadian standards. IC rated. DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

T SERIES LED

2TL

2' x 4' LED

eldoLED

Specifications
Length: 48 (122.0)
Width: 24 (61.0)
Depth: 3-3/4 (9.5)

All dimensions are inches (centimeters) unless otherwise noted.

Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

2TL 2X4 Recessed LED Lighting

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example:** 2TL4 40L RW A19 EZ1 LP835 N80

2TL4									
Series		**Lumens**[1]		**Door**		**Lens**		**Voltage**	
2TL4	Recessed LED 2x4	30L	3000 lumens	FW	Flush aluminum, white	A12	#12 pattern acrylic	(blank)	MVOLT (120-277V)
		40L	4000 lumens	RW	Regressed aluminum, white	A19	#19 pattern acrylic, 0.156" thick	347	347V[2]
		48L	4800 lumens			MWS	Matte white .040" thick		
		60L	6000 lumens			MPL	Micro prism		
		72L	7200 lumens			SWL	Satin white		

Driver		**Color temperature**		**Control**		**Options**	
EZ1	eldoLED dims to 1% (0-10 volt dimming)	LP830	3000 K	(blank)	No controls	EL7L	700 nominal lumen battery pack (Noncompliant with CA T20)
EZB	eldoLED dims to 0.1% (0-10 volt dimming)	LP835	3500 K	N80	eLight with 80% (L80) lumen management	EL14L	1400 nominal lumen battery pack (Noncompliant with CA T20)
GZ1	Dims to 1% (0-10V dimming)[3]	LP840	4000 K	N80EMG	eLight with 80% (L80) lumen management for use with generator supply EM power	E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS
GZ10	Dims to 10% (0-10V dimming)[3]	LP850	5000 K	N100	eLight without lumen management	CP	Chicago plenum[4]
ED8	eldoLED DALI[5]			N100EMG	eLight without lumen management for use with generator supply EM power		
EX8	eldoLED DMX/RDM[5]						
EXA1	Dims to 1%, XPoint wireless enabled[4,5]						
EXAB	Dims to dark, XPoint wireless enabled[4,5]						
SLD	Step-level dimming[6]						

Accessories: Order as separate catalog number.	
DGA24	Drywall grid adapter for 2x4 recessed fixture.

Notes
1. Approximate lumen output.
2. Not available with EL7L or EL14L battery packs or SLD driver.
3. GZ1, GZ10 drivers not available with any Controls options.
4. Not available with N80, N80EMG, N100, or N100EMG.
5. Gateway not included. Requires on-site commissioning. Visit www.lightingcontrols.com/XPointWireless for more information.

Performance Data				
Lumen	**Package**	**Lumens**	**Input Watts**	**LPW**
30L	LP830	3,010.9	25	120.4
30L	LP835	3,075.5	25	123.0
30L	LP840	3,097.0	25	123.9
30L	LP850	3,204.7	25	128.2
40L	LP830	3,835.1	32	119.8
40L	LP835	3,918.2	32	122.4
40L	LP840	3,945.8	32	123.3
40L	LP850	4,084.2	32	127.6
48L	LP830	4,730.1	40	118.3
48L	LP835	4,831.6	40	120.8
48L	LP840	4,865.4	40	121.6
48L	LP850	5,034.6	40	125.9
60L	LP830	5,431.3	47	115.6
60L	LP835	5,548.2	47	118.0
60L	LP840	5,588.2	47	118.9
60L	LP850	5,785.0	47	123.1
72L	LP830	7,511.4	67	112.1
72L	LP835	7,673.3	67	114.5
72L	LP840	7,728.7	67	115.4
72L	LP850	7,999.3	67	119.4

Performance based on standard #12 pattern acrylic lens.

How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode.
Delivered Lumens = 1.25 x P x LPW
P = Ouput power of emergency driver. P = 10W for E10WLCP option.
LPW = Lumens per watt rating of the luminaire. LPW information available in Performance Data section.

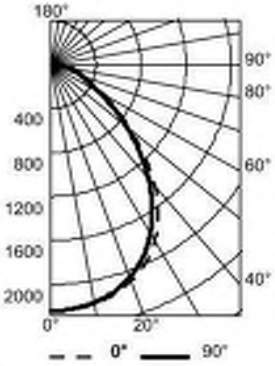
LEO: One Lithonia Way Conyers, GA 30012 Phone: 800-858-7763 Fax: 770-929-8789 www.lithonia.com

 Rev. 04/29/20

2TL 2X4 Recessed LED Lighting

PHOTOMETRICS

2TL4 48L FW A12 EZ1 LP840, 4865.4 delivered lumens, test no. LTL26934P10, tested in accordance to IESNA LM-79.



CP Summary

	0°	90
0°	2239	2239
5°	2234	2231
15°	2163	2144
25°	1990	1933
35°	1681	1569
45°	1174	1109
55°	717	668
65°	403	370
75°	228	240
85°	97	108
90	0	0

Coefficients of Utilization

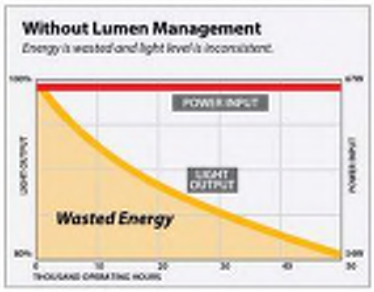
	pf	20%								
	pc	80%			70%			50%		
RCR	pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
	0	119	119	119	116	116	116	111	111	111
	1	110	106	102	103	100	97	99	96	94
	2	101	94	88	92	86	81	88	84	80
	3	93	84	76	82	75	70	79	73	69
	4	86	75	67	74	66	61	71	65	60
	5	80	68	60	67	59	53	65	58	53
	6	74	62	53	61	53	47	59	52	47
	7	69	56	48	56	48	42	54	47	42
	8	64	52	44	51	43	38	50	43	38
	9	60	48	40	47	40	35	46	39	34
	10	57	44	37	44	37	32	43	36	32

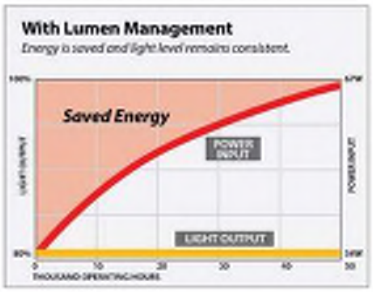
Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1713	35.2	35.2
0° - 40°	2710	55.7	55.7
0° - 60°	4192	86.2	86.2
0° - 90°	4865	100.0	100.0
90° - 120°	0	0.0	0.0
90° - 130°	0	0.0	0.0
90° - 150°	0	0.0	0.0
90° - 180°	0	0.0	0.0
0° - 180°	4865	100.0	100.0

Constant Lumen Management

Enabled by the embedded nLight control, the T Series LED actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.





LED: One Lithonia Way Conyers, GA 30012 Phone: 800-858-7763 Fax: 770-929-8789 www.lithonia.com

LITHONIA LIGHTING

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — The T Series LED combines digital lighting and control technologies with a high-performance optical system to deliver general ambient lighting for many applications such as schools, offices and hospitals.

High efficacy light engine delivers long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable. **Certain airborne contaminants can diminish integrity of acrylic.** Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.

CONSTRUCTION — Housing formed from cold-rolled steel. Housing is painted after fabrication for superior finish.

Smooth hemmed sides and smooth inward-formed end flanges, for easy handling.

Standard extruded aluminum door frame has superior structural integrity with premium appearance and mitered corners. Powder-painted rotary cam latches provide easy, secure door closure. Integral T-bar clips are standard. Acrylic shielding material is 100% UV stabilized.

OPTICS — Standard pattern #19 lens, 0.156" thick with highly transmissive overlay, is standard for superior brightness control. Overlay is 0.040" thick. Other lenses are available.

ELECTRICAL — Long life LEDs, coupled with high efficiency drivers, provide superior level and quality of illumination for extended service life. 90% LED lumen maintenance at 60,000 hours (L90/60,000).

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI. Optional nLight® embedded controls continuously monitor system performance, allow for constant lumen management/compensation function, facilitate simple "plug-and-play" network and controls upgrading via Cat-5 cable.

Driver disconnect is provided where required to comply with U.S. and Canadian codes.

INSTALLATION — Drivers and internal components are accessible from floor. LED boards include plug-in connectors for easy replacement or servicing. Suitable for direct insulation contact. Suitable for damp location.

LISTINGS — CSA certified to U.S. and Canadian standards. IC rated.

DesignLights Consortium® (DLC)-qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

T SERIES LED

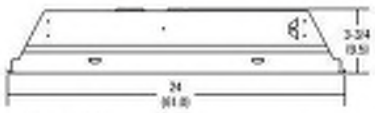
2TL

2' x 2' LED

eldoLED

Specifications

Length: 24 (61.0)
Width: 24 (61.0)
Depth: 3-3/4 (9.5)



All dimensions are inches (centimeters) unless otherwise noted.

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

2TL Recessed LED Lighting 2'x2'

A+ Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2TL2 33L RW A19 EZ1 LP835 N80

2TL2									
Series		**Lumens**[1]		**Door**		**Lens**		**Voltage**	
2TL2	Recessed LED 2x2	20L	2000 lumens	FW	Flush aluminum, white	A12	#12 pattern acrylic	(blank)	MVOLT (120-277V)
		33L	3300 lumens	RW	Regressed aluminum, white	A19	#19 pattern acrylic, 0.156" thick	347	347V[2]
		40L	4000 lumens			MWS	Matte white .040" thick		
						MPL	Micro prism		
						SWL	Satin white		

Driver		**Color temperature**		**Control**		**Options**	
EZ1	eldoLED dims to 1% (0-10 volt dimming)	LP830	3000 K	(blank)	No controls	EL7L	700 nominal lumen battery pack (Noncompliant with CA T20)
EZB	eldoLED dims to 0.1% (0-10 volt dimming)	LP835	3500 K	N80	nLight with 80% (L80) lumen management	EL14L	1400 nominal lumen battery pack (Noncompliant with CA T20)
GZ1	Dims to 1% (0-10V dimming)[3]	LP840	4000 K	N80EMG	nLight with 80% (L80) lumen management for use with generator supply EM power	E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS
GZ10	Dims to 10% (0-10V dimming)[3]	LP850	5000 K	N100	nLight without lumen management	CP	Chicago plenum[4]
ED8	eldoLED DALI[2]			N100EMG	nLight without lumen management for use with generator supply EM power		
EXA1	Dims to 1%, XPoint wireless enabled[4,5]						
EXA8	Dims to dark, XPoint wireless enabled[4,5]						
SLD	Step-level dimming[4]						

Accessories: *Order as separate catalog number.*	
DGA22	Drywall grid adapter for 2x2 recessed fixture.

Notes
1. Approximate lumen output.
2. Not available with EL7L or EL14L battery packs or SLD driver.
3. GZ1, GZ10 drivers not available with any Controls options.
4. Not available with N80, N80EMG, N100, or N100EMG.
5. Gateway not included. Requires on-site commissioning. Visit www.lightingcontrols.com/XPointWireless for more information.

Performance Data

Lumen	Package	Lumens	Input Watts	LPW
20L	LP830	2,034.7	18	113.0
20L	LP835	2,078.3	18	115.5
20L	LP840	2,092.9	18	116.3
20L	LP850	2,165.6	18	120.3
33L	LP830	3,246.3	29	111.9
33L	LP835	3,317.0	29	114.4
33L	LP840	3,339.8	29	115.2
33L	LP850	3,458.3	29	119.3
40L	LP830	3,811.6	35	108.9
40L	LP835	3,892.7	35	111.2
40L	LP840	3,921.8	35	112.1
40L	LP850	4,058.9	35	116.0

Performance based on standard #12 pattern acrylic lens.

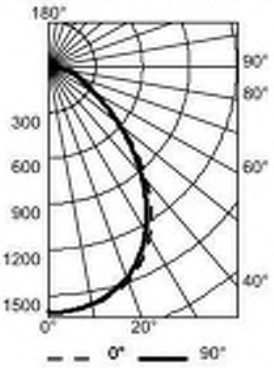
How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Delivered Lumens = 1.23 x P x LPW
P = Ouput power of emergency driver. P = 10W for E10WLCP option.
LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

LEO: One Lithonia Way Conyers, GA 30012 Phone: 800-858-7763 Fax: 770-929-8789 www.lithonia.com
 Rev. 07/22/20

2TL Recessed LED Lighting 2'x2'

PHOTOMETRICS

2TL2 33L FW A12 EZ1 LP840, 3339.8 delivered lumens, test no. LTL26923P6, tested in accordance to IESNA LM-79.



CP Summary

	0°	90
0°	1609	1609
5°	1609	1607
15°	1549	1536
25°	1406	1369
35°	1143	1086
45°	789	749
55°	460	444
65°	265	254
75°	146	170
85°	64	76
90	0	0

Coefficients of Utilization

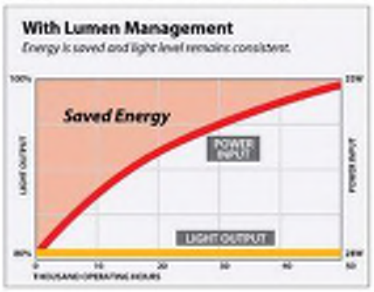
RCR	pf 20% / pc 80%			pf 20% / pc 70%			pf 20% / pc 50%		
pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	110	106	102	103	100	97	99	95	94
2	101	94	88	92	86	82	89	84	80
3	93	84	77	82	76	70	79	74	69
4	86	75	68	74	67	61	72	65	60
5	80	68	60	67	60	54	65	58	53
6	74	62	54	61	54	48	60	53	47
7	69	57	49	56	48	43	55	48	43
8	65	52	44	52	44	39	50	44	39
9	61	48	41	48	40	35	47	40	35
10	57	45	37	44	37	32	43	37	32

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1219	36.5	36.5
0° - 40°	1905	57.0	57.0
0° - 60°	2882	86.3	86.3
0° - 90°	3340	100.0	100.0
90° - 120°	0	0.0	0.0
90° - 130°	0	0.0	0.0
90° - 150°	0	0.0	0.0
90° - 180°	0	0.0	0.0
0° - 180°	3340	100.0	100.0

Constant Lumen Management

Enabled by the embedded nLight control, the T Series LED actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.



gotham® | EVO®

Multiple Layers of Light

Luminaire Type:

Catalog Number:

General Illumination Round Downlight 6"

OVERVIEW

Feature Set

- Bounding Ray™ optical design
- Unitized optics mechanically attach the light engine to the lower reflector for complete optical alignment.
- 45° cutoff to source and source image
- Fully serviceable and upgradeable lensed LED light engine
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- Fixtures are wet location, covered ceiling
- Available with 10% dimming, 1% dimming, or dim to dark
- Batwing distribution with feathered edges provides even illumination on horizontal and vertical surfaces
- ENERGY STAR® certified product

250 - 8,000 lumens

10,000 - 17,500 lumens

Distribution

Superior Performance

Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000	4500	5000	6000	8000	10,000	12,000	15,000	17,500
Delivered Lumens	297	519	776	994	1471	2006	2537	3077	3542	4027	4533	5256	6371	8247	10637	12332	15776	17801
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0	47.3	48.7	57.6	74.9	97.1	115.0	150.9	175.3
Lumens per Watt	87.4	83.7	94.6	103.5	100.1	101.8	102.7	104.3	104.8	103.3	95.8	107.9	110.6	110.1	109.5	107.2	104.5	101.5

COMPLIMENTARY PRODUCTS

Coordinated Apertures | Multiple Layers of Light

General Illumination Layer | EVO

High Center Beam Layer | Incito

EVO + Incito — Multiple Layers of Light

gotham | EVO

6" General Illumination Round Downlight

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Design2Ship Quick Ship Program: Options in green text qualify for Design2Ship — 5 business days from order entry to ship. Refer to Design2Ship Brochure for complete program details. Maximum Order Quantity: 100 units; 50 for Chicago Plenum.

Luminaire Type:

Catalog Number:

EXAMPLE: EV06 35/150 AR MWD LSS MVOLT EZ1

Series	Color Temperature	Nominal Lumen Values	Reflector & Flange Color	Trim Style	Distribution
EV06	27/ 2700 K 30/ 3000 K 35/ 3500 K 40/ 4000 K 50/ 5000 K	02 250 lumens 05 500 lumens 07 750 lumens 10 1000 lumens 15 1500 lumens 20 2000 lumens 25 2500 lumens 30 3000 lumens 35 3500 lumens 40 4000 lumens 45 4500 lumens 50 5000 lumens 60 6000 lumens 80 8000 lumens 100 10000 lumens 120 12000 lumens 150 15000 lumens 175 17500 lumens	AR Clear PR Pewter WTR Wheat GR Gold WR[7] White BR[7] Black WRAMF[7] White Anti-microbial	(blank) Self-flanged FL Flangeless	WND Very Narrow (0.5 s/mh) ND Narrow (0.7 s/mh) MD Medium (0.9 s/mh) MWD Medium Wide (1.0 s/mh) WD Wide (1.2 s/mh)

Finish	Voltage	Driver[4]
LSS Semi-specular LO Matte-diffuse LS Specular	MVOLT 120 277 347[1,5]	GZ10 0-10V driver dims to 10% GZ1 0-10V driver dims to 1% EZ10 eldoLED 0-10V ECOdrive. Linear dimming to 10% min. EZ1 eldoLED 0-10V ECOdrive. Linear dimming to 1% min. EZB eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%. EDAB[1] eldoLED SOLOdrive DALI. Logarithmic dimming to <1%. EDXB[1] eldoLED POWERdrive DMX with RDM (remote device management). Square Law dimming to <1%. Includes termination resistor. Refer to DMXR Manual. Minimum 1000 lumens/Maximum 15000 lumens. ECOS2[2] Lutron® Hi-Lume® 2-wire forward-phase driver. Minimum dimming level 1%. 120V only. Minimum 1000 lumens/Maximum 4000 lumens. ECO0[3] Lutron Ecosystem digital Hi-Lume 1% soft-on, fade to black. Max. 4000LM.

Control Interface	Options	
NLT[1] nLight® dimming pack controls NLTER[2,3,5] nLight® dimming pack controls emergency circuit NLTAIR2[13] nLight® AIR enabled NLTAIRE2[2,5,13] nLight® AIR enabled emergency EXA1 XPoint Wireless, eldoLED driver. Linear dimming to 1%. EXAB XPoint Wireless, eldoLED driver. Logarithmic dimming to dark.	SF Single fuse. Specify 120V or 277V. TRW[7] White painted flange TRBL[7] Black painted flange EL Emergency battery pack, 10W, with integral test switch ELR Emergency battery pack, 10W, with self-diagnostics, with remote test switch ELSD Emergency battery pack, 10W, with self-diagnostics, integral test switch ELRSD Emergency battery pack, 10W, with self-diagnostics, remote test switch E10WCP Emergency battery pack, 10W Constant Power, CA Title 20 compliant with integral test switch E10WCPR Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch	N80[8] nLight® Lumen Compensation BSTD Bodine generator transfer device. Specify 120V or 277V. 90CRI High CRI (90+) CP[11] Chicago Plenum. Specify 120V or 277V for 5000lm and above. HAO[12] HAO High Ambient Option (40°C) RRL_ RELOC®-ready luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Refer to RRL for complete nomenclature

ACCESSORIES – order as separate catalog numbers (shipped separately)

SCA6	Sloped ceiling adapter. Degree of slope must be specified (50, 100, 150, 200, 250, 300). Ex: SCA6 100. Refer to TECH-190.
CTA4-8 YKRL	Ceiling thickness adapter for 10,000LM and above (extends mounting frame to accommodate ceiling thickness up to 5"). Adds ~4" to fixture height.
CTA4-8 YK	Ceiling thickness adapter for 8,000LM and below (extends mounting frame to accommodate ceiling thickness up to 5"). Adds ~4" to fixture height.
GVRT	Vandal-resistant trim accessory. Refer to TECH-200.
ISD BC	0-10V wallbox dimmer. Refer to ISD-BC.

ORDERING NOTES

1. Not available with finishes.
2. Not available with emergency battery pack options.
3. Supplied with factory installed step down transformer.
4. Refer to TECH-240 for compatible dimmers.
5. Not available with nLight® and XPoint options.
6. Specify voltage.
7. For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not applicable with WR (white reflector) or FL (flangeless) option.
8. For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not applicable with BR (black reflector) or FL (flangeless) option.
9. ER for use with generator supply power. Will require an emergency hot feed and normal hot feed.
10. Fixture begins at 80% light level. Must be specified with NLT or NLTER. Only available with EZ10 and EZ1 drivers.
11. 12,000LM max with EL or nLight® options. 5,000LM max with Lutron drivers combined with EL. Not available with ELR, HAO, EXA1, or EXAB options.
12. Only available 5000LM - 15,000LM with eldoLED drivers.
13. Not available DALI or DMX drivers. Not available with CP or N80 options. Not recommended for metal ceiling installations.

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L4

gotham | EVO

6" **General Illumination Round Downlight**

SPECIFICATIONS

Optical Assembly
Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling.

Optical design is a Bounding Ray™ design with 45° cutoff to source and source image. Top-down flash characteristic for superior glare control.

Unitized optics shall have mechanical attachment of the light engine to the lower reflector for complete optical alignment.

Electrical
The luminaire shall operate from a 50 or 60 Hz ±3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.

The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.

Input wires shall be 18AWG, 300V minimum, solid copper.

Controls
Luminaire shall be equipped with interface for nLight wired or wireless network with integral power supply as per specification.

Dimming
The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.

eldoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.

Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction
Luminaire housing shall be constructed of 16-gauge galvanized steel and have preinstalled telescopic mounting bars with maximum 32" and minimum 15" extension and 4" vertical adjustment.

Luminaires shall be suitable for installation in ceilings up to 1½" thick. (specify ceiling thickness adapter to extend frame to accommodate ceiling thickness up to 5").

Tool-less adjustments shall be possible after installation.

The assembly and manufacturing process for the luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.

25°C ambient temperature standard (1/2" clearance on all sides from non-combustible materials in non-IC applications, unless marked spacing noted otherwise). For use in insulated ceilings, a 3" clearance on all sides from insulation is required (unless marked spacing noted otherwise). 40°C high ambient optional.

Listings
Fixtures are CSA certified to meet US and Canadian Standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, wet location covered ceiling. Luminaire configurations are Energy Star certified through testing in EPA–recognized laboratories, with the results reviewed by an independent, accredited certification organization. Visit www.energystar.gov for specific configurations listed.

Photometrics
LEDs tested to LM-80 standards. Measured by IESNA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.

Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by a point at the intersection of the CCT line and the black body locus line in CIE chromaticity space.

Warranty
5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

Note:
Actual performance may differ as a result of end user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight® control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

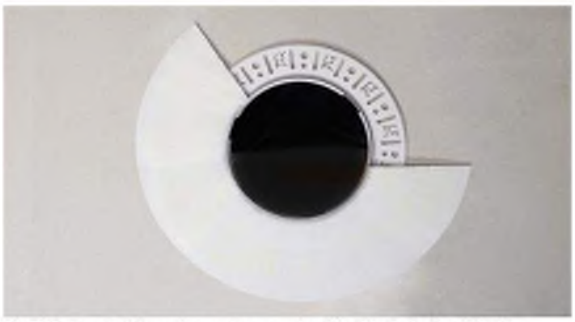
14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L4

Flangeless

Partially finished mud ring, showing cross-section detail.



An EVO downlight requires only approximately 3" of plaster to finish.

EVO with flangeless trim

Flangeless Installation

Gotham's flangeless option utilizes a micro-thin polymer mud ring that minimizes the amount of drywall compound required to finish the ceiling. The end result is a virtually undetectable flangeless downlight installation.

The polymer mud ring is installed independent of the of the recessed frame, therefore floating with the ceiling. This innovation minimizes any surface cracks during reflector installation, ceiling movement and any future service to the recessed frame, wiring, electronics, etc.

GOTHAM ARCHITECTURAL DOWNLIGHTING | 1400 Lester Road Conyers, GA 30012 | P 800-705-SERV (7378) | gothamlighting.com

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L4

Tables of Use

Marked Spacing in Inches 25°C Ambient			
Lumen Package	Fixed Center to Center MIN	Fixture Center to Building Member MIN	Space Above Fixture
500-5000	None	None	None
6000	24	12	5
8000	36	18	11
10000			9
12000			
15000			
17500	72	36	

Marked Spacing in Inches 40°C Ambient			
Lumen Package	Fixed Center to Center MIN	Fixture Center to Building Member MIN	Space Above Fixture
5000	24	12	5
6000			
8000	48	24	9
10000			
12000			
15000	72	36	9

Marked Spacing Chicago Plenum Open Frame in Inches 25°C Ambient			
Lumen Package	Fixed Center to Center MIN	Fixture Center to Building Member MIN	Space Above Fixture
250-5000	None	None	None
6000	24	12	5
8000	36	18	11
10000			9
12000			
15000			
17500	72	36	

Marked Spacing Chicago Plenum Enclosure in Inches 25°C Ambient			
Lumen Package	Fixed Center to Center MIN	Fixture Center to Building Member MIN	Space Above Fixture
250-6000	None	None	None
8000	36	18	6
10000	48	24	3
12000			

EVO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EXA1	1%	Linear	Linear/Logarithmic
EZB	<1%	Logarithmic	Linear
EDA8	<1%	Logarithmic	Linear
EXA8	<1%	Logarithmic	Linear
EDA3	<1%	Square	Linear

Lumen Output Multiplier		
CRI	CCT	Multiplier
80	2700K	0.96
	3000K	1.00
	3500K	1.00
	4000K	1.01
	5000K	1.01
90	2700K	0.80
	3000K	0.83
	3500K	0.85
	4000K	0.87
	5000K	0.91

Reflector Finish Multiplier	
Reflector Finish	Multiplier
LS - Specular	1
LSS - Semi Specular	0.956
WR - White	0.87
LD - Matte Diffuse	0.85
BR - Black	0.73

Distributions		
Nomenclature	Beam Angle	Field Angle
VND	30	64
ND	44	69
MD	54	82
MWD	67	89
WD	71	92

Driver		Control Provided (note: 347V/UVOLT versions provided with 347 option selected)			
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIRER2
GZ10	0-10V driver dims to 10%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
GZ1	0-10V driver dims to 1%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZB	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2

How to Estimate Delivered Lumens in Emergency Mode

Delivered Lumens = 1.25 x P x LPW

P = Output power of emergency driver. P = 10W for PS1055CP

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet.

gotham | EVO

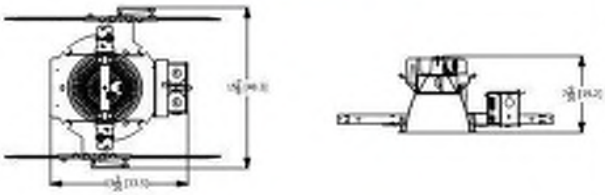
6" General Illumination Round Downlight

DIMENSIONAL DATA

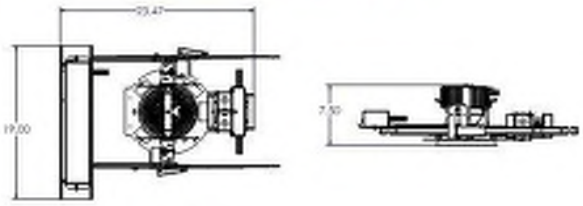
*Dimensions in inches [centimeters]

Aperture: 6 1/4" [15.9]	Ceiling Opening: 7 1/8" [18.1] self-flanged
Overlap Trim: 7 1/2" [19.1]	7 1/4" [18.4] flangeless

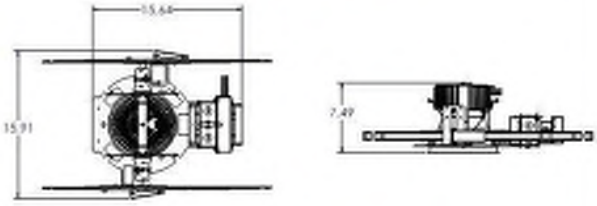
1000LM-4500LM Standard



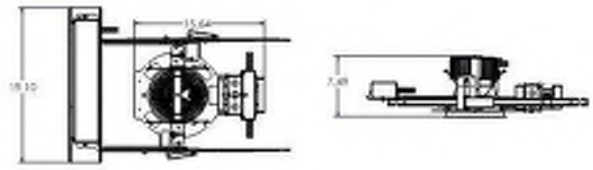
1000LM-4500LM Battery Pack



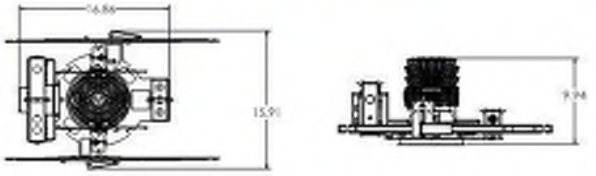
5000LM-8000LM Standard



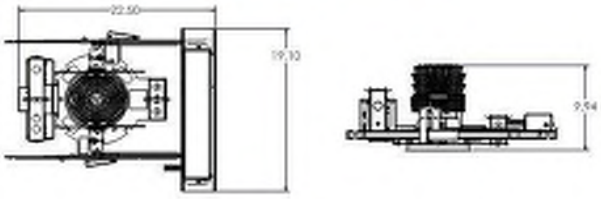
5000LM-8000LM Battery Pack



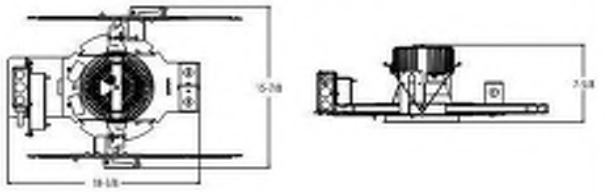
10,000LM-17,500LM Standard



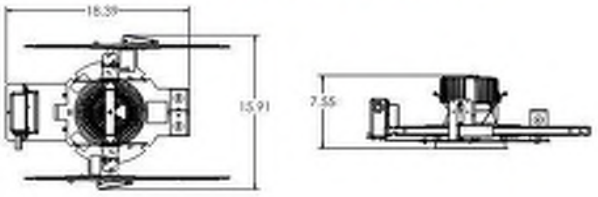
10,000LM-17,500LM Battery Pack



1000LM-4500LM CP



5000 Lumen ECO/SOLO Drive Open Frame CP



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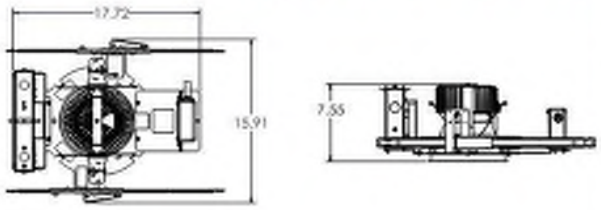
Date: **04-Jun-21**
Project #: DV20131

Type: L4

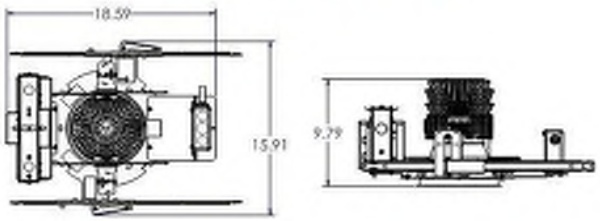
DIMENSIONAL DATA

*Dimensions in inches [centimeters]

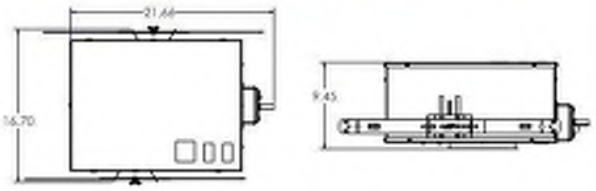
5000 (Lutron & POWER Drive Only), 6000 & 8000 Lumen Open Frame CP



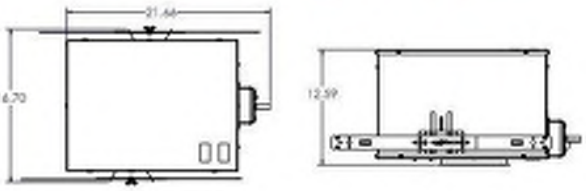
10000 - 17,500 Lumen Open Frame CP



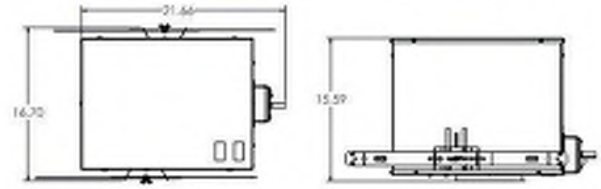
250 - 6000 Lumen CP for nLight® or Battery Pack



8,000LM Enclosed CP for nLight or Battery Pack



10,000LM-12,000LM Enclosed CP for nLight or Battery Pack



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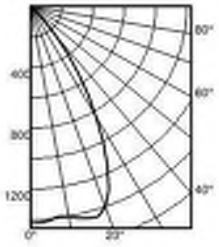
Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L4

Photometry

EVO6 35/15 AR MWD LS INPUT WATTS: 14.7, DELIVERED LUMENS: 1471LM, LPW= 100, 1.03 S/MH, TEST NO. LTL27783P1505



	Ave	Lumens
0	1431	
5	1410	134
15	1442	405
25	1161	523
35	540	332
45	78	72
55	3	4
65	1	1
75	0	1
85	0	0
90	0	

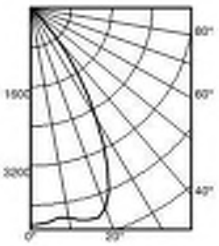
Zone	Lumens	% Lamp
0° - 30°	1061.4	72.2
0° - 40°	1383.5	94.7
0° - 60°	1469.5	99.9
0° - 90°	1470.9	100.0
90° - 180°	0.0	0.0
0° - 180°	1470.9	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	96	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	73	69	77	72	68
7	74	68	64	74	68	64	72	67	63
8	70	64	60	69	64	60	68	63	59
9	66	60	56	65	60	56	64	59	56
10	62	56	52	62	56	52	61	56	52

Mounting Height	Initial FC Center Beam	50% beam - 54.4° Diameter	50% beam - 54.4° FC	10% beam - 77.9° Diameter	10% beam - 77.9° FC
8.0	47.3	5.7	23.7	8.9	4.7
10.0	25.4	7.7	12.7	12.1	2.5
12.0	15.9	9.6	7.9	15.3	1.6
14.0	10.8	11.8	5.4	18.6	1.1
16.0	7.9	13.9	3.9	21.8	0.8

EVO6 35/45 AR MWD LS INPUT WATTS: 47.3, DELIVERED LUMENS: 4532.7LM, LPW= 95.8, 1.03 S/MH, TEST NO. LTL27783P1649



	Ave	Lumens
0	4411	
5	4346	413
15	4443	1247
25	3578	1610
35	1665	1024
45	242	222
55	8	12
65	2	3
75	1	2
85	0	0
90	0	

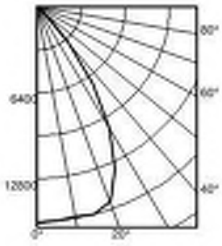
Zone	Lumens	% Lamp
0° - 30°	3270.7	72.2
0° - 40°	4294.2	94.7
0° - 60°	4528.3	99.9
0° - 90°	4532.7	100.0
90° - 180°	0.0	0.0
0° - 180°	4532.7	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	96	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	73	69	77	72	68
7	74	68	64	74	68	64	72	67	63
8	70	64	60	69	64	60	68	63	59
9	66	60	56	65	60	56	64	59	56
10	62	56	52	62	56	52	61	56	52

Mounting Height	Initial FC Center Beam	50% beam - 54.4° Diameter	50% beam - 54.4° FC	10% beam - 77.9° Diameter	10% beam - 77.9° FC
8.0	140.8	5.7	72.9	8.9	14.6
10.0	78.4	7.7	39.2	12.1	7.8
12.0	48.9	9.8	24.4	15.3	4.9
14.0	33.4	11.8	16.7	18.6	3.3
16.0	24.2	13.9	12.1	21.8	2.4

EVO6 35/175 AR MWD LS INPUT WATTS: 175.3, DELIVERED LUMENS: 17801LM, LPW=101.5, 1.06 S/MH, TEST NO. ISF 34035P268



	Ave	Lumens
0	16146	
5	15898	1521
15	16006	4479
25	13362	6061
35	7018	4289
45	1470	1299
55	190	156
65	37	38
75	13	14
85	2	2
90	0	

Zone	Lumens	% Lamp
0° - 30°	12002.3	67.4
0° - 40°	16291.0	91.5
0° - 60°	17746.3	99.7
0° - 90°	17801.0	100.0
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.0	0.0
90° - 180°	0.0	0.0
0° - 180°	17801.0	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	106	106	104	104	103	101
2	103	98	95	101	97	94	98	95	92
3	95	90	86	94	89	86	91	87	84
4	89	83	79	88	82	78	85	81	77
5	83	77	72	82	76	72	80	75	71
6	77	71	67	77	71	67	75	70	66
7	73	66	62	72	66	62	71	65	61
8	68	62	58	67	62	57	66	61	57
9	64	58	54	63	58	54	62	57	53
10	60	54	50	60	54	50	59	54	50

Mounting Height	Initial FC Center Beam	50% beam - 55.7° Diameter	50% beam - 55.7° FC	10% beam - 79.8° Diameter	10% beam - 79.8° FC
8.0	533.7	5.8	266.9	9.2	53.4
10.0	287.0	7.9	143.5	12.5	28.7
12.0	178.9	10.0	89.4	15.9	17.9
14.0	122.1	12.1	61.0	19.2	12.2
16.0	88.6	14.3	44.3	22.6	8.9

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Type: L4

gotham | EVO

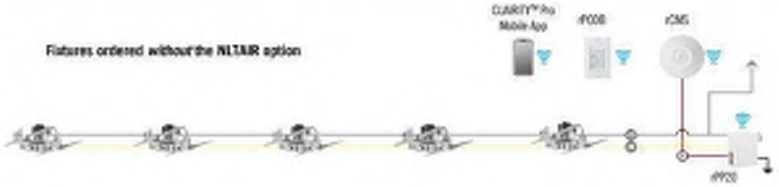
6" General Illumination Round Downlight

NLIGHT AIR

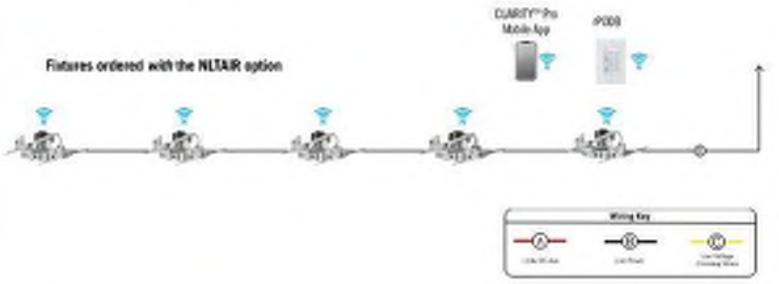
nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR rPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

Possibilites for nLight® AIR

Fixtures ordered without the NLTAIR option



Fixtures ordered with the NLTAIR option



nLight® AIR Control Accessories
Order as separate catalog number. Visit nLight AIR.

Wall Switches	Model Number
On/Off single pole	rPODB (color) G2
On/Off two pole	rPODB 2P (color) G2
On/Off & raise/lower single pole	rPODB DX (color) G2
On/Off & raise/lower two pole	rPODB 2P DX (color) G2

nLight® AIR Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	rCMS 9 / rCMS PDT 9
Large motion 360°, ceiling	rCMS 10 / rCMS PDT 10

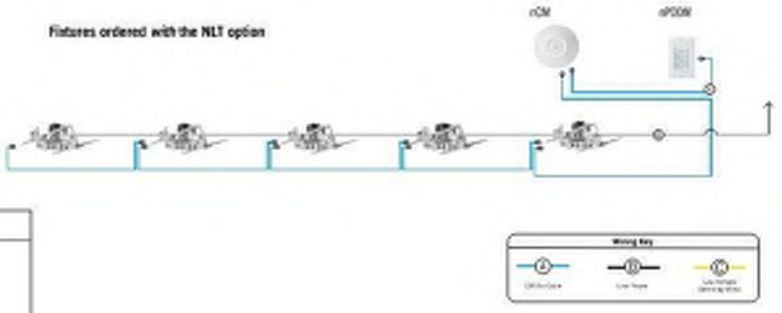
NLIGHT

nLight® The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

Possibilites for nLight® wired

Fixtures ordered without the NLT option

Fixtures ordered with the NLT option



nLight® Wired Control Accessories
Order as separate catalog number. Visit nLight.

Wall Switches	Model Number
On/Off single pole	nPODM (color)
On/Off two pole	nPODM 2P (color)
On/Off & raise/lower single pole	nPOD DX (color)
On/Off & raise/lower two pole	nPODM 2P DX (color)
Graphic touchscreen	nPOD GFX (color)
Photocell Controls	
Dimming	nCM ADCX

nLight® Wired Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

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Date: **04-Jun-21**
Project #: DV20131

Type: L4

gotham® | E V O®

Multiple Layers of Light

Luminaire Type:

Catalog Number:

General Illumination Shower Downlight 6"

OVERVIEW

Feature Set

- Wipe down flush or regressed lens
- NSF2 Splash/Non-food Zone
- Fully serviceable and upgradeable lensed LED light engine
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- IP66 rated room-side, Fixtures are wet location, covered ceiling
- Anti-microbial paint finish, optional
- Non-conductive dead-front trim
- Suitable for steam room application

Distribution

Superior Performance (Flush, Clear Lens)

Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	219	437	656	857	1274	1729	2187	2634	3062	3499
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	64.4	70.5	80.0	89.3	86.7	87.8	88.5	88.9	90.6	89.7

*Lumen output for 80CRI - 3500K

COMPLIMENTARY PRODUCTS

Coordinated Apertures | Multiple Layers of Light

General Illumination Layer | EVO

High Center Beam Layer | Incito

EVO + Incito — Multiple Layers of Light

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Issue: **BP4C - KVC IFC & PERMI**

Date: **04-Jun-21**

Project #: DV20131

Type: L4B

gotham | EVO

6" General Illumination Shower Downlight

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Luminaire Type:

Catalog Number:

EXAMPLE: EVO6SH 35/2D DFF SDL MVOLT EZ1O

Series	Color Temperature	Nominal Lumen Values	Lens Setting	Lens	Voltage
EVO6SH	27/ 2700 K 30/ 3000 K 35/ 3500 K 40/ 4000 K 50/ 5000 K	02 250 lumens 05 500 lumens 07 750 lumens 10 1000 lumens 15 1500 lumens 20 2000 lumens 25 2500 lumens 30 3000 lumens 35 3500 lumens 40 4000 lumens	DFR Regressed lensed white painted trim DFF Flush lensed white painted trim DFRBR Regressed lensed black painted trim DFFBR Flush lensed black painted trim DFRAMF Regressed lensed trim with anti-microbial finish DFFAMF Flush lensed trim with anti-microbial finish	SDL Textured Lens SMO Smooth Clear Lens	MVOLT 120 277

Driver[1]	Control Interface	Options
EZ1O eldoLED 0-10V ECOdrive. Linear dimming to 10% min. EZ1 eldoLED 0-10V ECOdrive. Linear dimming to 1% min. EZB eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%. EDAB eldoLED SOLOdrive DALI. Logarithmic dimming to <1%.	NLT[2] nLight dimming pack controls NLTER[2,3] nLight dimming pack controls emergency circuit	SF Single fuse. Specify 120V or 277V. ELR[4] Emergency battery pack, 10W, with remote test switch. E10WCPR[4] Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch BGTD Bodine generator transfer device. Specify 120V or 277V. 90CRI High CRI (90+). CP Chicago Plenum.

ACCESSORIES — order as separate catalog numbers (shipped separately)

SCA6	Sloped ceiling adapter. Degree of slope must be specified (50, 100, 150, 200, 250, 300). Ex: SCA6 100. Refer to TECH-196.
CTA4-8 YK	Ceiling thickness adapter for 8,000lm and below (extends mounting frame to accommodate ceiling thickness up to 5"). Adds ~4" to fixture height.
ISD BC	0-10V wallbox dimmer. Refer to ISD-BC.

ORDERING NOTES

1. Refer to TECH-240 for compatible dimmers.
2. Specify voltage.
3. For use with generator supply EM power. Will require an emergency hot feed and normal hot feed.
4. Not available with CP option.

GOTHAM ARCHITECTURAL DOWNLIGHTING | 1400 Lester Road Conyers, GA 30012 | P 800-705-SERV (7378) | gothamlighting.com

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L4B

gotham | EVO

6" General Illumination Shower Downlight

SPECIFICATIONS

Optical Assembly
Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling.

Unitized optics shall have mechanical attachment of the light engine to the lower reflector for complete optical alignment.

Electrical
The luminaire shall operate from a 50 or 60 Hz ±3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.

The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.

Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.

Input wires shall be 18AWG, 300V minimum, solid copper.

Controls
Luminaire shall be equipped with interface for nLight wired network with integral power supply as per specification.

Dimming
The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.

eldoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.

Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction
Luminaire housing shall be constructed of 16-gauge galvanized steel and have preinstalled telescopic mounting bars with maximum 32" and minimum 15" extension and 4" vertical adjustment.

Luminaires shall be suitable for installation in ceilings up to 1½" thick. (specify ceiling thickness adapter to extend frame to accommodate ceiling thickness up to 5").

Tool-less adjustments shall be possible after installation.

The assembly and manufacturing process for the luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.

25°C ambient temperature standard (1/2" clearance on all sides from non-combustible materials in non-IC applications, unless marked spacing noted otherwise). For use in insulated ceilings, a 3" clearance on all sides from insulation is required (unless marked spacing noted otherwise).

Listings
Fixtures are CSA certified to meet US and Canadian standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, wet location covered ceiling.

Photometrics
LEDs tested to LM-80 standards. Measured by IES/NA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.

Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by a point at the intersection of the CCT line and the black body locus line in CIE chromaticity space.

Warranty
5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

Note:
Actual performance may differ as a result of end user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight® control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

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www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L4B

Tables of Use

DFF SMD - Flush Clear										
Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	219	437	656	857	1274	1729	2187	2634	3062	3499
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	64.4	70.5	80.0	89.3	86.7	87.8	88.5	88.9	90.6	89.7

*Lumen output for 80CRI - 3500K

DFF SOL - Flush Textured										
Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	214	428	642	839	1247	1693	2141	2583	2997	3426
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	62.9	69.0	78.3	87.4	84.8	85.9	86.7	87.1	88.7	87.8

*Lumen output for 80CRI - 3500K

DFR SMD - Flush Clear										
Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	168	336	505	659	980	1330	1682	2038	2355	2651
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	49.4	54.2	61.6	68.6	66.7	67.5	68.1	68.4	69.7	68.0

*Lumen output for 80CRI - 3500K

DFR SOL - Regressed Textured										
Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	162	325	487	636	946	1283	1623	1948	2272	2557
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	47.6	52.4	59.4	66.3	64.4	65.1	65.7	66.0	67.2	66.6

*Lumen output for 80CRI - 3500K

EVO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EWA1	1%	Linear	Linear/Logarithmic
EZ0	<1%	Logarithmic	Linear
EDAB	<1%	Logarithmic	Linear
EXAB	<1%	Logarithmic	Linear
EDXB	<1%	Square	Linear

Lumen Output Multiplier		
CRI	CCT	Multiplier
80	2700K	0.96
	3000K	1.00
	3500K	1.00
	4000K	1.01
	5000K	1.07
90	2700K	0.80
	3000K	0.83
	3500K	0.85
	4000K	0.87
	5000K	0.91

	Driver	Control Provided (note: 347V/UVOLT versions provided with 347 option selected)			
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIRER2
EZ10	0-10V driver dims to 10%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V C2	RPP20 D 24V ER C2
EZ1	0-10V driver dims to 1%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V C2	RPP20 D 24V ER C2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V C2	RPP20 D 24V ER C2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V C2	RPP20 D 24V ER C2
EZ0	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V C2	RPP20 D 24V ER C2

How to Estimate Delivered Lumens in Emergency Mode

Delivered Lumens = 1.25 x P x LPW

P = Output power of emergency driver. P = 10W for PS1055CP

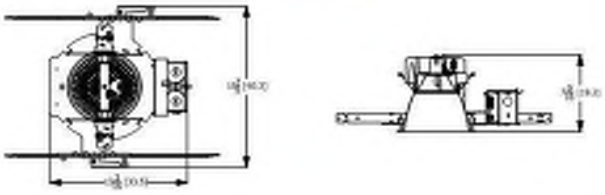
LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet.

DIMENSIONAL DATA

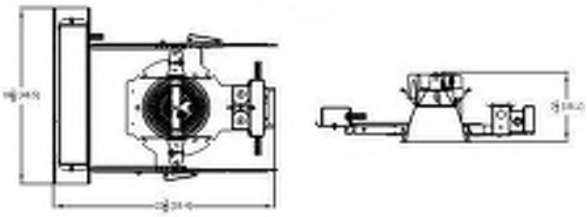
*Dimensions in inches [centimeters]

Aperture: 61/4" [15.9]	Ceiling Opening: 71/8" [18.1] self-flanged
Overlap Trim: 71/2" [19.1]	71/4" [18.4] flangeless

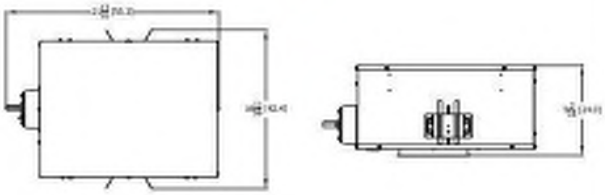
Standard



Battery Pack



CP



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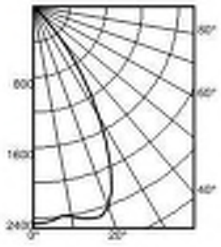
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L4B

Photometry

EV06SH 35/25 AR MWD LS 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 2536.7LM, LPW = 102.7, 1.03 S/MH, TEST NO: LTL27783P2461



Avg	Lumens
0	2468	
5	2432	231
15	2487	698
25	2302	901
35	932	573
45	135	124
55	4	7
65	1	1
75	1	1
85	0	0
90	0	

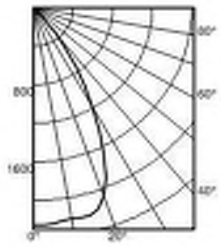
Zone	Lumens	% Lamp
0° - 30°	1830.5	72.2
0° - 40°	2403.3	94.7
0° - 60°	2534.3	99.9
0° - 90°	2536.7	100.0
90° - 180°	0.0	0.0
0° - 180°	2536.7	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	73	69	77	72	68
7	74	68	64	74	68	64	72	67	63
8	70	64	60	69	64	60	68	63	59
9	66	60	56	65	60	56	64	59	56
10	62	56	52	62	56	52	61	56	52

Mounting Height	Initial FC Center Beam	50% beam - 54.4° Diameter	50% beam - 54.4° FC	10% beam - 77.9° Diameter	10% beam - 77.9° FC
8.0	81.6	5.7	40.6	8.9	8.2
10.0	43.9	7.7	21.9	12.1	4.4
12.0	27.4	9.8	13.7	15.3	2.7
14.0	18.7	11.8	9.3	18.6	1.9
16.0	13.5	13.9	6.8	21.8	1.4

EV06SH 35/25 DFF SM0 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 2186.6LM, LPW = 88.5, 1 S/MH, TEST NO: LTL29886P477



Avg	Lumens
0	2259	
5	2248	213
15	2231	622
25	1677	756
35	745	462
45	121	109
55	14	14
65	6	6
75	3	3
85	0	1
90	0	

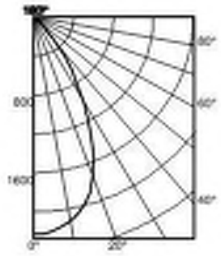
Zone	Lumens	% Lamp
0° - 30°	1590.7	72.7
0° - 40°	2053.0	93.9
0° - 60°	2178.1	99.5
0° - 90°	2186.6	100.0
90° - 180°	0.0	0.0
0° - 180°	2186.6	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	85	80	89	84	80	87	82	79
5	84	79	74	83	78	74	82	77	73
6	79	73	69	78	73	69	77	72	68
7	74	68	64	74	68	64	72	67	64
8	70	64	60	70	64	60	68	63	60
9	66	60	56	66	60	56	65	60	56
10	63	57	53	62	57	53	61	56	53

Mounting Height	Initial FC Center Beam	50% beam - 52.4° Diameter	50% beam - 52.4° FC	10% beam - 76.8° Diameter	10% beam - 76.8° FC
8.0	74.7	5.4	37.3	8.7	7.5
10.0	40.2	7.4	20.1	11.9	4.0
12.0	25.0	9.3	12.5	15.1	2.5
14.0	17.1	11.3	8.5	18.2	1.7
16.0	12.4	13.3	6.2	21.4	1.2

EV06SH 35/25 DFF S0L 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 2140.5LM, LPW = 86.6, 0.9 S/MH, TEST NO: LTL29885P477



Avg	Lumens
0	2235	
5	2207	208
15	1991	552
25	1380	626
35	652	411
45	212	173
55	82	76
65	50	50
75	31	33
85	8	10
90	0	

Zone	Lumens	% Lamp
0° - 30°	1386.4	64.8
0° - 40°	1797.0	84.0
0° - 60°	2046.8	95.6
0° - 90°	2138.9	99.9
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.7	0.0
90° - 180°	1.8	0.1
0° - 180°	2140.5	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	110	107	104	107	105	103	103	101	99
2	101	96	93	99	95	92	96	92	89
3	93	88	83	92	87	83	89	85	81
4	87	81	76	85	80	75	83	78	74
5	81	74	70	80	74	69	78	73	69
6	75	69	64	74	68	64	73	68	64
7	71	64	60	70	64	59	69	63	59
8	66	60	56	66	60	55	65	59	55
9	62	56	52	62	56	52	61	55	52
10	59	53	49	59	53	49	58	52	49

Mounting Height	Initial FC Center Beam	50% beam - 47.8° Diameter	50% beam - 47.8° FC	10% beam - 76.7° Diameter	10% beam - 76.7° FC
8.0	73.9	4.9	36.9	8.7	7.4
10.0	39.7	6.6	19.9	11.9	4.0
12.0	24.6	8.4	12.4	15.0	2.5
14.0	16.9	10.2	8.5	18.2	1.7
16.0	12.3	12.0	6.1	21.4	1.2

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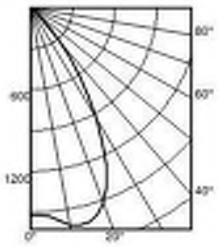
Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L4B

Photometry

EV06SH 35/25 DFR SM0 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 1682LM, LPW = 68, 1.08 S/MH, TEST NO: LTL29888P477



Ave	Lumens
0	1624
5	1638
15	1624
25	1278
35	814
45	117
55	11
65	5
75	2
85	1
90	0

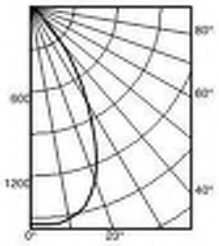
Zone	Lumens	% Lamp
0° - 30°	1176.6	69.9
0° - 40°	1558.9	92.7
0° - 60°	1673.7	99.5
0° - 90°	1682.1	100.0
90° - 180°	0.0	0.0
0° - 180°	1682.1	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	20% 70% 50%	20% 70% 30%	20% 70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	108	106	104	104	103	101
2	103	99	95	101	97	94	98	95	92
3	96	91	87	94	90	86	92	88	85
4	89	84	79	88	83	79	86	82	78
5	83	78	73	83	77	73	81	76	72
6	78	72	68	77	72	68	76	71	67
7	73	67	63	73	67	63	71	66	62
8	69	63	59	68	63	59	67	62	58
9	65	59	55	64	59	55	63	58	55
10	61	55	51	61	55	51	60	55	51

Mounting Height	Intial FC Center Beam	50% beam - 58.3° Diameter	50% beam - 58.3° FC	10% beam - 79.5° Diameter	10% beam - 79.5° FC
8.0	50.4	5.8	25.2	9.2	5.0
10.0	27.1	7.9	13.5	12.5	2.7
12.0	16.9	10.0	8.4	15.8	1.7
14.0	11.5	12.1	5.8	19.1	1.2
16.0	8.4	14.2	4.2	22.5	0.8

EV06SH 35/25 DFR SOL 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 1623.2LM, LPW = 66.7, 0.97 S/MH, TEST NO: LTL29887P477



Ave	Lumens
0	1549
5	1549
15	1460
25	1081
35	538
45	177
55	60
65	34
75	16
85	2
90	0

Zone	Lumens	% Lamp
0° - 30°	1003.2	63.7
0° - 40°	1369.7	84.4
0° - 60°	1570.9	96.8
0° - 90°	1623.2	100.0
90° - 180°	0.0	0.0
0° - 180°	1623.2	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	20% 70% 50%	20% 70% 30%	20% 70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	113	107	105	108	105	103	104	102	100
2	101	97	93	99	95	92	96	93	90
3	94	88	84	92	87	83	89	85	82
4	87	81	78	86	80	78	83	78	75
5	81	74	70	80	74	69	78	73	69
6	75	69	64	74	68	64	73	67	63
7	70	64	59	70	64	59	68	63	59
8	66	60	55	65	59	55	64	59	55
9	62	56	52	62	56	51	61	55	51
10	59	52	48	58	52	48	57	52	48

Mounting Height	Intial FC Center Beam	50% beam - 58.6° Diameter	50% beam - 58.6° FC	10% beam - 79.3° Diameter	10% beam - 79.3° FC
8.0	51.1	5.2	25.6	9.1	5.1
10.0	27.5	7.1	13.7	12.4	2.7
12.0	17.1	9.0	8.6	15.7	1.7
14.0	11.7	10.9	5.8	19.1	1.2
16.0	8.5	12.8	4.2	22.4	0.8

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L4B

gotham | EVO

6" General Illumination Shower Downlight

NLIGHT AIR

nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR rPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

nLight® AIR Control Accessories

Order as separate catalog number. Visit nLight AIR.

Wall Switches	Model Number
On/Off single pole	rPODB (color) G2
On/Off two pole	rPODB 2P (color) G2
On/Off & raise/lower single pole	rPODB DX (color) G2
On/Off & raise/lower two pole	rPODB 2P DX (color) G2

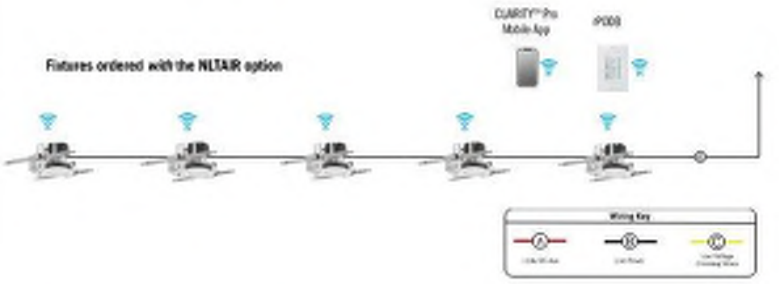
nLight® AIR Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	rCMS 9 / rCMS PDT 9
Large motion 360°, ceiling	rCMS 10 / rCMS PDT 10

Possibilites for nLight® AIR

Fixtures ordered without the NLTAIR option

Fixtures ordered with the NLTAIR option



NLIGHT

nLight® Wired The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

nLight® Wired Control Accessories

Order as separate catalog number. Visit nLight.

Wall Switches	Model Number
On/Off single pole	nPODM XX
On/Off two pole	nPODM 2P XX
On/Off & raise/lower single pole	nPOD DX XX
On/Off & raise/lower two pole	nPODM 2P DX XX
Graphic touchscreen	nPOD GFX XX
Photocell Controls	
Dimming	nCM ADCX

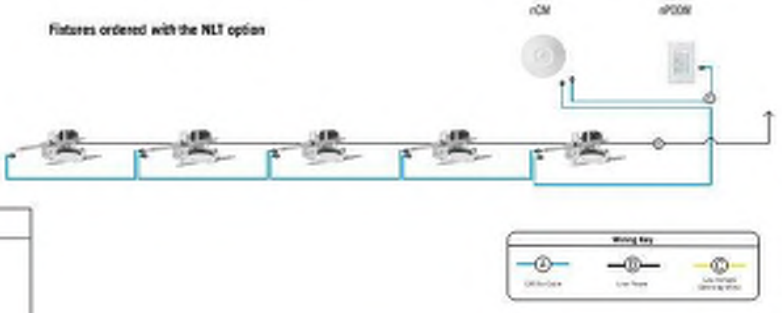
nLight® Wired Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

Possibilites for nLight® wired

Fixtures ordered without the NLT option

Fixtures ordered with the NLT option



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gotham® | E V O®

Multiple Layers of Light

Luminaire Type:

Catalog Number:

Buy American

General Illumination Pendant Stem Cylinder 4"

OVERVIEW

Feature Set

- Batwing distribution with feathered edges provides even illumination on horizontal and vertical surfaces
- Bounding Ray™ optical design
- 45° cutoff to source and source image
- Fully serviceable lensed LED light engine
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- Fixtures are damp location standard; wet location option (WL)
- 20 standard colors in textured and gloss finish; custom or RAL colors also available
- Field cuttable 1/2" stems with concealed couplers.
- Multiple recessed or surface j-box mounting configurations available
- ENERGY STAR® Certified product

Distribution

Superior Performance

Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000	4500	5000
Delivered Lumens	271	573	808	1001	1527	1994	2580	3130	3612	4120	4584	5045
Wattage	3.1	7.2	7.9	8.8	13.7	19.5	25.7	31.2	38.4	35.4	40.1	44.7
Lumens per Watt	87.4	79.6	102.3	113.8	111.5	102.3	100.4	99.7	94.1	116	114	113

COMPLEMENTARY PRODUCTS

Coordinated Apertures | Multiple Layers of Light

General Illumination Layer | EVD

High Center Beam Layer | Incito

EVD + Incito — Multiple Layers of Light

Core

Healthcare

Special Applications

me engineers

STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L5

gotham | EVO

4" General Illumination Pendant Stem Cylinder

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Luminaire Type:

Catalog Number:

EXAMPLE: EVD4PC 35/15 AR MWD LSS MVOLT EZ1 JBXCC PCAN S12 DWHG

Series		Color Temperature		Lumens		Reflector Color		Distribution		Reflector Finish		Voltage	
EVD4PC	EVO 4 in Pendent Stem Round Cylinder Open Downlight	27/	2700 K	02	250 lumens	AR	Clear	MD	Medium (0.9 s/mh)	LSS	Semi-specular	MVOLT	120V - 277V
		30/	3000 K	05	500 lumens	PR	Pewter	MWD	Medium wide (1.0 s/mh)	LD	Matte diffuse	120	120V
		35/	3500 K	07	750 lumens	WTR	Wheat	WD	Wide (1.2 s/mh)	LS	Specular	277	277V
		40/	4000 K	10	1000 lumens	GR	Gold					347[3]	347V
		50/	5000 K	15	1500 lumens	WR[1]	White painted						
				20	2000 lumens	BR[1]	Black						
				25	2500 lumens	WRAMF[1]	White Anti-microbial						
				30	3000 lumens	BZR[1]	Dark Bronze painted						
				35	3500 lumens								
				40	4000 lumens								
				45	4500 lumens								
				50	5000 lumens								

Driver[2]		Mounting		Canopy Type		Stem Length[3]	
GZ10	0-10V driver dims to 10%	JBX	Integral driver, Recessed or Surface J-Box	PCAN	5" Stem canopy with "hang straight" swivel	S2	2 foot 1/2" stem
GZ1	0-10V driver dims to 1%	JBXCC	Integral driver, Surface J-Box with Conduit Covers	PCAN45[1]	45° Stem canopy with "hang straight" swivel	S4	4 foot 1/2" stem
EZ10	eldoLED 0-10V ECOdrive. Linear dimming to 10% min.	SGB[1]	Surface Gear Box, Recessed Or Surface J-Box			S6	6 foot 1/2" stem
EZ1	eldoLED 0-10V ECOdrive. Linear dimming to 1% min.	SGBCC[2]	Surface Gear Box, Surface J-Box With Conduit Covers			S8	8 foot 1/2" stem
EZB	eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%.	RGH	Recessed Gear Housing			S10	10 foot 1/2" stem
EDAB[4]	eldoLED SOLOdrive DALI. Logarithmic dimming to <1%.					S12	12 foot 1/2" stem
EDXB[4,5]	eldoLED POWERdrive DMX with RDM (remote device management). Square Law dimming to <1%. Min: 1000LM; Max: 4000LM.						
ECOS2[4]	Lutron® Hi-Lume® 2-wire forward-phase driver. 120V Only. Minimum dimming level 1%. Min: 1000LM; Max: 2500LM.						
ECOD[4]	Lutron® EcoSystem® digital Hi-Lume 1% soft-on, fade to black. Max: 4000LM.						
ELV[6]	Electronic line voltage (120V only)						

Control Interface[6]		Options		Architectural Colors - Powder Paint[11]			
(blank)	No controls	SF	Single fuse. Specify 120V or 277V.	DDB	Gloss Dark Bronze	DDBT	Textured Dark Bronze
NLT	nLight® dimming pack. Specify 120V or 277V	90CRI	High CRI (90+)	DBL	Matte Black	DBLB	Textured Black
NLTER[11]	nLight® dimming pack for fixtures on emergency circuit. Specify 120V or 277V	NBO	nLight Lumen Compensation	DWH	Gloss White	DWHG	Textured White
NLTAIR2	nLight® AIR dimming pack. Specify 120V or 277V	HAO[12]	HAO High Ambient Option (40°C)	DMB	Matte Medium Bronze	DBNH	Textured Bronze
NLTAIRER2[11]	nLight® AIR dimming pack for fixtures on emergency circuit. Specify 120V or 277V	WL[13]	Wet Location	DNA	Gloss Natural Aluminum	DNAT	Textured Natural Aluminum
		E10WCPR	Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch (requires RGH)	DSS	Gloss Sandstone	DSST	Textured Sandstone
		CP[11]	Chicago Plenum. Specify 120V or 277V (requires RGH)	DGC	Gloss Charcoal Grey	DSPD	Textured Dark Grey
		GTD	IOTA Generator Transfer Device. Specify 120V or 277V (requires RGH)	DTG	Gloss Tennis Green	DSPE	Textured Green
				DBR	Gloss Bright Red	DSPH	Textured Light Red
				DSB	Gloss Steel Blue	DWHAMF	Gloss White with Anti-microbial finish

ACCESSORIES — order as separate catalog numbers (shipped separately)	
EVDLORS KIT	Architectural colors chip kit, consisting of powder-coat and plated finishes
CYLJBOXADPT 4SQ2OCT __	4in Square J-box to 4in Octagonal J-box adaptor. Replace __ with Architectural Color or PRM for primed ready for field painting
CYLSTBL KIT	Stabilization Kit for securing pendant stem fixtures

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L5

ORDERING INFORMATION

ORDERING NOTES

1. Not Available with Finishes.
2. Factory supplied step down transformer must be remote mounted. Access required to location of remote mounted device.
3. Refer to Tech 240 for compatible dimmers.
4. Not Available with Control Interfaces.
5. Requires SGB, or SGBCC mounting option.
6. Includes terminator resistor.
7. Only available with DMX driver (ED8B).
8. Not available with SGB or SGBCC; these mountings require a flat ceiling.
9. Stem section adjacent to cylinder can be cut in field to achieve non-uniform lengths (i.e. for a field cut 3' length, order 4' stem).
10. Factory installed with RGH option otherwise field installed. Access required to location of remote mounted device.
11. ER for use as UL924 Emergency Operation via power sense lead. Will require an emergency hot feed and normal hot feed. EM for use as UL924 Emergency Operation via power interrupt detection.
12. Only available up to 2500 lumens; not available with WL or ECOS2.
13. Not available with JBXCC, SGB, or SGBCC. Max: 3000LM.
14. For details on RAL and Custom colors please see Architectural colors.
15. CP not valid with NLDIMR2, NLTAIRER2 or E10WCPR.

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Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L5

gotham | EVO

4" General Illumination Pendant Stem Cylinder

SPECIFICATIONS

Optical Assembly
Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling.
Optical design is a Bounding Ray™ design with 45° cutoff to source and source image. Top down flash characteristic for superior glare control.

Electrical
The luminaire shall operate from a 50 or 60 Hz ±3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. Support 347V via remote-mounted stepdown transformer. The fluctuations of line voltage shall have no visible effect on the luminous output.
The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.
Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.
Input wires shall be 18AWG, 300V minimum solid copper.

Controls
Luminaire shall be equipped with interface for nLight wired or nLight AIR networks with integral power supply as per specification.

Emergency
Luminaires supplied with a battery pack comply with NFPA 101 (Life Safety code) and deliver constant light output throughout the 90 minutes of code required emergency operation period when there is a normal AC power loss.
Luminaires equipped with a generator transfer device work in conjunction with an auxiliary generator or a central inverter system to power fixtures for safe egress lighting.

Dimming
The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.
eldoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.
Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction
Heavy-gauge aluminum construction. Extruded cylinder body with flangeless reflector allows flow-through passive thermal management. Canopy matches cylinder in finish and diameter.
Pendant stem mount for installation to 4" recessed or surface octagonal junction box with integral driver.
Recessed gear box available for driver above ceiling, nLight, battery pack, CP, and GTD options.
Surface gear box available for driver at ceiling installation.
Optional field configurable conduit covers available. Conduit covers match cylinder in finish and diameter.
WARNING: All pendant fixtures exposed to wind require tethering – contact factory.

Listings
Fixtures are CSA Certified to meet US and Canadian Standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, damp location standard; wet location covered ceiling optional (WL).
Luminaire configurations are Energy Star certified through testing in EPA–recognized laboratories, with the results reviewed by an independent, accredited certification organization. Visit www.energystar.gov for specific configurations listed.

Photometrics
LEDs tested to LM-80 standards. Measured by IESNA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.
Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by the center of the quadrangles defined in ANSI C78.377-2015.

Buy American
This product is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT. Please refer to www.acuitybrands.com/buy-american for additional information.

Warranty
5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Note:
Actual performance may differ as a result of end user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.
- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight® control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.
*See ordering tree for details

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

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Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L5

gotham | EVO

4" General Illumination Pendant Stem Cylinder

Tables of Use

EVO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EZ8	<1%	Logarithmic	Linear
EDAB	<1%	Logarithmic*	Linear
EDXB	<1%	Square	Linear

*Changable through DALI controller

Lumen Output Multiplier		
CRI	CCT	Multiplier
80	2700K	0.906
	3000K	0.968
	3500K	1
	4000K	1.037
	5000K	1.1
90	2700K	0.748
	3000K	0.8
	3500K	0.838
	4000K	0.845
	5000K	0.945

Reflector Finish Multiplier	
Reflector Finish	Multiplier
LS - Specular	1
LSS - Semi Specular	0.956
WR - White	0.87
LD - Matte Diffuse	0.85
BR - Black	0.73
BZR - Bronze	0.73

Distributions		
Nomenclature	Beam Angle	Field Angle
NFD	54	82
MWD	67	89
WD	71	92

	Driver	Control Provided (note: 347V/UVOLT versions provided with 347 option selected)			
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIRER2
GZ10	0-10V driver dims to 10%	nPP16 D ETP	nPP16 D ER ETP	RPP20 D 24V E2	RPP20 D 24V ER E2
GZ1	0-10V driver dims to 1%	nPP16 D ETP	nPP16 D ER ETP	RPP20 D 24V E2	RPP20 D 24V ER E2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V E2	RPP20 D 24V ER E2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V E2	RPP20 D 24V ER E2
EZ8	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V E2	RPP20 D 24V ER E2

J-box Compatibility Matrix		Cylinder Configurations					
		JBX	SQB	SQBCC	SQB w/EDXB Driver	SQBCC w/EDXB Driver	JBXCC
Recommended J-box (by others)	4" Octagonal 4x4x1.5 deep*	✓	✓	✓	✓	✓	✓
	4" Octagonal 4x4x2.125 deep	✓	✓	✗	✓	✗	✗
	4" Square 4x4x1.5 deep	✓ *with adaptor plate accessory	✓ *with adaptor plate accessory	✗	✓ *with adaptor plate accessory	✗	✗

Standard Architectural Color Options for Cylinder Bodies

DSS P12 LITHONIA Sandstone
DSST P90 TEXTURED Sandstone
DBR P34 LITHONIA Bright Red
DSPH P80 TEXTURED Light Red
DMB P11 LITHONIA Medium Bronze
DBNH P24 TEXTURED Bronze
DTG P33 LITHONIA Tennis Green
DSPE P70 TEXTURED Green
DSB P49 LITHONIA Steel Blue
DNA P07 LITHONIA Natural Aluminum
DNAT P99 TEXTURED Natural Aluminum
DGC P32 LITHONIA Charcoal Gray
DSPD P77 TEXTURED Dark Gray
DDB P50 LITHONIA Dark Bronze
DDBT P66 TEXTURED Dark Bronze
DBL P10 LITHONIA Black
DBLB P75 TEXTURED Black
DWH P21 LITHONIA White
DWHG P86 TEXTURED White

NOTE: These colors were carefully reproduced to give as true a depiction as possible of finished product color. Some colors, however, may vary slightly from actual appearance due to display/printing variations and limitations. Please always contact a Gotham representative for an accurate paint chip sample.

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L5

SPECIFICATIONS

Stabilization Kit (CYLSTBL KIT) Accessory
The Stabilization Kit offers additional support for applications where wind may be a factor and the pendant stem cylinder needs to be secured.

Cables
Three (3) 20 ft. 304 grade stainless steel aircraft cables with outer diameters of 1/16" are attached to anchoring mechanisms in the mounting surface at one end and the provided stem collar around the pendant stem at the other end.

Cables should be anchored 120° +/- 10° from each other radially and positioned at 45° or greater from the stem for optimal support of the fixture.

Clamps and Stem Collars
The stem collar consists of two (2) half stem collars made of 304 stainless steel. Both stem collar halves are attached around the pendant stem with 304 stainless steel socket head cap screws.

Six (6) cable clamps made of 304 stainless steel are used in the stabilization kit with two (2) clamps per cable attached to each anchoring point and the stem collar.

The cable tension can be adjusted from either end.

Wind Load
The Stabilization Kit is designed to withstand 90mph winds for 3 seconds comparable to ASCE 7-10, MRI 50-year (fixture EPA is 0.2 sq ft)

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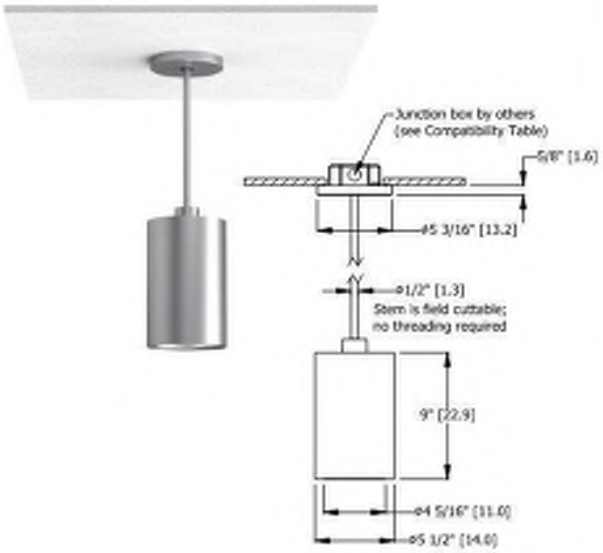
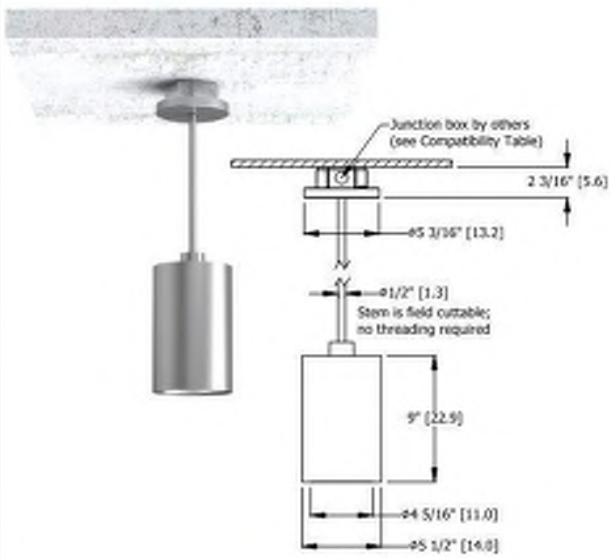
DIMENSIONAL DATA

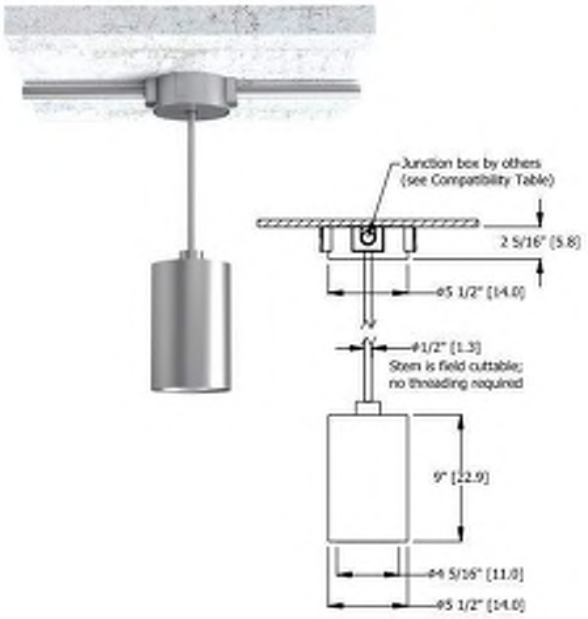
JBX Recessed J-Box



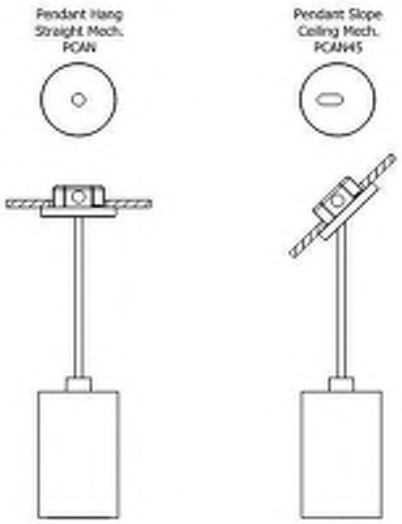
JBX Surface J-Box



JBXCC Surface J-Box with Conduit Covers



Stem_PCAN vs PCAN45



*Dimensions in inches [centimeters]

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Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

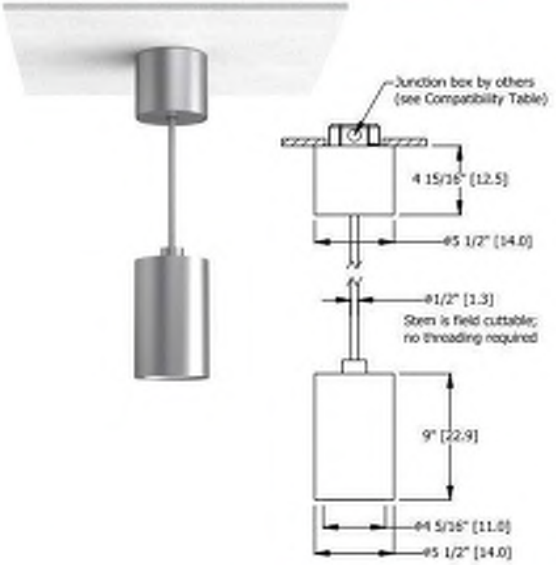
Type: L5

gotham | EVO

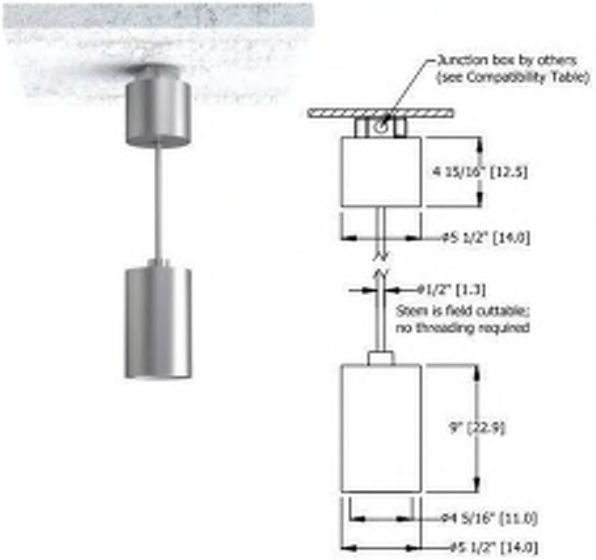
4" General Illumination Pendant Stem Cylinder

DIMENSIONAL DATA

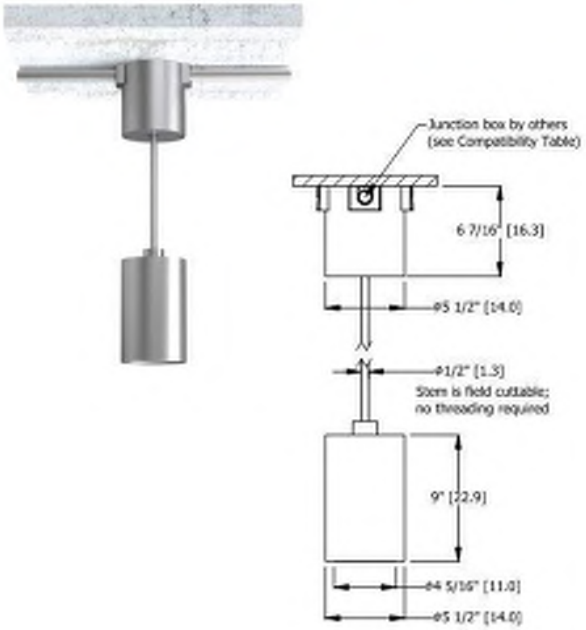
SGB Surface Gear Box for EDXB recessed J-box



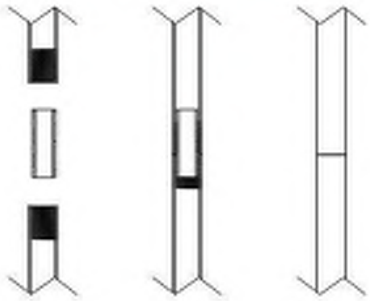
SGB Surface Gear Box for EDXB surface J-box



SGBCC Surface Gear Box for EDXB with Conduit Covers



Stem Connection Method



*Dimensions in inches [centimeters]

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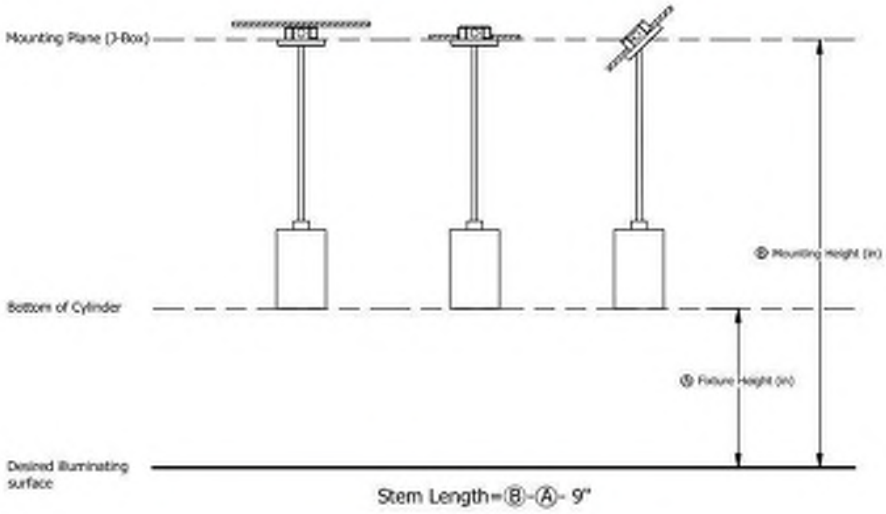
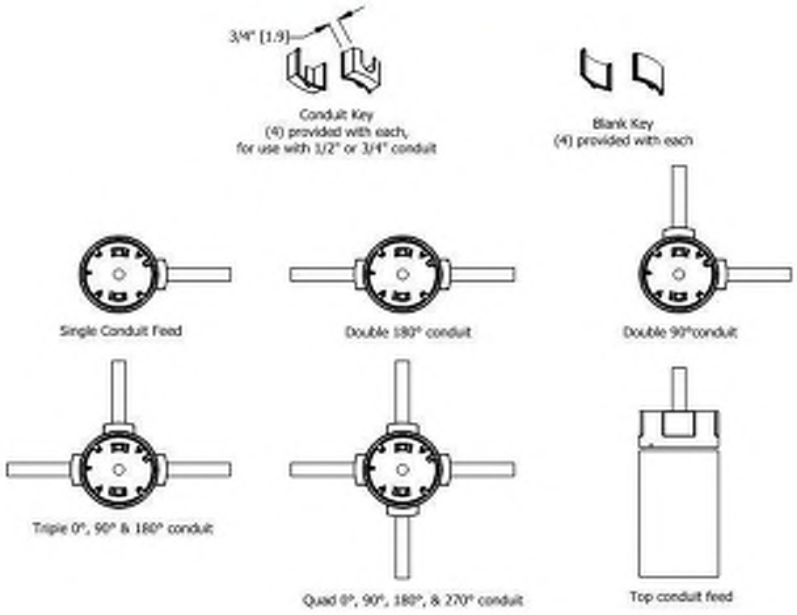
Type: L5

DIMENSIONAL DATA

Stem Cutting Formulas for JBX/JBXCC



Conduit Feed Examples and Keys



*Dimensions in inches [centimeters]

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

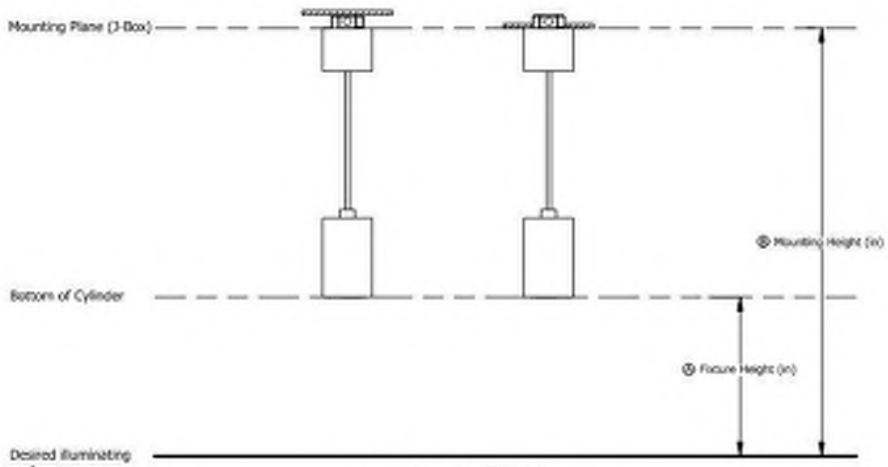
14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L5

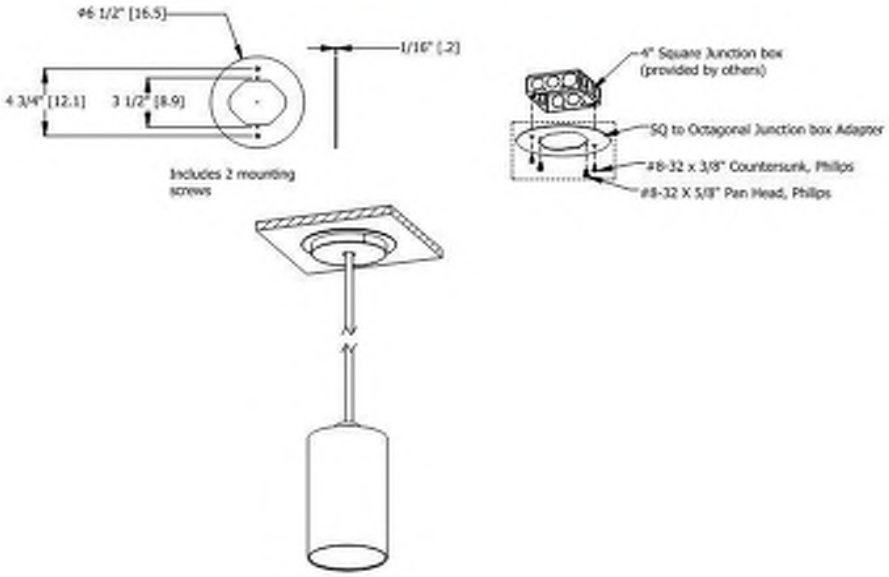
DIMENSIONAL DATA

Stem Cutting Formulas for SGB



Stem Length=Ⓑ-Ⓐ- 13"

Cylinder Adaptor Plate



*Dimensions in inches [centimeters]

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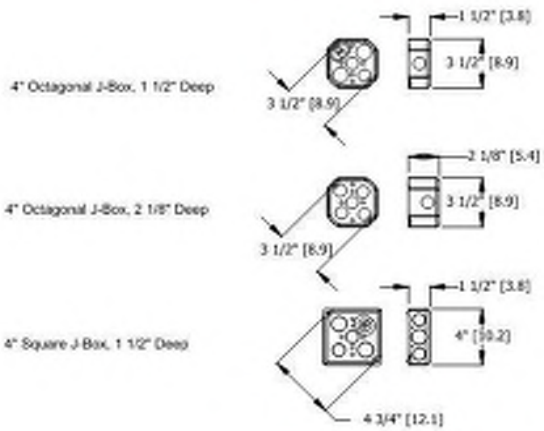
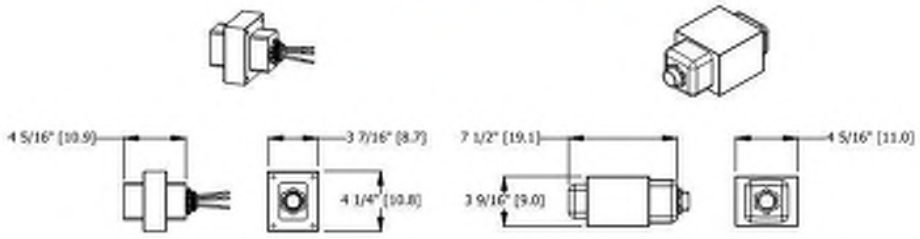
DIMENSIONAL DATA

Junction Box Dimensions (by others)



347V Stepdown Transformer



347 Transformer:
Up to 6000LM
Install to accessible
junction box by others

347 Transformer:
8000LM and up
Install to accessible
junction box by others

*Dimensions in inches [centimeters]

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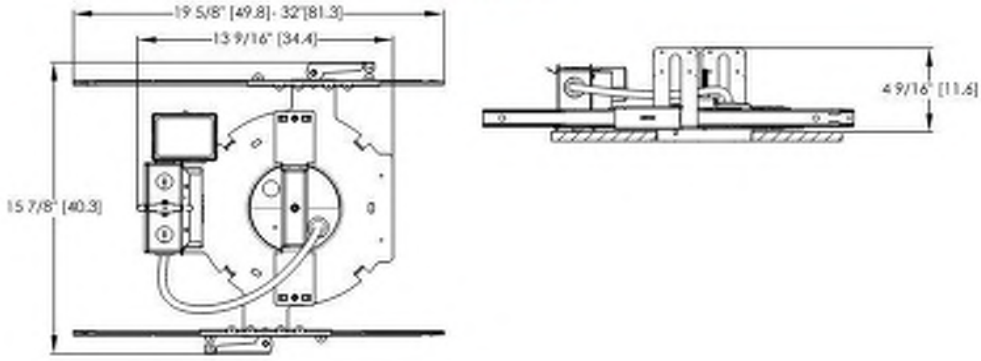
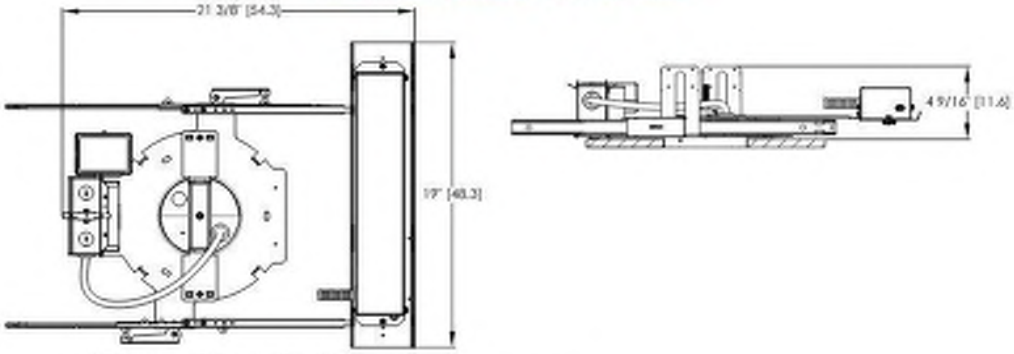
DIMENSIONAL DATA

RGH Standard



Ceiling thickness range: 1/2" [1.3] to 3" [7.6]
Ceiling cutout: 5 1/16" [12.9]

RGH with Battery Backup (E10WCPR) Standard



With Emergency Battery or GTD option
Minimum plenum height for emergency batteries in non-accessible ceilings: 12 1/2" [31.8]
Ceiling thickness range: 1/2" [1.3] to 3" [7.6]
Ceiling cutout: 5 1/16" [12.9]

*Dimensions in inches [centimeters]

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

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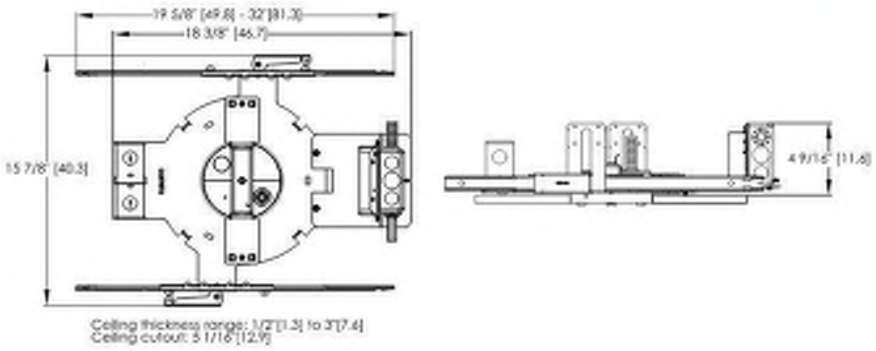
Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

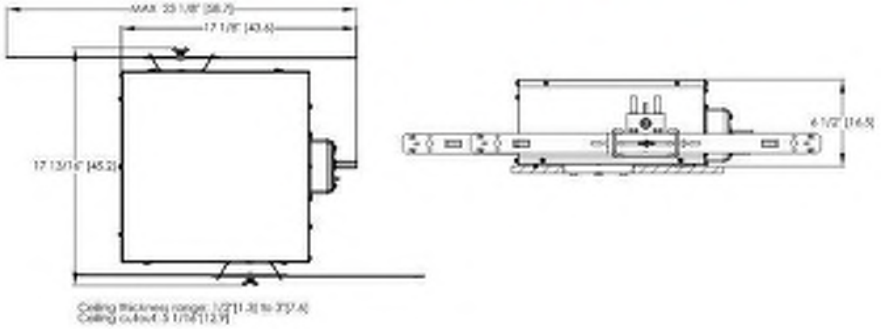
Type: L5

DIMENSIONAL DATA

RGH CP Standard



RGH with Chicago Plenum (CP) for use with nLight Enclosed



*Dimensions in inches [centimeters]

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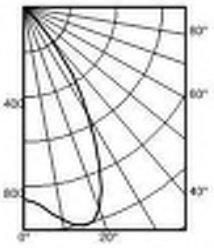
Date: **04-Jun-21**
Project #: DV20131

Type: L5

Photometry

CONSULT WWW.GOTHAMLIGHTING.COM FOR ADDITIONAL PHOTOMETRY.

EV04PC 35/10 MWD LS INPUT WATTS: 8.8W, DELIVERED LUMENS: 1001.7LM, LPW = 113.8, 1.08 S/MH, TEST NO. LTL27786P



	Ave	Lumens
0	856	
5	886	87
15	1010	280
25	775	350
35	363	225
45	61	56
55	2	2
65	1	1
75	0	0
85	0	0
90	0	

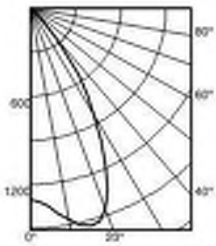
Zone	Lumens	% Lamp
0° - 30°	717.4	71.6
0° - 40°	942.0	94.0
0° - 60°	1000.8	99.9
0° - 90°	1001.7	100.0
90° - 180°	0.0	0.0
0° - 180°	1001.7	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	119	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Initial FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	28.3	5.9	14.1	9.2	2.8
10.0	15.2	8.1	7.6	12.5	1.5
12.0	9.5	10.3	4.7	15.9	0.9
14.0	6.5	12.4	3.2	19.2	0.6
16.0	4.7	14.6	2.3	22.5	0.5

EV04PC 35/15 MWD LSS INPUT WATTS: 13.7W, DELIVERED LUMENS: 1527.3LM, LPW = 111.4, 1.08 S/MH, TEST NO. LTL27786P



	Ave	Lumens
0	1305	
5	1354	133
15	1539	428
25	1181	533
35	553	342
45	93	86
55	2	4
65	1	1
75	0	0
85	0	0
90	0	

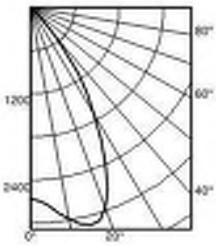
Zone	Lumens	% Lamp
0° - 30°	1093.9	71.6
0° - 40°	1436.2	94.0
0° - 60°	1525.8	99.9
0° - 90°	1527.3	100.0
90° - 180°	0.0	0.0
0° - 180°	1527.3	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Initial FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	43.2	5.9	21.6	9.2	4.3
10.0	23.2	8.1	11.6	12.5	2.3
12.0	14.5	10.3	7.2	15.9	1.4
14.0	9.9	12.4	4.9	19.2	1.0
16.0	7.2	14.6	3.6	22.5	0.7

EV04PC 35/30 MWD LSS INPUT WATTS: 31.2W, DELIVERED LUMENS: 3110.6LM, LPW = 99.6, 1.08 S/MH, TEST NO. LTL27786P



	Ave	Lumens
0	2659	
5	2758	271
15	3135	871
25	2406	1086
35	1126	697
45	189	175
55	5	7
65	2	2
75	0	1
85	0	0
90	0	

Zone	Lumens	% Lamp
0° - 30°	2227.9	71.6
0° - 40°	2925.0	94.0
0° - 60°	3107.6	99.9
0° - 90°	3110.6	100.0
90° - 180°	0.0	0.0
0° - 180°	3110.6	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Initial FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	67.9	5.9	43.9	9.2	6.8
10.0	47.3	8.1	23.6	12.5	4.7
12.0	29.5	10.3	14.7	15.9	2.9
14.0	20.1	12.4	10.1	19.2	2.0
16.0	14.6	14.6	7.3	22.5	1.5

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L5

gotham | EVO

4" General Illumination Pendant Stem Cylinder

NLIGHT AIR

nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR rPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

nLight® AIR Control Accessories

Order as separate catalog number. Visit nLight AIR.

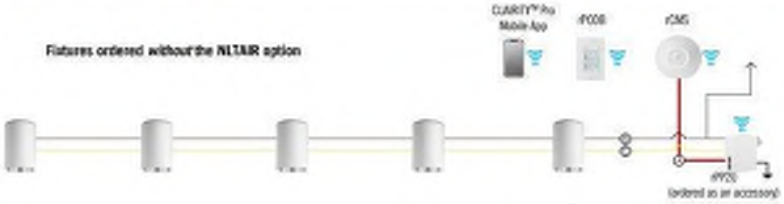
Wall Switches	Model Number
On/Off single pole	rPODB (color) G2
On/Off two pole	rPODB 2P (color) G2
On/Off & raise/lower single pole	rPODB DX (color) G2
On/Off & raise/lower two pole	rPODB 2P DX (color) G2

nLight® AIR Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	rCMS 9 / rCMS PDT 9
Large motion 360°, ceiling	rCMS 10 / rCMS PDT 10

Possibilites for nLight® AIR

Fixtures ordered without the NLTAIR option



Fixtures ordered with the NLTAIR option

NLIGHT

nLight® Wired The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

nLight® Wired Control Accessories

Order as separate catalog number. Visit nLight.

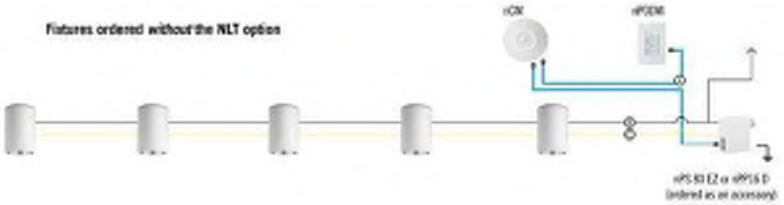
Wall Switches	Model Number
On/Off single pole	nPODM (00)
On/Off two pole	nPODM 2P (00)
On/Off & raise/lower single pole	nPOD DX (00)
On/Off & raise/lower two pole	nPODM 2P DX (00)
Graphic touchscreen	nPOD GPX (00)
Photocell Controls	
Dimming	nCM ADCX

nLight® Wired Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

Possibilites for nLight® wired

Fixtures ordered without the NLT option



Fixtures ordered with the NLT option

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L5

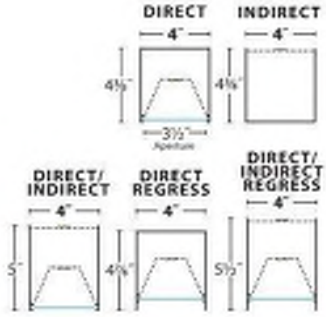
BionicPro4 | Linear

PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

Technical Questions

CLICK HERE



5 YEAR

Made in the USA

Lumen output may vary +/- 5%
Light Loss Factor (LLF) for CCTs other than 3500K:
4000K +2%, 3000K -5%, 2700K -20%
90 CRI -15% (3K, 3500K, 4K & 5K
ADC -2% LLF
See LED Details PDF for more info

UPTO 127 LM/W

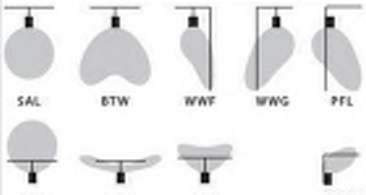
DIRECT:		LO	MO	SO	HO
BTW	Lm/Ft	470	685	950	1200
SAL	Lm/Ft	435	640	885	1100
WWF	Lm/Ft	500	750	1025	1325
WWG/PFL	Lm/Ft	500	750	1000	1275
	W/Ft	4	6	8	10.5
INDIRECT:		LO	MO	SO	HO
SYM	Lm/Ft	625	850	1125	1400
HCW	Lm/Ft	315	475	660	825
SCW	Lm/Ft	575	875	1170	1450
SACW	Lm/Ft	500	750	1000	1200
	W/Ft	4	6	8	10.5
DIRECT / INDIRECT:					
	W/Ft	8	12	16	21

LUMEN CHART AT 3500K-80 CRI

What distinguishes BionicPro?

2" - 3" - 4" - 5" luminaires with a seamless lens for clean lines of light and no light leaks, anywhere. Fantastic optical performance via our TruBeam™ technology delivering the industry's best batwing with remarkably soft, even illumination and low glare (UGR <19), a vastly improved Ceiling Wash, two wall washes to fit your design intent, our Perimeter Fill to wash corridors with light from one side, all with just a lens change.

SERIES	LENS POS.	LED COLOR	OUTPUT	NOM. LENGTH	FINISH COLOR	LOUVER COLOR	DISTRIBUTION	UP OPTIONS	CIRCUITING	VOLTAGE	MOUNTING	CEILING SYSTEMS	DRIVERS	OPTIONS & CONTROL SENSORS
BPro4-Lin			–				–							
Bionic Point Linear	FLSH Flush Lens REG.5 ½" Regress LVR ½" Regress with Louver	LED27 2700K (90CRI) LED3 3000K LED35 3500K LED4 4000K LED3-90 3000K (90CRI) LED35-90 3500K (90CRI) LED4-90 4000K (90CRI) LED5-90 5000K (90CRI)	LO Low MO Medium SO Standard HO High PROG Programmable Light Output (Specify desired lm/ft or w/ft) SPECIFY DOWN THEN UP IF DIFFERENT OUTPUT DESIRED	2" 3" 4" 5" 6" 7" 8" R___ (Row Length, 1" increments) SRL Symmetric Row Length (See page 7) NOTE: Individual fixtures are NOT intended for row mounting	TMW Textured Matte White (Standard) YGW Gloss White Y___ Premium Color CC Custom Color	YBK Black Matte (Standard) TMW Textured Matte White YGW Gloss White Y___ Premium Color CC Custom Color	CHOOSE DOWN –AND– UP DOWN: NW No Downlight, SAL Satin Lens, BTW Batwing, WWF Flat Wall Wash, WWG Focal Glow Wall Wash, PFL Perimeter Fill (Wall mounted) UP: NU No Uplight, HCW Hard Ceiling Wash, SYM Symmetric (Tested ADC standard), SCW Soft Ceiling Wash, SACW Soft Asymmetric Ceiling Wash	TG Top Glow ADC Acrylic Dust Cover (Clear) (Standard for SYM) (Frosted) TGADC Top Glow with Acrylic Dust Cover UP OPTIONS AVAILABLE WITH ANY UP DISTRIBUTION	SC Single Circuit (Down & Up will dim together) DC Dual Circuit (Needed if dimming Down separately from Up)	UNV (120-277) 347 (Emergency battery requires remote driver box)	CA48", 96" or 144" Aircraft Cable (Adjustable) SUR Surface Mount (Direct only) WM Direct to Wall WS ½" Wall Spacer WS2 2" Wall Spacer WBx.x Wall Bracket (2"-6" in .5" increments, 3" standard if not specified)	X1 T-Bar X3 Hard Ceiling X6 Slot Grid	ND Non-Dimming DM01 0-10v, 1% Dimming (Standard) LDES S-Series EcoSystem LED LDE1 Hi-lume 1% EcoSystem LED (Soft fade on, fade-to-black dimming) ECO 1% 0-10v, EldoLED (Logarithmic dimming std) ECDA 1% DALI, EldoLED (Logarithmic dimming std) SOLO 0.1% 0-10v, EldoLED (Dim-to-dark, Logarithmic dimming std) SODA 0.1% DALI, EldoLED (Dim-to-dark, Logarithmic dimming std) STEP Signify Advance Step Dimming	EMHE CA T20 Emergency Battery (1250 Delivered lumens, CA Title 20 compliant) ETS-DR Iota ETS-DR Emergency Transfer Switch EMC Emergency Circuiting EBCP1G /2G Single / Dual Gang (Electrical Box Cover Plate/Mud Ring) PIF Pre-Installed Individual Fixture (Saves time on individual Fixture installs, see page 4) SENSORS: 20S WattStopper PIR Occupancy 20S ON/OFF 20S-STEP: Dim to 50% 20S-DM: Dim to 1% ENL Enlighted SU-SE-IOT LUX Phillips DL LVOC Lutron Vive (Occ & IR) LVRF Lutron Vive IR Only NXSMP Hubbell (Occ) NLT Acuity N-Light CORNERS: C2-60 Lit 60° C2-90 Lit 90° C2-120 Lit 120° C2-135 Lit 135° C3T Lit 90° 3-Way: T C3Y Lit 120° 3-Way: Y C4T Lit 90° 4-Way: + C4X Lit 45°-135° 4-Way: X C8I Lit Inside 2-Plane C8O Lit Outside 2-Plane LRT Linear to Recessed Transition (Straight runs only)



03-25-2021

me engineers

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Date: **04-Jun-21**
Project #: DV20131

Type: L6

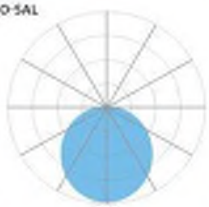
BionicPro4 | Linear

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

DISTRIBUTIONS:

SATIN LENS — DISTRIBUTION

Medium Output:
BPRO4-LIN-FLSH-LED3S-MO-SAL
2740 Delivered Lumens
23 Watts
120 lm/w
3500 CCT
1.22 Spacing Criteria
Test
#104013131LAX-003F

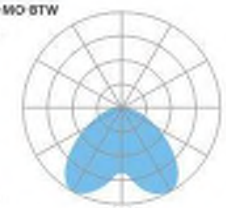


Zonal Lumen Summary:
0-90 = 100%

Vertical Angle	0°	25°	45°	65°	90°
0°	986	986	986	986	986
5°	980	980	977	982	982
15°	934	935	934	942	943
25°	852	852	854	865	869
35°	742	742	746	760	463
45°	613	612	617	630	639
55°	472	471	477	488	497
65°	323	323	329	339	348
75°	175	175	181	190	198
85°	37	37	42	49	56
90°	0	0	0	0	0

BATWING — DISTRIBUTION

Medium Output:
BPRO4-LIN-FLSH-LED3S-MO-BTW
2886 Delivered Lumens
23 Watts
127 lm/w
3500 CCT
1.90 Spacing Criteria
Test
#104013131LAX-003B

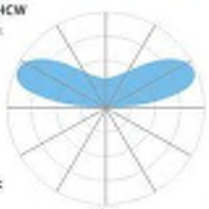


Zonal Lumen Summary:
0-90 = 100%

Vertical Angle	0°	25°	45°	65°	90°
0°	721	721	721	721	721
5°	773	765	742	724	714
15°	996	961	854	724	655
25°	1110	1074	933	698	561
35°	1084	1057	925	634	463
45°	906	907	824	533	378
55°	612	640	635	411	306
65°	360	381	402	287	235
75°	183	192	204	170	154
85°	48	49	55	55	55
90°	0	0	0	0	0

HARD CEILING WASH

Standard Output:
BPRO4-LED3S-SO-NW-HCW
2653 Delivered Lumens
33 Watts
80 lm/w
3500 CCT
Test
#104491851LAX-012

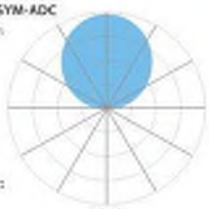


Zonal Lumen Summary:
90-180 = 100%

Vertical Angle	0°	22.5°	45°	67.5°	90°
90°	0	0	0	0	0
95°	74	125	163	129	25
105°	859	777	525	255	96
115°	1040	913	598	301	169
125°	932	815	556	322	229
135°	716	636	474	330	272
145°	530	489	406	331	299
155°	417	399	363	330	315
165°	356	351	339	329	324
175°	330	330	328	328	329
180°	327	327	327	327	327

SYMMETRIC

Standard Output:
BPRO4-LED3S-SO-NW-SYM-ADC
4570 Delivered Lumens
33 Watts
139 lm/w
3500 CCT
Test
#L104503052LAX-003



Zonal Lumen Summary:
90-180 = 100%

Vertical Angle	0°	22.5°	45°	67.5°	90°
90°	0	0	0	0	0
95°	73	73	72	71	73
105°	261	263	262	261	266
115°	505	503	499	500	508
125°	764	765	769	774	786
135°	1050	1052	1054	1063	1075
145°	1325	1327	1326	1338	1350
155°	1554	1555	1552	1564	1578
165°	1711	1712	1708	1720	1735
175°	1791	1792	1786	1799	1816
180°	1805	1805	1805	1805	1805

BionicPro4 | Linear

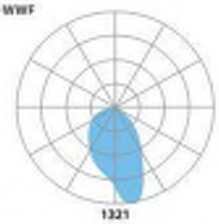
PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

DISTRIBUTIONS:

FLAT WALL WASH — DISTRIBUTION

Standard Output:
BPRO4-FLSH-LED35-LO-4-WWF
2056 Delivered Lumens
15.37 Watts
134 lm/w
3500 CCT
Test
104361023LAX-0043

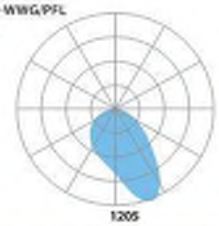


Zonal Lumen Summary:
0-90 = 100%

	Vertical Angle	0°	25°	45°	65°	90°
WALL SIDE	90°	0	0	0	0	0
	85°	22	23	25	27	28
	75°	75	82	91	96	93
	65°	135	159	181	201	185
	55°	224	274	316	393	346
	45°	372	457	526	668	533
	35°	625	736	821	944	670
	25°	967	1070	1140	1095	763
	15°	1321	1297	1257	1058	828
	5°	1065	1027	992	930	862
	0°	863	863	863	863	863
ROOM SIDE	5°	740	757	766	804	862
	15°	646	655	661	704	828
	25°	567	583	591	622	763
	35°	456	482	497	533	670
	45°	344	369	384	419	533
	55°	496	506	531	570	690
	65°	173	167	165	164	185
	75°	109	96	89	85	93
	85°	33	30	27	26	28
	90°	0	0	0	0	0
	Vertical Angle	180°	202.5°	225°	247.5°	270°

FOCAL GLOW WALL WASH / PERIMETER FILL

Low Output:
BPRO4-FLSH-LED35-LO-4-WWG/PFL
1989 Delivered Lumens
15 Watts
132 lm/w
3500 CCT
Test
104664711LAX-015



Zonal Lumen Summary:
0-90 = 100%

	Vertical Angle	0°	25°	45°	65°	90°
WALL SIDE	90°	0	0	0	0	0
	85°	23	24	28	30	30
	75°	77	81	103	108	96
	65°	153	165	225	224	166
	55°	278	309	437	416	256
	45°	513	574	756	629	370
	35°	946	998	1014	746	487
	25°	1205	1165	1006	794	600
	15°	1022	997	910	810	693
	5°	844	836	810	779	739
	0°	747	747	747	747	747
ROOM SIDE	5°	644	658	810	779	739
	15°	518	525	543	595	693
	25°	458	461	468	497	600
	35°	408	409	411	417	475
	45°	403	403	405	416	487
	55°	291	284	262	244	256
	65°	222	210	183	160	166
	75°	137	130	104	92	96
	85°	42	42	33	29	30
	90°	0	0	0	0	0
	Vertical Angle	180°	202.5°	225°	247.5°	270°

LUMEN MAINTENANCE

L70 — 200,000+ Hours
L90 — 100,000+ Hours (LO, MO & SO)
L90 — 60,000+ Hours (HO)

LED SYSTEM LED modules and drivers are field replaceable.

PROG Programmable light output. Specify desired lumens or watts per linear foot.

BINNING Standard binning (all Prudential LED boards) includes testing at the chip level and board integration to provide consistent color temperature within a 3-step MacAdams ellipse, with +/- 5% lumen output range and +/- .004 Duv.

LABELS CSA and ETL damp labeled and L.B.E.W. manufactured.

ELECTRICAL Must specify LED dimming controls. LED fixtures have constant current driver(s) with less than 20% THD when loaded to a minimum of 60%. Drivers sink a maximum of 6mA per driver. DM01 LED drivers are 0-10V dimmable and are compatible with most 0-10V wall slide dimmers and direct 0-10V analog signal dimmers. Max driver size 1.65" w x 1.25" h.

CONSTRUCTION

Housing: Extruded aluminum housing and side wall
>25% PC recycled, 100% recyclable.

Lens: Polymer, 100% recyclable.

Weight: 3.25 lbs/ft

MOUNTING Surface mounted to walls or ceilings, wall spacer, wall bracket to wall, suspended by cable.

WARRANTY Single-source, 5 year limited warranty covers standard components and construction.

me engineers

STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L6

BionicPro4 | Linear

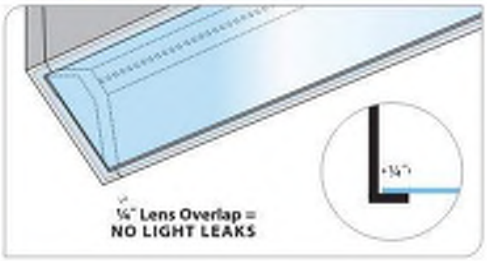
PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

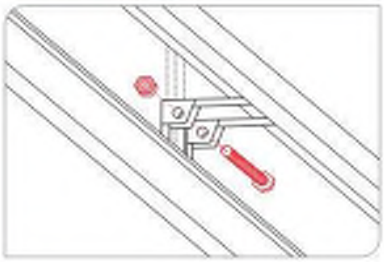
Choose from one of our Premium Colors with no set-up fee.

For paint chip samples, please email: info@prulite.com

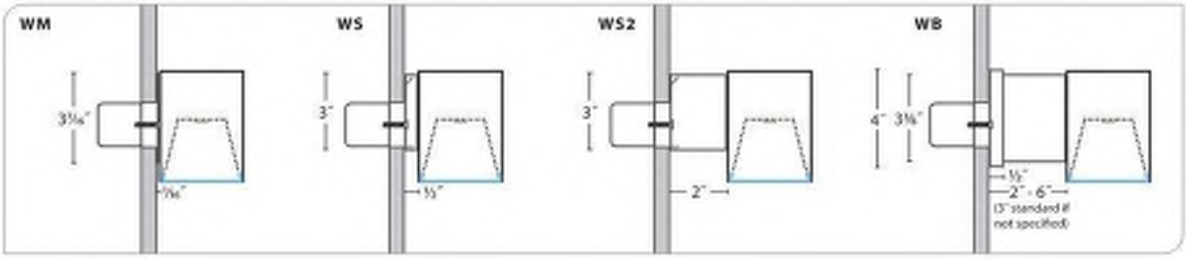
CAST ALUMINUM END CAPS



ADJOINING DETAILS



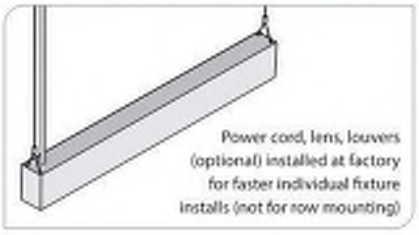
WALL CROSS SECTIONS



FIXTURE SIZE VARIES

SENSOR PLATE

PIF — PRE-INSTALLED INDIVIDUAL FIXTURE



EBCP — ELECTRICAL BOX COVER PLATE

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

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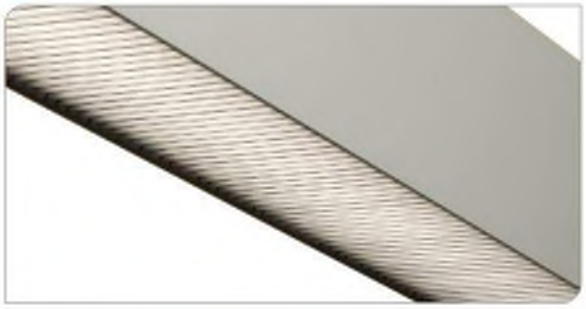
Date: **04-Jun-21**
Project #: DV20131

Type: L6

BionicPro4 | Linear

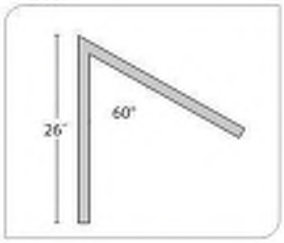
PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

LOUVER DETAIL

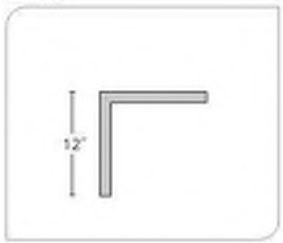


CORNERS

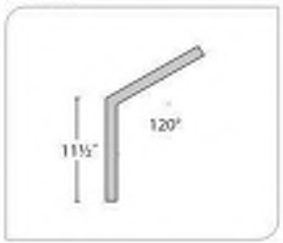
C2-60:



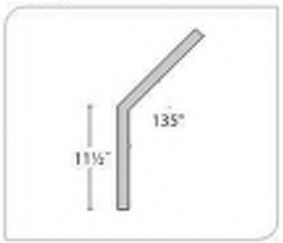
C2-90:



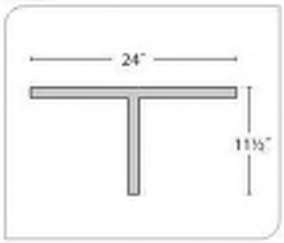
C2-120:



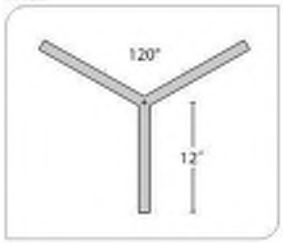
C2-135:



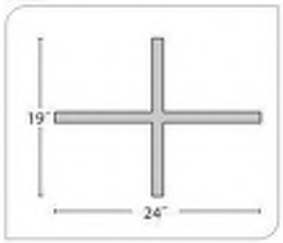
C3T:



C3Y:



C4T:



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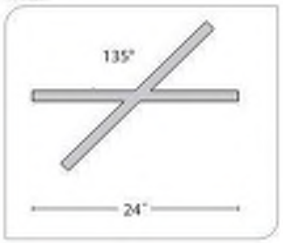
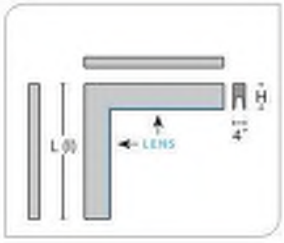


C8I:



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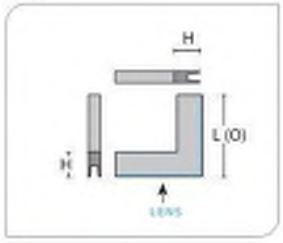

BODY TYPE	DIM "H"	DIM "L" (I)	DIM "L" (O)
Direct Flush	4 ⅜"	16 ⅜"	12"
Direct Regress	4 ⅜"	16 ⅜"	12 ⅜"
Direct/Indirect Flush	5"	17"	12"
Direct/Indirect Regress	5 ½"	17"	12 ½"

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STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

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Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L6

BionicPro4 | Linear

PRUDENTIAL LTG.

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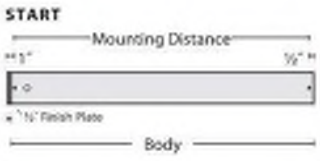
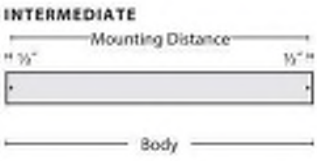
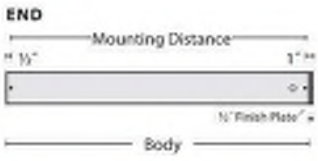
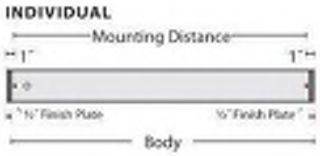
SURFACE MOUNT





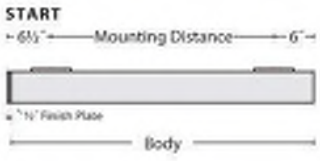


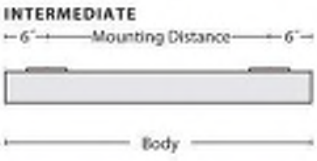


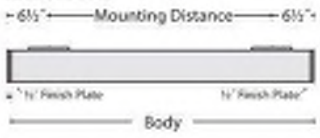
	MOUNTING	BODY*
2'	23"	24"
3'	35"	36"
4'	47"	48"
5'	59"	60"
6'	71"	72"
7'	83"	84"
8'	95"	96"

* For overall dimensions add finish plate(s) where required

WALL MOUNT







	MOUNTING	BODY*
2'	12"	24"
3'	24"	36"
4'	36"	48"
5'	48"	60"
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* For overall dimensions add finish plate(s) where required

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Date: **04-Jun-21**
Project #: DV20131

Type: L6

18˝ STANDARD ROW LENGTH:

18˝ SYMMETRIC ROW LENGTH (SRL):

ROW LENGTH	STANDARD ROW LENGTH	SYMMETRIC ROW LENGTH (SRL)
9˝	5+4	3+3+3
10˝	6+4	5+5
11˝	7+4	4+3+4
12˝	8+4	6+6
13˝	8+5	4+5+4
14˝	8+6	7+7
15˝	8+7	5+5+5
16˝	8+8	8+8
17˝	8+5+4	6+5+6
18˝	8+6+4	6+6+6
19˝	8+7+4	6+7+6
20˝	8+8+4	8+4+8
21˝	8+8+5	8+5+8
22˝	8+8+6	8+6+8
23˝	8+8+7	8+7+8
24˝	8+8+8	8+8+8
25˝	8+8+5+4	6+4+5+4+6
26˝	8+8+6+4	8+5+5+8
27˝	8+8+7+4	6+5+5+5+6
28˝	8+8+8+4	8+6+6+8
29˝	8+8+8+5	8+4+5+4+8

ROW LENGTH	STANDARD ROW LENGTH	SYMMETRIC ROW LENGTH (SRL)
30˝	8+8+8+6	8+7+7+8
31˝	8+8+8+7	8+5+5+5+8
32˝	8+8+8+8	8+8+8
33˝	8+8+8+5+4	8+6+5+6+8
34˝	8+8+8+6+4	8+6+6+6+8
35˝	8+8+8+7+4	8+6+7+6+8
36˝	8+8+8+8+4	8+8+4+8+8
37˝	8+8+8+8+5	8+8+5+8+8
38˝	8+8+8+8+6	8+8+6+8+8
39˝	8+8+8+8+7	8+8+7+8+8
40˝	8+8+8+8+8	8+8+8+8+8
41˝	8+8+8+8+5+4	8+6+4+5+4+6+8
42˝	8+8+8+8+6+4	8+8+5+5+8+8
43˝	8+8+8+8+7+4	8+6+5+5+5+6+8
44˝	8+8+8+8+8+4	8+8+6+6+8+8
45˝	8+8+8+8+8+5	8+8+4+5+4+8+8
46˝	8+8+8+8+8+6	8+8+7+7+8+8
47˝	8+8+8+8+8+7	8+8+5+5+5+8+8
48	8+8+8+8+8+8	8+8+8+8+8+8
49˝	8+8+8+8+8+5+4	8+8+6+5+6+8+8
50˝	8+8+8+8+8+6+4	8+8+6+6+6+8+8

NOTE: SRL will effect pricing – please consult factory.

me engineers

STEAMBOAT BASE AREA

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www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

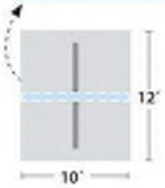
Type: L6

BionicPro4 Batwing Vs. Top 4" Competitor (Satin Lens)

SINGLE OFFICE

BionicPro4

Top Competitor



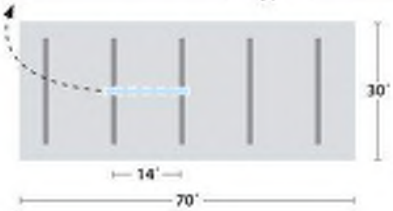
	BionicPro4	Competitor
LPW	127	113
SPACING CRITERIA	**1.9**	**1.2**
MAX/MIN	1.6	2.6
W/SQ. FT.	.38	.4
FC AVERAGE	27	29

9' ceiling .85 lf BionicPro4— 5.7w/ft Competitor—6w/ft Footcandles at 30" working plane

OPEN OFFICE

BionicPro4

Top Competitor



	BionicPro4	Competitor
LPW	127	117
SPACING CRITERIA	**1.9**	**1.2**
MAX/MIN	2.0	4.5
MAX/MIN BETWEEN ROWS	1.2	2.7
W/SQ. FT.	.36	.38
FC AVERAGE	36	37

9' ceiling .85 lf BionicPro4— 5.7w/ft Competitor—6w/ft Footcandles at 30" working plane

me engineers
14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L6

BionicPro4 | Linear

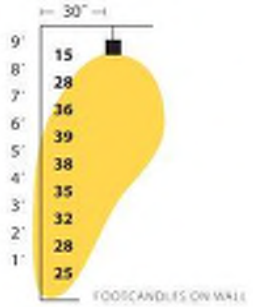
PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

Smooth, flat wall washing (WWF)

Our patent-pending TruBeam™ optics redirect light in an ideal flat wall wash for smooth, even illumination.

	Watts/ Ft.	Ceiling Height	Average Illuminance	Max/Min	Max/Min Ratio
Medium Output | 750 lumens/ft	6	9'	31 fc	39/15	2.6



Focal glow wall washing (WWG)

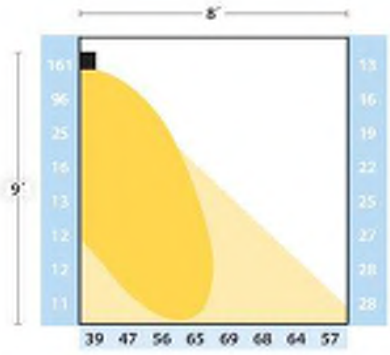
Pique interest by giving works of art 'pop' — more light at eye level

	Watts/ Ft.	Ceiling Height	Average Illuminance	Max/Min	Max/Min Ratio
Medium Output | 750 lumens/ft	6	9'	36 fc	50/15	3.3

Perimeter Fill (PFL)

Wash a corridor in light from one side of the perimeter. Our Perimeter Fill is ideal for hospital corridors where a 50 fc average is needed.

	Watts/ Ft.	Ceiling Height	Average Illuminance	Max/Min	Max/Min Ratio
High Output | 1275 lumens/ft	1	10'	64 fc	70/57	1.2



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Date: **04-Jun-21**
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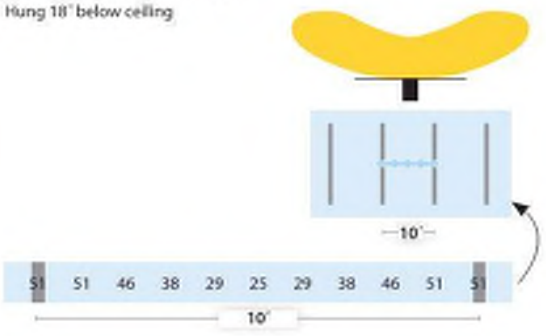
Type: L6

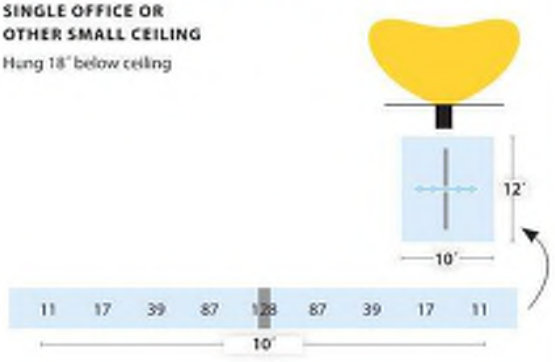
Hard ceiling wash (HCW)

OPEN OFFICE/CLASSROOM
Hung 18" below ceiling



Soft ceiling wash (SCW)

SINGLE OFFICE OR OTHER SMALL CEILING
Hung 18" below ceiling



BionicPro to Bionic/P23-43 Optics Crossing Matrix

DOWNLIGHT:

	Satin	Batwing	Flat Wall Wash	Focal Glow Wall Wash	Perimeter Fill
BionicPro	SAL	BTW	WWF	WWG	PFL
Bio2 / P23 = BionicPro3	SAL	MBW	MWW/D1W	—	MWW/D1R
Bionic4 / P43 = BionicPro4	SAL	ABW/D1X	—	AWL/D1W	AWL/D1R

UPLIGHT:

WWG = PFL
Lens almost away from wall

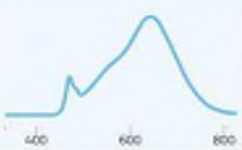
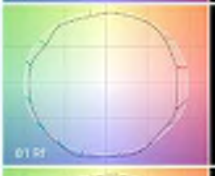
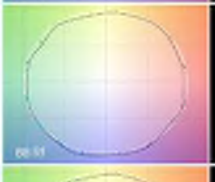
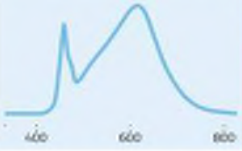
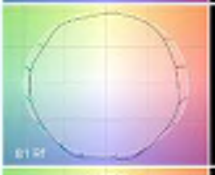
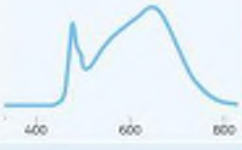
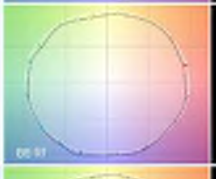
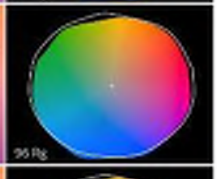
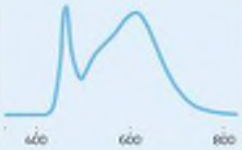
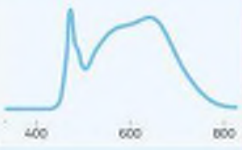
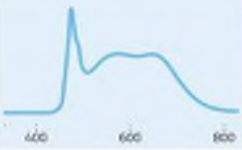
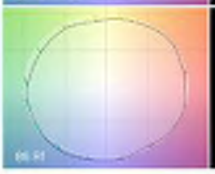
	Symmetric	Ceiling Wash	Soft Ceiling Wash	Asymmetric Ceiling Wash
BionicPro	SYM	HCW NA BionicPro2	SCW	SACW
Bio2 / P23 = BionicPro3	SYM	CW	—	ACW
Bionic4 / P43 = BionicPro4	SYM	CW	—	—

BionicPro4 | Linear

PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

LM79 & TM30 DATA:

	MEASURED CCT	MEASURED LUMENS	CRI	R9	DuV	SPD	TM30 — COLOR VECTOR	TM30 — COLOR DISTORTION
LED27	2680	80%	93	58	0.001			
LED3	3042	95%	82	6	0.001			
LED3-90	3016	85%	93	61	0.000			
LED35	3482	100%	82	3	0.002			
LED35-90	3417	85%	93	67	0.000			
LED4	3952	102%	82	4	0.003			
LED4-90	3882	85%	92	67	0.003			
LED5-90	4889	85%	94	84	0.002			

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STEAMBOAT BASE AREA

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Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L6

Peerless Lighting for People

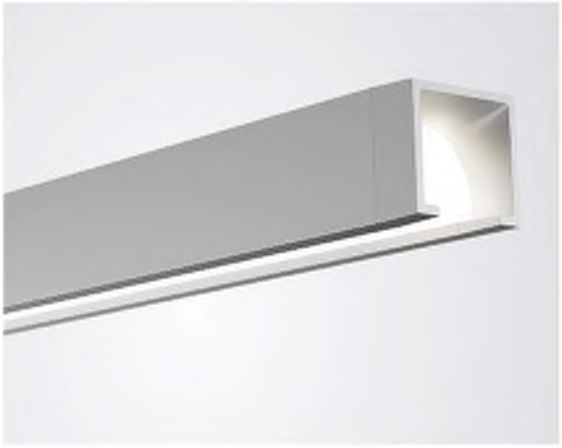
Open LED

OPM4 | LED | Indirect/Direct | Suspended

SPECIFICATIONS

Type:

Project:

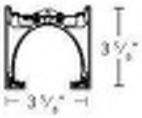


HIGHLIGHTS

- Total System Integration features 5-year limited warranty by Acuity Brands covering all components and construction
- 4', 6' and 8' sections
- Up to 134 lm/W
- Ten distributions available
- High performance batwing distribution using injection molded optic
- Seam eraser technology provides continuous illumination for long runs
- Flicker-free dimming to dark powered by remote eldoLED® driver
- Optional dual circuit switching for independent dimming of indirect and direct light outputs.
- Integrated nLight® module for system networking (optional)
- Integrated sensor for daylight dimming and/or occupancy detection (optional)
- Modular 4' and 2' light engines to allow for easy upgrades and replacement
- White, black, painted aluminum or custom color

DIMENSIONS

☐ OPM4



DETAILS


Seam Eraser


Square open end cap: Option SEP


Flat solid end cap: Option FEP

COMPANION LUMINAIRE(S)


OPM-4W Open I/D Wall Wash


OPRS Open Recessed Direct


OPMW S Open Direct Wall Wash Surface

CUSTOMIZATION

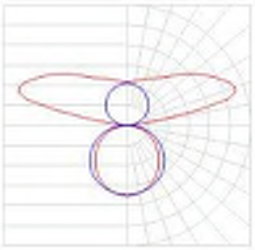
Ask us about the following possibilities: up to 6000 lumens for the uplight portion, alternate section lengths, alternate distributions, additional mounting options, additional CCTs for LED boards, custom colors and other modifications.

LUMEN PACKAGES Based on 80CRI 35K

Indirect LED Output/ Direct LED Output	I610LMF/ 510LMF	I670LMF/ 810LMF	I910LMF/ 510LMF	I910LMF/ 810LMF	I1200LMF/ 510LMF	I1200LMF/ 810LMF
Indirect Delivered Lumens Per Foot/ Direct Delivered Lumens Per Foot	619/504	676/827	946/504	946/827	1228/504	1228/827
Total Delivered Lumens Per Foot	1123	1446	1450	1773	1732	2055
Input Watts Per Foot	8.6	11.5	10.8	13.6	13.1	15.9
Lumens Per Watt	130	126	134	130	132	129

DISTRIBUTION

60% Up | 40% Down



me engineers

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Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L7

Peerless Lighting for People

Open LED

OPM4 | LED | Indirect/Direct | Suspended

Type:

Project:

SPECIFICATIONS

Housing
Extruded aluminum housing.

End Caps
Die-cast aluminum end caps are mechanically attached with no exposed fasteners. Sculptured end caps with curved inner opening standard. For squared open end caps, choose option SEP; for flat solid end caps, choose option FEP.

Color
Color for housing and end caps is white, black or painted aluminum. Consult factory for custom colors.

Luminaire Length
4', 6' and 8' lengths in a single section for nominal suspension spacing of 4', 6' and 8'. For total length, add 1 ½" for each sculptured end cap and ¾" for each squared or flat end cap. Longer rows are comprised of starter, joiner and ender sections.

Source
Four LED lumen packages and five available color temperature options (2700K, 3000K, 3500K, 4000K and 5000K) in 80+ CRI and 90+ CRI options — all within 2.5 MacAdam ellipses.

Optics
Optical system consists of high performance film. Injection-molded indirect optic for optimized batwing distribution.

Remote Dimming Driver
Remote eldoLED® driver (see page 3) with default logarithmic dimming curve provides "natural dimming" with smooth, continuous and flicker-free dimming to dark. Syncing for controls: 2mA max.

THD: < 20%. Insignificant inrush current at 120 and 277VAC. FCC Class A tested for EMI and RFI. When Control Input of 0-10V is specified driver will be set for linear dimming curve, if NLIGHT is specified driver will be set for logarithmic dimming curve.
For 0-10V and DALI details go to: PeerlessLighting.com/SOLOdrive

Controls and System Networking Options
For wired networking via Cat-5e, choose an integrated nLight® module. For daylight dimming and/or dual technology occupancy detection, see Integrated Sensor Layout Page for more details.

Electrical
LED light engine — consisting of modular LED boards and eldoLED® dimming driver — is rated for 60,000 hours (L_{70}) at 25° C ambient temperature. Specify 120V, 277V or 347V. For special circuiting or wire gauge, consult factory. Plug-in electrical connectors included.

Environment
Suitable for damp location. IC Rated

Validation
CSA/CUS listed. CSA tested to UL 1598 standards. LM-79 tested. Individual sections meet FCC Part 15 requirements.

Packaging
Recycled cardboard box and inserts. Biodegradable, protective luminaire bag. Recycled kraft paper tape.

Warranty
5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/support/customer-support/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

Peerless Lighting for People

Open LED

OPM4 | LED | Indirect/Direct | Suspended

Type:

Project:

A+ Capable options indicated by this color background.

MODEL NUMBER

Example: OPM4 LLP 8FT MSL8 80CRI 35K I610LMF I510LMF DARK ZT 120 SCT F1/24F C041

Luminaire	Linear Length Plan	Total Run Length	Maximum Section Length	LED Color Rendering	LED Color Temperature	Indirect LED Ouput	Direct LED Output
OPM4	LLP Linear longest possible LCB Linear center balanced LSL Longest same length	__FT Indicate luminaire row length in 2" increments. Ex: 10FT	MSL4 4' section(s) MSL6 6' section(s) MSL8 8' section(s)	80CRI 80+ CRI 90CRI 90+ CRI	27K 2700K 30K 3000K 35K 3500K 40K 4000K 50K 5000K	I610LMF 610 Nominal indirect lumens per foot I910LMF 910 Nominal indirect lumens per foot I1200LMF 1200 Nominal indirect lumens per foot	I510LMF 510 Nominal direct lumens per foot I810LMF* 810 Nominal direct lumens per foot *Does not meet RP-1 standards for high angle glare

Minimum Dimming Level	Control Input	Voltage	Wiring Option	Emergency Options	Primary Sensor	Secondary Sensor
DARK Constant current, dimming to < 1%	ZT* 0-10V NLIGHT** nLight enabled DALI*** DALI enabled *0-10V will use linear dimming curve **Will use Logarithmic dimming curve ***Not available with sensors ****Will use Logarithmic dimming curve	120 120V 277 277V 347 347V* *Not with nLight	SCT Single circuit DCT Dual circuit For independent dimming of indirect and direct light outputs, choose DCT	(Blank) None 1EC (1) Emergency circuit module 2EC (2) Emergency circuit module __EC ___ Emergency circuit modules __E10WLCP ___ 10-Watt emergency battery pack, CEC Certified Emergency type is installed in last 4' of luminaire sections. Separate feed required. Not available with CSA options.	(blank) No factory-installed, integrated sensor PDT_ Dual technology occupancy sensor, PIR & microphonics sensor ADC_ Daylight Dimming Sensor APD_ Dual technology PDT and ADC sensor *Available with ZT or nLight only **Available with FEP (Flat end plate) only	(blank) No factory-installed, integrated sensor SPDT_ Dual technology occupancy sensor, PIR & microphonics sensor SADC_ Daylight Dimming Sensor SAPD_ Dual technology PDT and ADC sensor *Available with ZT or nLight only **Available with FEP (Flat end plate) only

Mounting Type/	Overall Suspension	Color	Options
F1/ T-bar ceiling (universal mounting bracket) F2/* Hard ceiling (horizontal J box) *F2 not available with E10WLCP **F1 Mount uses standard 3 1/2" canopy on both feed and support. Emergency feed uses 5" canopy ***F2 Mount uses standard 5" canopy on both feed and support **** All feed cords, cord reinagers and canopies are standard white. They are not painted to match fixture color.	12F 12" Fixed cable with +0/-12 18F 18" Fixed cable with +0/-12 24F 24" Fixed cable with +0/-12 36F 36" Fixed cable with +0/-12 48F 48" Fixed cable with +0/-12 72F 72" Fixed cable with +0/-12 96F 96" Fixed cable with +0/-12 Measured from ceiling to bottom of luminaire. *Maximum suspension with 12" of adjustability (+3"/-12"), i.e. for 36" suspension choose 24" length.	C041 White white (low gloss) CT10 Painted Aluminum (low gloss) C201 Black (low gloss) C099 Custom color RALTBD* Ral Paint Finishes *RAL TBD for pricing only, replace with applicable RAL call out when ready to order. See the RAL BROCHURE for available options	SCN* 5" Canopy CSA** Manufactured to Canadian Standards CP Chicago Plenum DU Dust cover GLR Fast blow GMF Slow blow HCF Healthcare facility cover SEP Square open end cap FEP Flat solid end cap *F1 mount only. **When chosen with EC entire section must be EC. EX: MSL8 section would need to be 2EC for entire section

Peerless Lighting for People

Open LED

OPM4 | LED | Indirect/Direct | Suspended

Type:

Project:

PHOTOMETRICS

I910LMF/510LMF 80CRI 35K
134 lm/W
5806 delivered lumens per 4' section
66% up/34% down

I910LMF/810LMF 80CRI 35K
130 lm/W
7096 delivered lumens per 4' section
55% up/45% down

EXPECTED LIFE L90@60,000 HOURS

CCT SCALING CHART

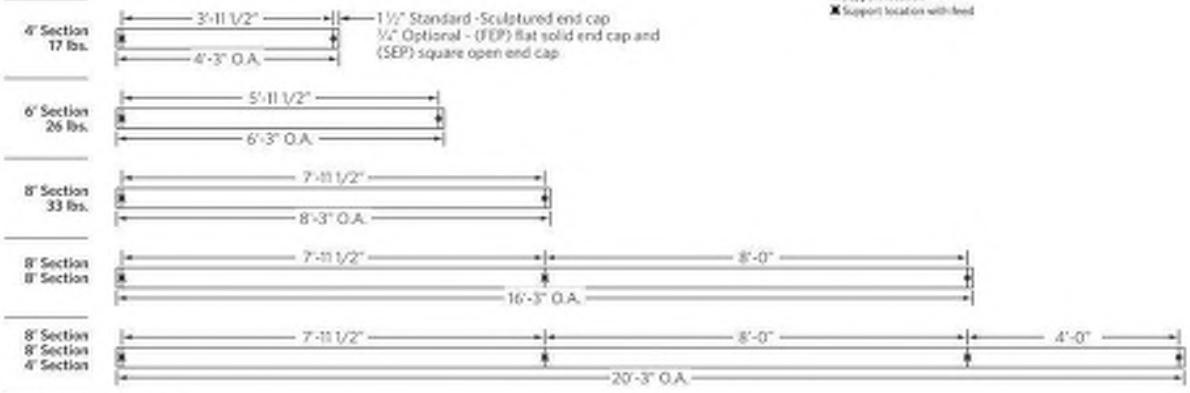
CCT	CRI	MULTIPLIER
27K	80CRI	0.96
30K	80CRI	0.97
35K	80CRI	1
40K	80CRI	1
50K	80CRI	1.03
27K	90CRI	0.79
30K	90CRI	0.81
35K	90CRI	0.83
40K	90CRI	0.84
50K	90CRI	0.89

WEIGHTS & SUPPORT SPACING

Suspension spacing equals section length. Default location shown.

STANDARD SECTIONS

Key
● Support location
✖ Support location with feed



PLAN VIEW

1-800-705-SERV (7378) | TechSupport-Peerless@AcuityBrands.com
PeerlessLighting.com

Rev. 07/13/20

Peerless Lighting for People

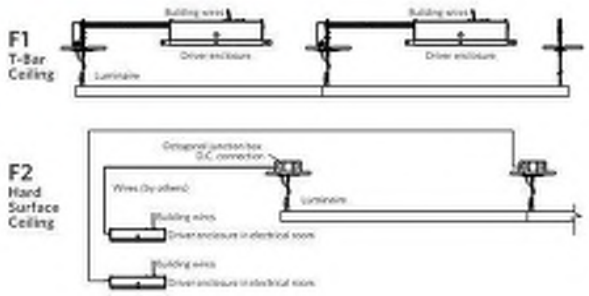
Open LED

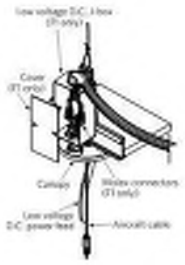
OPM4 | LED | Indirect/Direct | Suspended

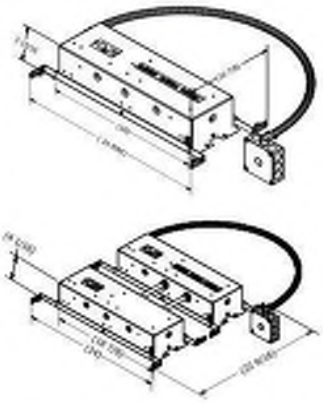
Type:

Project:

REMOTE DRIVER MOUNTING

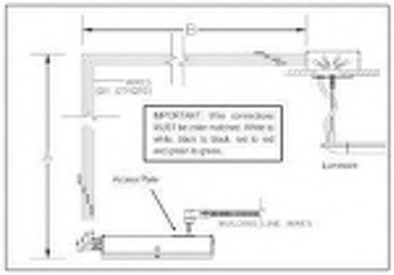






The driver is housed in a remote-mounted, aluminum enclosure measuring 4"H X 6"W X 19"L. In T-bar ceiling installations, the driver enclosure attaches to the grid bars with provided hanging brackets and clips. For hard ceiling installations, the driver enclosure resides inside an electrical room and can be mounted to a rack or wall with screws (by others), if necessary.

NOTE: Every 4', 6' and 8' luminaire section comes with at least (1) driver enclosure and each section has at least (1) low voltage D.C. power feed leading out of the luminaire. See installation instructions for further details.



Connect white, black, red and green wires coming out of driver enclosure and into terminal blocks to a matching set of colored wires (by others) leading to luminaire. Next, at the luminaire, connect out of wires (by others) to terminal blocks underneath J-box making sure colors match. Unscrew and remove access plate on driver enclosure. Run building wires to driver enclosure. Knock out one hole in access plate. Pass building wires through hole. Perform wire splices, insert wires back into enclosure and reattach access plate.

IMPORTANT:

Run wires (by others) from the driver enclosure to the Luminaire following these requirements. Maximum distance must not be exceeded.

Wire Gauge	Maximum Distance (ft.) (A + B)
18	56
16	102
14	175
12	270

LINEAR PLAN:

PEERLESS offers the ability to provide a continuous run plan to suit your requirements by optionally offering three different methods of configuration.

LSL- Linear Same Length:
In this configuration, each segment is the same length and is standardized based on the longest length available and is the only option provided. Because it is dependent on one segment length there are mathematical limitations on what overall row lengths can be achieved. Example: 20 FT row would be achieved with 5, 4 FT long segments equaling 20 FT (nominal).

LSL	4FT	4FT	4FT	4FT	4FT

LCB- Linear Center Balanced:
This configuration incorporates the longest center segment(s) along with any additional lengths required to fill the run length, added to the run ends. Example: 20 FT run would have 2, 4 FT segments (one at each end) and 1, 8 FT segment in the center.

LCB	4 FT	8 FT	4FT

LLP- Linear Longest Possible
In this configuration, the longest length available is optimized, resulting in the fewest segments and mounting locations. Caution, should be used where balanced appearance is a concern. Example: 20 FT run would have 2, 8 FT segment and 1, 4 FT segment at the end of the run.

LLP	8 FT	8 FT	4FT

me engineers

STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

Issue: BP4C - KVC IFC & PERMI
Date: 04-Jun-21
Project #: DV20131

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

www.me-engineers.com

Type: L7

Peerless Lighting for People

Open LED

OPM4 | LED | Indirect/Direct | Suspended

Type:

Project:

For more information about sensor and networking options, download the controls guide at PeerlessLighting.com/ControlsGuide

INTEGRATED SENSOR OPTIONS

Control Input	Integrated Sensor	Daylight Dimming	Occupancy Detection	nLight Wired Networking	nLight Wireless Networking	Link to Spec Sheet
NLIGHT	ADC	X		X		nES-ADCX
NLIGHT	PDT		X	X		nES-7
NLIGHT	APD	X	X	X		nES-7
ZT	ADC	X				nES-ADCX
ZT	PDT		X			nES-7
ZT	APD	X	X			nES-7

Daylight harvesting deactivated by default and field programmed per sequence of operations for PDT sensor options.

Luminaires specified with integrated sensor option ship with one RJ-45 connector integrated into the luminaire, 10' of Cat-5e cable and a splitter to control the entire luminaire row (depending on wattage/voltage limitations). Sensor will be located at either the front or end of a fixture section. For multiple zones, please contact TechSupport@PeerlessLighting.com.

nES ADCX

nES PDT 7

OCCUPANCY DETECTION COVERAGE

At the 7.5 ft (2.9 m) hanging height of a typical pendant mount fixture the sensor provides 10 ft (3.05 m) radial detection of small motion. At a 9 ft (2.74 m) hanging height the radius is 12 ft (3.66 m) for small motion.

Adequate for walking motion detection from mounting heights between 7.5 ft (2.29 m) and 20 ft (6.10 m).

Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor.

Initial detection of walking motion into long coverage segment will occur at distances of 2x the mounting height up to 15 ft (4.57 m) and 1.75x up to 20 ft (6.10 m). Lens assembly rotates 15° to enable adjustment in order to line up long segments.

COMPATIBLE nLIGHT COMPONENTS WITH INTEGRATED CONTROLS

nPODM DX WH nPODM 2P DX WH nPODM 4P DX WH

SensorSwitch.com/DataSheets/nPODM.pdf

nPODM 2L WH

SensorSwitch.com/DataSheets/nPODM-xL.pdf

nPOD GFX WH

SensorSwitch.com/DataSheets/nPOD-GFX.pdf

eldoLED COMPATIBILITY Additional control options with eldoLED 0-10V drivers(1).

PeerlessLighting.com/eldoLED-compatibility

1-800-705-SERV (7378) | TechSupport-Peerless@AcuityBrands.com

PeerlessLighting.com

Rev. 07/13/20

Peerless Lighting for People

Open LED

OPM4 | LED | Indirect/Direct | Suspended

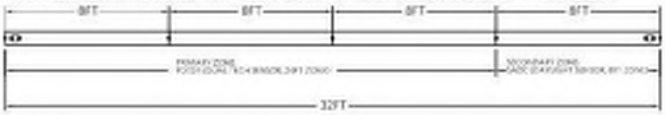
Type:

Project:

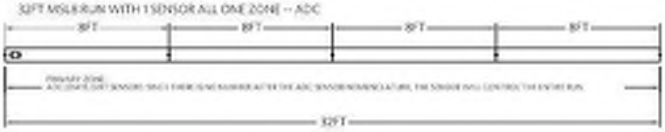
INTEGRATED SENSOR LAYOUT

CORRECT:

32FT MSL8 RUN WITH 2 SENSORS WITH PRIMARY ZONE 24FT AND SECONDARY ZONE 8FT -- PDT24 SADC8



32FT MSL8 RUN WITH 1 SENSOR ALL ONE ZONE -- ADC

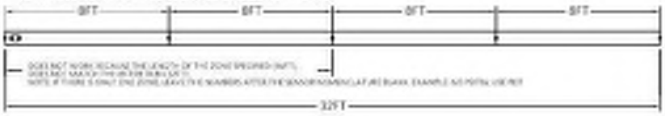


Notes:

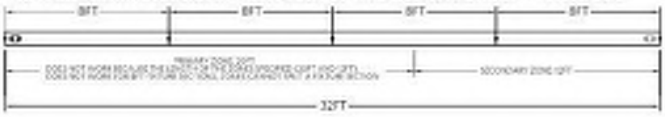
- Only one sensor per zone
- At the most, the entire run can only have 2 sensors (Thus 2 sensors zones at the most)
- Sensor zone can not split fixture sections
- No overlapping zones
- One nLight or NLTAIR2 device per zone or per sensor, for multiple zones without sensors contact factory

INCORRECT:

32FT MSL8 RUN WITH 1 SENSOR ALL ONE ZONE -- PDT16



32FT MSL8 RUN WITH 2 SENSORS WITH PRIMARY ZONE 20FT AND SECONDARY ZONE 12FT -- PDT20 SADC12



BRETT 502

LINEAR EASY-SPEC™

Fixture Type: _____

Project: _____

Location: _____

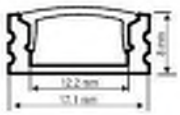
FEATURES

- 100 to 1000 Lumens per Foot
- Field Replaceable Light Source
- 50,000 Hour Lamp Life
- Dimmable to 1%
- Anodized Finish
- Adjustable-Length Power Feed Included

White Lens (SW)

Mounting Clips (CP)

Pivot Clips (PV)



SPECIFICATIONS

Input Voltage	24V DC / Constant Voltage
CRI	90+
Diode	Epistar
Dimming Options	PWM, Triac, 0-10V
Temp Range	-40°F to 149°F
Channel Height	8mm (5/16")
Channel Width	17.1mm (11/16")

KELVIN COLOR TEMPERATURE SCALE

PART NUMBER BUILDER

Example:
502-I-60-DV-35K-WH-CP-SV-ULV

Model	Setting	Length (Unlimited)[1]	Output	CCT	Lens	Mounting Method	Finish	Power Supply
502	I	Inches	DL - 200+ lm/ft DK - 400+ lm/ft DV - 700+ lm/ft VT - 1000+ lm/ft RGBW-2 RGBW-3	24K - 2400 Kelvin 27K - 2700 Kelvin 30K - 3000 Kelvin 35K - 3500 Kelvin 40K - 4000 Kelvin 50K - 5000 Kelvin	NA - None WH - White	CP - Mounting Clips PV - Pivot Clips	SV - Silver (Custom Finishes Available)	ULV - Universal Power Supply[2]

[1] Light Source is installed in field allowing for unlimited run lengths
[2] 120V = Forward Phase Dimming | 120/277 = 0-10V Dimming

For use with cULus Light Source

Certified to CAN/CSA Standard C22.2 No. 250.0

RoHS COMPLIANT | 24V DC | DRY LOCATION RATED

Questions/Support | 800-789-3810 | quotes@kelvix.com

072020DM

P43 | Cove & Perimeter

4" Perimeter

PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

Type:

Job:

High performance wall grazer.

Optics: Glow, Wall Graze or wash a corridor in light (D1R).
Series: P43 recessed linear and Wall Wash for visual continuity.

Bionic Perimeter System contains same great optics with extruded aluminum housing to accommodate more ceiling systems.

LOW OUTPUT:
P43-PSTD-FLSH-LED4-LO-AWW-D1G
1620 Delivered Lumens
16 Watts
101 Lm/W
4000 CCT

UP TO 101 LM/W

FLUSH:		LO	MO	SO	HO
SAL-D1	Lm/Ft	400	600	800	900
AWW-D1G	Lm/ft	400	600	800	900
AWL-D1R	Lm/Ft	400	600	800	900
REGRESS 3:					
REG3-SAL	Lm/Ft	350	500	700	800
REG3-D1G	Lm/Ft	350	500	700	800
	W/Ft	4	6	8.3	10

CLICK HERE

Made in the USA

LED Details

Lumen output may vary +/- 5%
4000K used for lm/ft estimates above
3500K -2% ff, 3000K -4%, 2700K -6%
-10% LLF for 90 CRI (4K, 3500K and 3K)
See LED Details PDF for more info

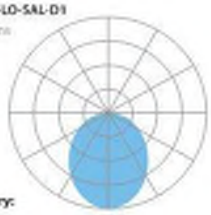
SERIES	LENS POSITION	LED COLOR	OUTPUT	NOMINAL LENGTH	TRIM COLOR	SHIELDING	DISTRIBUTION	MOUNTING	CIRCUITING	CEILING SYSTEMS	VOLTAGE	DRIVERS	OPTIONS, SENSORS & CORNERS
P43-PSTD									SC				
Perimeter Standard	FLSH Flush Lens REG1 1" Regress Lens REG3 3" Regress Lens	LED27 2700K (90CRI) LED3 3000K LED35 3500K LED4 4000K LED3-90 90CRI LED35-90 90CRI LED4-90 90CRI	LO Low MO Medium SO Standard HO High PROG Programmable Light Output (Specify desired lm/ft or w/ft)	2' 3' 4' 6' 7' 8' R___ (Row length) Any row length is achievable with field trimable filler kit NOTE: Individual not intended for row mounting	TMW Textured Matte White (Standard) YGW Gloss White Y___ Premium Color CC Custom Color	SAL Satin Acrylic Lens (D1 only) AWW Acrylic Wall Grazer Lens (D1G only) AWL Perimeter Fill Lens (D1R only)	D1 Direct (SAL only) D1G Wall Grazer (AWW only) D1R Perimeter Fill (AWL only; NA - REG3)	WTW Wall to Wall (Any row length) LP Light Pocket (Typically 1' increments, fixture stops before wall)	SC Single Circuit	X1 T-Bar 15/16" Exposed X1M T-Bar 9/16" Exposed X2 Interlude T-Bar X6 Slot Grid X38 Hard Ceiling (Overlapping flange) X7 Hard Ceiling (Trimless mud-over concealed flange)	UNV (120-277) 347 (Emergency battery requires a Step Down transformer)	ND Non-Dimming DM01 0-10v, 1% Dimming (Standard) LDE5* Lutron 5-Series EcoSystem LED LDE1* Lutron Hi-lume 1% EcoSystem LED (Soft fade on, fade-to-black dimming) * Lutron NA with HO ECO 1% 0-10v, EldoLED (Logarithmic dimming std) ECDA 1% DALI, EldoLED (Logarithmic dimming std) SOLO 0.1% 0-10v, EldoLED (Dim-to-dark, Logarithmic dimming std) SODA 0.1% DALI, EldoLED (Dim-to-dark, Logarithmic dimming std)	EMHE CA T20 Emergency Battery (D1, D1R=1000, D1G=750 delivered lumens, CA Title 20 compliant, 4' or longer (remote for < 4')) PRUBIN Meticulous Binning and Labeling every LED Board within a 2-Step MacAdams Ellipse SENSORS: 205-ON/OFF WattStopper PIR Occupancy 205-STEP: Dim to 50% 205-DIM: Dim to 1% LUX Phillips DLH ENL Enlighted 2-Wire DLH & Environmental CORNERS: C2I Lit 90° 2-Way Inside C2O Lit 90° 2-Way Outside C2X Special Angled Connector (Consult factory)

P43 | Cove & Perimeter
4" Perimeter

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

DIRECT

LOW OUTPUT:
P43-PSTD-FLSH-LED4-LO-SAL-D1
1934 Delivered Lumens
19 Watts
101 Lm/W
4000 CCT



Zonal Lumen Summary:
0-90 = 100%

878

Vertical Angle	0°	25°	45°	65°	90°
0°	885	885	885	885	885
5°	876	878	878	885	884
15°	828	825	815	803	797
25°	739	727	704	681	670
35°	619	601	569	540	525
45°	421	403	373	349	337
55°	484	463	429	402	388
65°	229	216	196	181	174
75°	115	107	97	90	86
85°	28	26	24	23	23
90°	0	0	0	0	0

Luminance Chart:

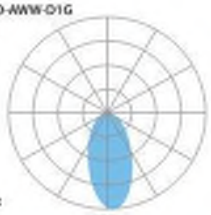
Angle	0°	45°	90°
45°	5823	5168	4058
55°	5173	4484	3997
65°	4618	3950	3500
75°	3768	3189	2841
85°	2711	2362	2243

UPTO 101 LM/W

FLUSH:	LO	MO	SO	HO
Lm/Ft	400	600	800	900
W/Ft	4	6	8.3	10

WALL GRAZER

LOW OUTPUT:
P43-PSTD-FLSH-LED4-LO-WWW-D1G
1620 Delivered Lumens
16 Watts
101 Lm/W
4000 CCT



Zonal Lumen Summary:
0-90 = 100%

1327

Vertical Angle	0°	25°	45°	65°	90°
0°	1317	1317	1317	1317	1317
5°	1271	1285	1311	1327	1296
15°	814	861	981	1159	1258
25°	521	549	638	861	1042
35°	386	393	429	580	828
45°	290	297	309	384	578
55°	205	208	217	253	346
65°	141	145	147	160	187
75°	48	77	84	81	79
85°	24	24	24	23	17
90°	0	0	0	0	0

Luminance Chart:

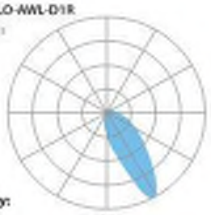
Angle	0°	45°	90°
45°	3390	3618	6847
55°	2952	3134	4958
65°	2768	2881	3646
75°	1543	2683	2572
85°	2292	2292	1746

UPTO 101 LM/W

FLUSH:	LO	MO	SO	HO
Lm/ft	400	600	800	900
W/Ft	4	6	8.3	10

PERIMETER FILL

LOW OUTPUT:
P43-PSTD-FLSH-LED3-LO-WWL-D1R
1594 Delivered Lumens
16 Watts
100 Lm/W
3000 CCT



Zonal Lumen Summary:
0-90 = 100%

1217

Vertical Angle	0°	22.5°	45°	67.5°	90°
0°	461	461	461	461	461
5°	552	545	525	494	460
15°	903	842	698	558	448
25°	1217	1212	1006	634	422
35°	899	944	1064	700	382
45°	614	635	730	705	325
55°	392	402	442	538	250
65°	225	230	244	301	159
75°	98	101	106	123	73
85°	15	16	17	29	12
90°	0	0	0	0	0

Luminance Chart:

Angle	0°	45°	90°
45°	7071	8411	3744
55°	5568	6274	3547
65°	4336	4704	3056
75°	3074	3344	2287
85°	1355	1598	1150

UPTO 100 LM/W

FLUSH:	LO	MO	SO	HO
Lm/Ft	400	600	800	900
W/Ft	4	6	8.3	10

me engineers
14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

STEAMBOAT BASE AREA
KVC (KIDS VACATION CLUB)

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L10

P43 | Cove & Perimeter
4" Perimeter

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

LUMEN MAINTENANCE
Designed to last with cool running mid-power LEDs projected to maintain 90% (L90) of their initial output for 100,000 hours (at HOL and L70 exceeding 150,000 hours.

LED SYSTEM LED modules and drivers are field replaceable.

PROG Programmable light output. Specify desired lumens or watts per linear foot. Min: 2½ w/ft, consult factory for requests above 12 w/ft.

BINNING Standard binning (all Prudential LED boards) includes testing at the chip level and board integration to provide consistent color temperature within a 3-step MacAdams ellipse, with +/- 5% lumen output range and +/- .004 Duv.

PRUBIN™ Prudential Ltg's exclusive 'job binning' method that ensures color temperature consistency across all luminaires on a project. Meticulously testing and labeling **EVERY LED BOARD** to +/- 25 lumens, +/- 50k CCT and +/- .004 Duv — while also separating positive from negative — allows us to match color, hue and intensity throughout a project and provides a consistent color temperature within a 2-step MacAdams ellipse.

LABELS CSA and ETL damp labeled and I.B.E.W. manufactured.

ELECTRICAL Must specify LED dimming controls. LED fixtures have constant current driver(s) with less than 20% THD when loaded to a minimum of 60%. Drivers sink a maximum of 6mA per driver. DM01 LED drivers are 0-10V dimmable and are compatible with most 0-10V wall slide dimmers and direct 0-10V analog signal dimmers. Max driver size 1¼" w x 1" h.

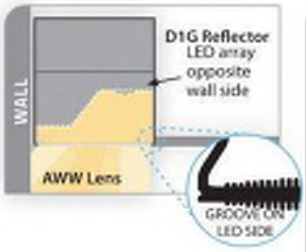
CONSTRUCTION

Housing	20-gauge steel, >20% PC recycled, 100% recyclable.
Lens	Acrylic, 100% recyclable.
X1, X2, X6 Trim	Steel.
X3, X7 Trim	Extruded aluminum.
Weight	**FLUSH** 4 lbs / ft.
	3" REGRESS 5 lbs / ft.

MOUNTING Recessed into drywall or T-bar ceilings.

WARRANTY Single-source, 5 year limited warranty covers standard components and construction.

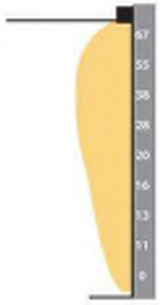
WALL GRAZER ORIENTATION



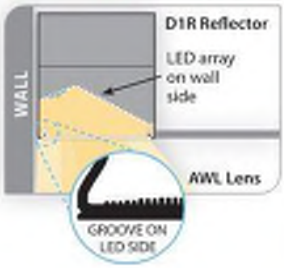
Smooth Wall Grazing.

A tight, focused beam grazes wall textures evenly, accenting and highlighting details to elevate the visual drama.

	Watts/ft	Ceiling Height	Average Illuminance	Max	Min	Max/Min Ratio
Standard Output - 750 lm/ft	10	9'	40fc	76fc	16fc	4.75



PERIMETER FILL ORIENTATION



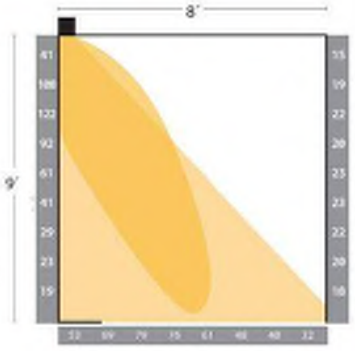
Perimeter Fill.

Fill a Corridor with Light — from the Perimeter.

It's a perimeter optic that washes corridors in light, offering outstanding light distribution, far more energy efficient than typical soft glow solutions and significantly reduces installation cost. Ideal for corridors where budget and energy efficiency conflict with strict IES requirements for high footcandles.

Suspended, surface mounted or recessed, perimeter lighting system.

	Watts/Sq. Ft.	Ceiling Height	Average Illuminance	Max/Min	Max/Min Ratio
Standard Output - 875 lm/ft	1.25	9'	57fc	79/32	2.5:1



Footcandles along the floor Reflectances 80: 50: 20

me engineers

STEAMBOAT BASE AREA
KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

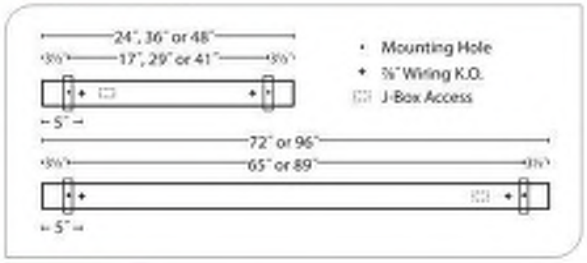
Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L10

P43 | Cove & Perimeter
4" Perimeter

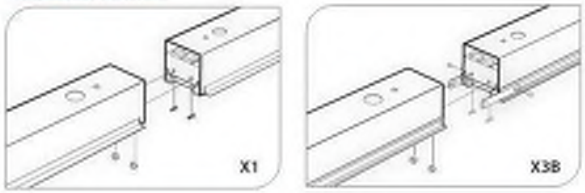
PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

MOUNTING LOCATIONS



CEILING SYSTEMS

ADJOINING DETAILS



Choose from one of our Premium Colors with no set-up fee.

For paint chip samples, please email: info@prulite.com

me engineers

STEAMBOAT BASE AREA

KVC (KIDS VACATION CLUB)

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4C - KVC IFC & PERMI**
Date: **04-Jun-21**
Project #: DV20131

Type: L10

P43 | Cove & Perimeter
4" Perimeter

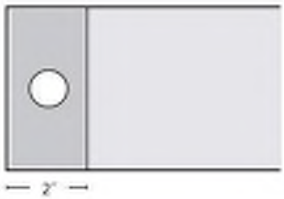
PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

CONTROL SENSORS

20S WattStopper PIR Occupancy

LUX Philips LuxSense Daylight Harvesting, used with Philips HFIR Driver

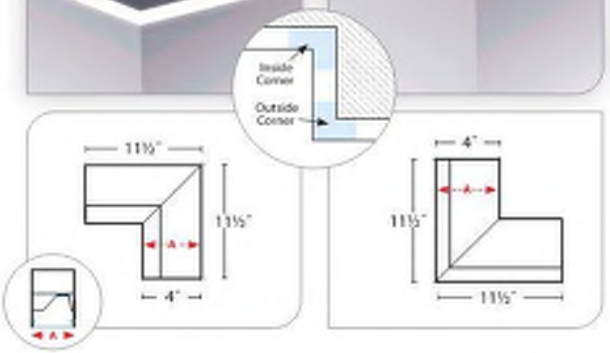
ENL Enlighted 2-Wire PIR Daylight, Motion & Environmental Sensor



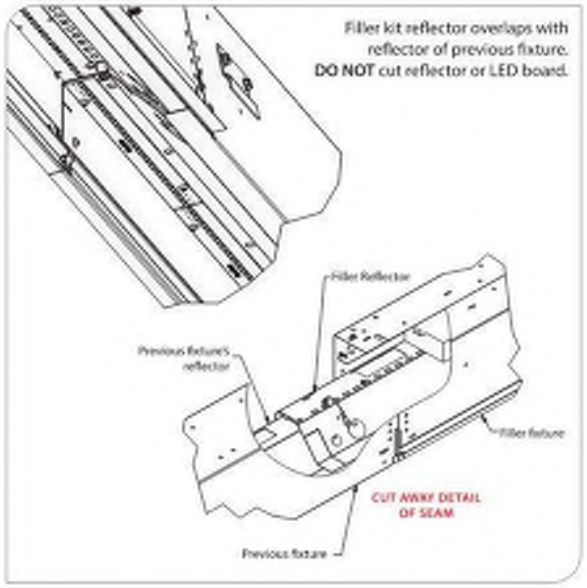
NOTE: Sensor plate will match fixture color finish

Consult factory for other sensors, please email: **info@prulite.com**

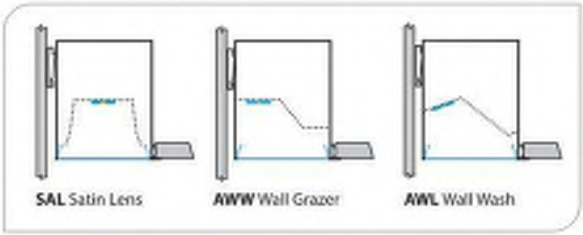
CORNERS



FIELD TRIMMABLE FILLER KIT



DISTRIBUTION CROSS SECTIONS



SAL Satin Lens

AWW Wall Grazer

AWL Wall Wash

PENDANTS

MODEL: D514

PREPARED BY: _____

TYPE: _____

JOB NAME: _____

DATE: _____

CERTIFICATION: UL LISTED

D514/41.5-80U/FWSTC/PR3/150INC

FINISH – Five stage pretreatment process, coated with a lead free TGI C polyester powder coat finish. White is standard inside reflectors, *some finish options excluded. See color chart below for color options (unless specified). Some finish options are not available for certain fixtures. Custom colors and Marine options are available upon request.

LAMP HOLDERS – Accommodates **Incandescent** – medium base porcelain socket, copper shell with nickel plate, rated 250v, 660W.

MOUNTING – Available with stem mounting, fixture is prewired with 48" or 96" leads.

REFLECTOR – Spun from heavy gauge 1100-0 aluminum, ranging in thickness from .050 to .125. Galvanized is from 20 gauge sheets.

MODEL #	FINISH	LIGHT SOURCE				MOUNTING OPTIONS	ACCESSORIES
		INC	CF*	MH*	LED		
D514	18, 19", 19P, 21P", 22P", 23P", 40", 41, 42, 43, 44, 45, 46, 48", 49", 50, 51, 52, 53, 54", 55, 57", 58", 59, 60, 61", 62", 63", 70", 71", 72", 73", 74, 75, 76, 77, 78", 79, 80, 81, 82, 83," 84", 85, 86, 87, 88", 89, 90, 91, 92", 93", 94", 95, 96, 97, 98", 99, PN	150W	N/A	N/A	N/A	STEM	N/A

* same finish color inside and out.
* remote ballast / driver.

.SUBJECT TO MODIFICATION WITHOUT NOTICE.

BASELITE CORPORATION
12260 EAST END AVE.
CHINO, CA 91710

PH: 877-999-1990
WEB: WWW.BASELITE.COM
EMAIL: SALES@BASELITE.COM

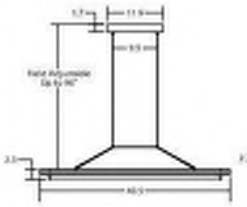
C UL LISTED

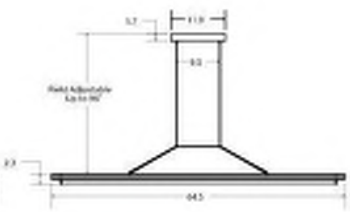
MADE IN U.S.A.

cerno

Penna 40 / Penna 64

linear pendant





Penna 40 dimensions: 40.5" x 7.7", 2.3"
Penna 64 dimensions: 64.5" x 7.7", 2.3"
Penna 40 weight: 7 lb
Penna 64 weight: 10 lb
Light source: integrated LED
Penna 40 light output: 1550 Lumens (source)
Penna 64 light output: 2350 Lumens (source)
Light color*: 2700 K or 3500 K
Color accuracy: 90+ CRI
Penna 40 power usage: 21 W
Penna 64 power usage: 35 W
Dimmable (see driver below)
Linear canopy included
Canopy dimensions: 11.9" x 4.4", 1.7"
Canopy finish: matte black (CM-085)
See website for more canopy information
8'-0" drop length, field adjustable
Suitable for a sloped ceiling
Wood grain will vary
Specifications subject to change

linear canopy,
matte black finish

brushed brass
(CM-008)

walnut
(CM-001)

distressed brass
(CM-009)

dark stained walnut
(CM-002)

brown leather
(CM-098)

MATERIAL & FINISH OPTIONS

Penna pendant part # 07-150- B -

Penna 40	40
Penna 64	64
Metal Finish	
brushed brass (CM-008)	R
distressed brass (CM-009)	D
Wood Body	
walnut (CM-001)	W
dark stained walnut (CM-002)	D
*Lamping**	
2700 K LED	27
3500 K LED	35
Driver	
120 V AC input voltage TRIAC, ELV & 0-10 V dimming	P1
277 V AC input voltage TRIAC, ELV & 0-10 V dimming	P2

Includes
brown leather (CM-098)
frosted polyneer (CM-057)

*Available in 3000K, 4000K and other color temperatures upon request

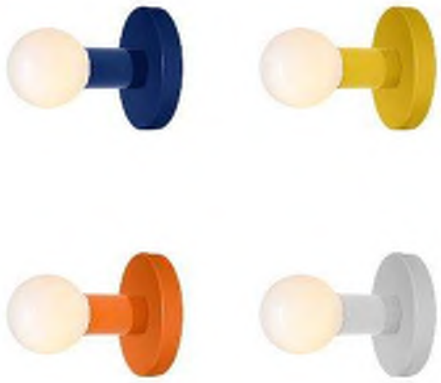
On our Cerno journey, we continue to evolve as designers and craftsmen. The Penna is a celebration of us showing and reflecting on our last ten years. This design is an embodiment of all the lessons that we have learned from designing and building thousands of lights. This fixture balances utility and sophisticated beauty well. The walnut, brass, and leather work in concert to compose a modern form with materials that have been used for thousands of years.

Nick Sheridan
Designer

WARNING. California Proposition 65 Warning for California Consumers. This product can expose you to chemicals including wood dust and lead which are known to the State of California to cause cancer or birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

949.715.1534 | CERNOGROUP.COM

Color Twink Sconce
60125



Measurements:

Backplate	5"
Depth	3.5"
Weight	1 lb

Available Finishes:

Available in multiple colors. Custom colors also available.

Material:

Steel

Wiring:

Configured to be hard-wired only; can be installed on ceiling.

Lampholder:

One medium base (E26) socket

Rating:

120V 60Hz, MAX 60W, Type A bulb (not included); fixture is dimmable. Fixture may be labeled for lower maximum wattage to meet energy efficiency requirements by request. UL Listed for dry locations. Damp locations available by request.

Dutton Brown Design LLC
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support@duttonbrown.com
www.duttonbrown.com

instagram.com/duttonbrown
facebook.com/duttonbrowndesign
pinterest.com/duttonbrown

EMERGENCY
Fixtures

LITHONIA LIGHTING

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for applications requiring attractive edge-lit exit signage, universal installation and low energy consumption.

CONSTRUCTION — Extruded brushed aluminum finish.

Clear acrylic panels- letters measure 6" high with 3/4" stroke, with 100 ft viewing distance rating, based upon UL 924 standard.

For single-face clear panels, EXIT is seen as a reversed image from the back.

OPTICS — LEDs mounted on printed circuit board. The typical life of the exit LED lamp is 10 years.

The LED operating frequency is 120Hz.

ELECTRICAL — Dual voltage input capacity (120/277V).

Battery: (EL Option) – Sealed, maintenance free nickel-cadmium battery delivers 90 minutes capacity to emergency lamps. Test switch provides manual activation of 30-second diagnostic testing for on-demand visual inspection.

Self-diagnostic testing (EL Option Only) for 30 seconds every 30 days and 90 minutes annually. Diagnostic evaluation of LED light source, AC to DC transfer, charging and battery condition.

INSTALLATION — EDG – Universal mounting canopy for top or end mount. Back mount standard for single face only. Canopy provided.

EDGR – Recessed mounting. Bar hanger and brackets provided for both new or restricted ceiling access installation applications. Back wall mount (WM) option.

Universal directional indicators. Field selected and attached.

LISTINGS — UL damp location listed 32°-122°F (0°-50°C) standard. Meets UL924, NFPA 101 (current Life Safety Code), NEC and OSHA illumination standards. Meets all applicable FCC Title 47, Part 15, Subpart B requirements.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25°C.

Specifications subject to change without notice.

† Exit Signs Certified in the CA Title 20 Appliance Efficiency Database.

EDG (surface mount)

EDGR (recessed mount)

LED Edge-Lit Exits

EDG
EDGR

LED Lamps

Specifications

EDG (End Mount)	EDG (Top Mount)
Length: 13-5/8 (34.6)	Length: 13 (33.0)
Depth: 5-1/2(14.0)	Depth: 4-5/16 (11.0)
Height: 11-1/8 (28.3)	Height: 11-3/4 (29.8)
Shipping Weight : 4 lbs (1.8 kgs)	Shipping Weight : 4 lbs (1.8 kgs)
EDG (Back Mount)	**EDGR**
Length: 13 (33.0)	Length: 13 (33.0)
Depth: 3 (7.6)	Depth: 1-3/4 (4.4)
Height: 11-1/8 (28.3)	Height: 8 (20.3)
Shipping Weight : 4 lbs (1.8 kgs)	Shipping Weight : 6.8 lbs (3.1 kgs) Shipping Weight (WM option) : 8.1 lbs (3.7 kgs)

All dimensions are inches (centimeters) unless otherwise noted.

ORDERING INFORMATION For shortest lead times, configure products using **bolded options.** **Example**: EDG 1 R EL

Family		Housing color		Number of faces	Letter color		Operations		Options	
EDG	Surface mount LED edge-lit exit	**(blank)**	Brushed aluminum	**1**	Single face	**R**	Red on clear (single face only)[2]	**(blank)**	AC only	**(blank)**	None
EDGR	Recessed LED edge-lit exit	W	White	**2**	Double face	**G**	Green on clear (single face only)[2]	**EL**	Nickel-cadmium battery	WM	Recessed wall mount[8]
						RMR	Red on mirror[2]	X2	Lamp wired on two separate AC circuits (specify 120V or 277V)[4]		
						GMR	Green on mirror[2]	SD	Self-diagnostics[5]		
						RW	Red on white[2]				
						GW	Green on white[2]				

Accessories: Order as separate item.	
ELA US12	12" stem kit with brushed aluminum canopy[7]
ELA W US12	12" stem kit with white canopy[7]
ELA WG1	Wireguard[6]

Notes

1. For single-face clear panels, EXIT is seen as a reversed image from the back.
2. Available with single and double face.
3. White panel standard for double and single face.
4. Not available with EL and SD options. Both circuits can be energized at the same time.
5. Available with EL option only.
6. Available on EDGR single face only.
7. See spec sheet ELA Standoffs. Only available for EDG.
8. Back mount only.

EDG-EDGR LED, Surface and Recessed Mount Edge-Lit Exits

SPECIFICATIONS

ELECTRICAL						
Primary Circuit						
Type	Typical LED life[1]	Supply voltage	EDG		EDGR	
			Input Watts	Max amps.	Input Watts	Max amps.
Red LED AC only	10 years	120	2.5	0.020	3.8	0.030
		277	2.8	0.010	4.5	0.014
Green LED AC only	10 years	120	2.2	0.020	3.8	0.030
		277	2.2	0.010	4.5	0.020
Red LED emergency	10 years	120	3.0	0.030	3.8	0.031
		277	3.1	0.010	4.5	0.015
Green LED emergency	10 years	120	2.6	0.020	3.8	0.031
		277	2.8	0.010	4.5	0.020

BATTERY (EL option)			
Sealed Nickel-Cadmium			
Shelf life[1]	Typical life[2]	Maintenance[3]	Temperature range[4]
3 years	7-9 years	none	32-122°F (0-50°C)

Notes:

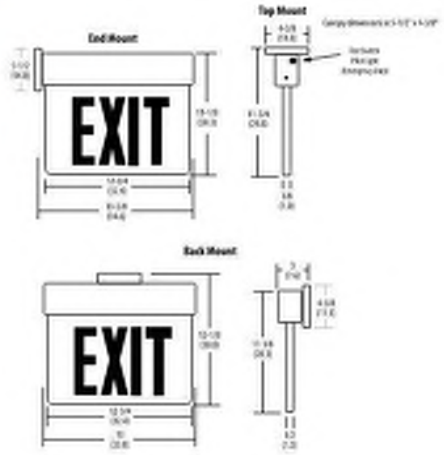
1. Based on continuous operation. The typical life of the exit LED lamp is 10 years.
2. At 77°F (25°C).
3. All life safety equipment, including emergency lighting for path of egress must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.
4. Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

KEY FEATURES

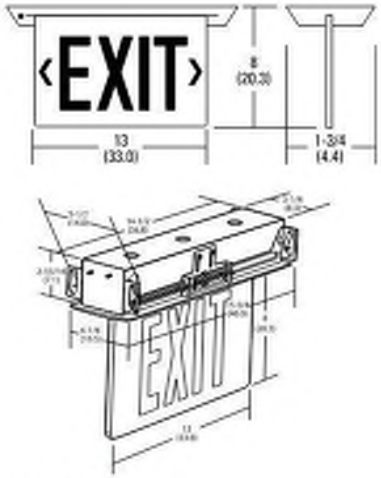
Universal chevron indicators for field selection/installation.

MOUNTING

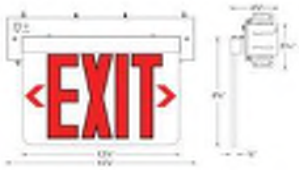
EDG



EDGR



EDGR WM option



APPENDIX A
Fixture Cuts

STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS
(A/C/F) & KVC

me engineers

Job Number:	Issue Description:	Issue Date:
DV20131	3P4D - GONDOLA SQUARE INTERIORS	5/21/2021

LED Fixtures

LITHONIA LIGHTING®

Catalog Number	
Notes	
Type	

LED Linear

CLX

24", 36", 48" and 96" Lengths

Flat Diffuse Lens

Round Diffuse Lens

Wide Diffuse Lens

FEATURES & SPECIFICATIONS

INTENDED USE — The CLX is a linear lighting solution that is available in multiple lengths, lumen packages and distributions. Designed for versatility, the CLX can address virtually any indoor lighting need. The CLX is also offered in standard and high efficacy configurations and capable of being continuous row mounted or installed as a stand-alone fixture. Ideal for uplight and downlight in commercial, retail, manufacturing, warehouse, and display applications. **Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate.** Click here for Acrylic Polycarbonate Compatibility table for suitable uses.

CONSTRUCTION — Channel and cover are formed from code-gauge cold-rolled steel. Housing and lens endcaps are injection-molded plastic to provide a more architectural look and feel. The endcaps come standard with a 7/8" knock out for continuous mounting but can be ordered without.

Finish: Paint options include high-gloss, baked white polyester (WH), galvanized (GALV), matte black (MBL) and smoke gray (SMGY). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

OPTICS — Offered with acrylic lens and less lens configurations. Provides a choice of optical distributions including, wide, narrow, and axile.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications. (See PLR_ ordering information on page 14.) Electronic LED driver is multi-volt input and 0-10V dimming standard (see Operational Data on page 12 for actual wattage consumption). This fixture is designed to withstand a maximum line surge of 2.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

L70>100,000 hours at 25°C.

LEDs provide nominal 80 CRI or 90 CRI at 3000 K, 3500 K, 4000 K, or 5000 K.

Lumen output up to 2,500 lumens per foot.

INSTALLATION — Fixture may be ceiling or wall mounted (with or without THCLX hanger or angle mounted with CLXANGBRT), pendant or stem mounted with appropriate mounting options.

WARNING — Removing the lens and opening the fixture during installation exposes the LEDs, putting them at risk for damage.

If you plan to surface mount the fixture, we recommend using the THCLX. This eliminates the need to open the fixture.

If you plan to continuous row mount, we recommend using the PLR wiring harness option. This eliminates the need to open the fixture.

Damage to the LEDs caused during installation will not be covered under the warranty.

LISTINGS — CSA certified to US and Canadian safety standards. For use in damp locations between -4°F (-20°C) and 104°F (40°C). Optional High Ambient (HA) ranging to 122°F(50°C) available on certain lumen packages (See ambient temperature chart for additional information).
DesignLights Consortium® (DLC) Premium qualified product and DLC qualified product. Not all versions of this product may be DLC Premium qualified or DLC qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Note: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Stock configurations are offered for shorter lead times:

Stock Part Number	UPC	DLC QPL Product ID	DLC Premium
CLX L48 3000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525816	PSANK2R4	Yes
CLX L48 3000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525885	PKW32VKL	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525939	P778Z20	Yes
CLX L48 5000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525908	P8442C1H	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525861	PPFTGR8V	Yes
CLX L96 6000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525915	PWK250TE	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 40K 80CRI WH	00191723525922	PYRDC7EW	Yes
CLX L96 10000LM SEF FDL MVOLT GZ10 50K 80CRI WH	00191723525830	PKYPL35K	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525960	PSANK2R4	Yes
CLX L48 3000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525892	PKW32VKL	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525854	P778Z20	Yes
CLX L48 5000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525946	P8442C1H	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525878	PPFTGR8V	Yes
CLX L96 6000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525823	PD0SSHKD	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 40K 80CRI WH	00191723525953	PYRDC7EW	Yes
CLX L96 10000LM SEF RDL MVOLT GZ10 50K 80CRI WH	00191723525847	PKYPL35K	Yes

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or XPoint™ Wireless control networks marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

CLX LED Linear

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: CLX L48 5000LM SEF WDL MVOLT GZ10 40K 80CRI WH

Series	Length		Nominal lumens		Performance package		Louver		Lens	
CLX LED linear	L24	24"[1,2]	1500LM	1,500 lumens	SEF	Standard efficiency[3]	(Blank)	Less louver	L/Lens	Less lens
			2000LM	2,000 lumens	HEF	Premium efficiency	SBLW	Straight blade louver, white	FDL	Flat diffuse[3,4]
			2500LM	2,500 lumens			SBLMB	Straight blade louver, matte black	RDL	Round diffuse
			3500LM	3,500 lumens			SBLGV	Straight blade louver, galvanized	WDL	Wide diffuse
			4500LM	4,500 lumens			SBLSMGY	Straight blade louver, smoke gray		
			5000LM	5,000 lumens						
	L36	36"[2]	2250LM	2,250 lumens						
			3000LM	3,000 lumens						
			3750LM	3,750 lumens						
			5250LM	5,250 lumens						
			6750LM	6,750 lumens						
			7500LM	7,500 lumens						
	L48	48"	3000LM	3,000 lumens						
			4000LM	4,000 lumens						
			5000LM	5,000 lumens						
			7000LM	7,000 lumens						
			9000LM	9,000 lumens						
			10000LM	10,000 lumens						
	L96	96"	6000LM	6,000 lumens						
			8000LM	8,000 lumens						
			10000LM	10,000 lumens						
			14000LM	14,000 lumens						
			18000LM	18,000 lumens						
			20000LM	20,000 lumens						

Distribution		Voltage				Driver		Color temperature		Coloring rendering index	
(Blank)	General	MVOLT	120-277V	277	277V	GZ10	0-10V dimming	30K	3000 K	80CRI	80 CRI
ND	Narrow	120	120V	347	347V	EZ1	Dimming to 1%	35K	3500 K	90CRI	90 CRI
WD	Wide	208	208V	480	480V			40K	4000 K		
AD2	Aisle, 24" off center	240	240V					50K	5000 K		

Options

PS1050	Emergency battery pack, 10W, CA Title 20 Noncompliant
E10WLCP	Emergency battery pack, 10W Linear Constant Power, Certified in CA Title 20 MAEDBS
BGTD	Generator transfer device, not available with PS1050
OCS	5', 18/3 Reloc selectable One Pass cable
HA	High ambient, for use in ambient temperatures up to 50°C
EPNKO	Decorative endplate, no knock out
OUTCTR	Wiring leads pulled through back center of fixture
OUTEND	Wiring leads pulled through end of fixture
Cord Sets:	
CS1W	Straight blade plug, 120V
CS3W	NEMA twist-lock plug, 120V
CS7W	Straight blade plug, 277V
CS11W	NEMA twist-lock plug, 277V
CS25W	NEMA twist-lock plug, 347V
CS97W	NEMA twist-lock plug, 480V
CS93W	600V SEOOW white cord, no plug (no voltage required)
CS6WC16S10WDSO	6' white cord, 16/5, no plug, includes low voltage dimming wires (no voltage required)
PLR___	Plug-in wiring, see page 16 for ordering information
PLR1LVG	Plug-in wiring, low voltage dimming
RRL___	RELOC®-ready luminaire. See page 15 for ordering information
SPD	Surge protection device, provides up to 6kV protection
USPOM	Assembled in the United States
nLight® Wireless:	
NLTAIR2 RES7	nLight® Generation 2 enabled PIR integral occupancy sensor with automatic dimming photocell
NLTAIR2 RES7PDT	nLight AIR Generation 2 enabled dual technology integral occupancy sensor with automatic dimming photocell
NLTAIR2 RIO	No sensor control
nLight® Wired:	
N100	nLight® without lumen management
NES7	nLight® nES 7 PIR integral occupancy sensor
NESPDT7	nLight® nES PDT 7 dual technology integral occupancy control
NES7ADCX	nLight® nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell
NESPDT7ADCX	nLight® nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell
Individual controls:	
MSD7	PIR integral occupancy sensor
MSDPDT7	PDT 7 dual technology integral occupancy control
MSD7ADC	PIR integral occupancy sensor with automatic dimming control photocell
MSDPDT7ADC	PDT integral occupancy sensor with automatic dimming control photocell

Finish

WH	White
GALVW	Galvanized with white lens end caps
GALVB	Galvanized with black lens end caps
MB	Matte black
SMGYW	Smoke gray with white lens end caps
SMGYB	Smoke gray with black lens end caps

See Accessories and footnotes on next page

CLX LED Linear

Accessories: *Order as separate catalog number.*

Mounting:

ZACVH W100	Adjustable 10' aircraft cable with Y hanger (1 pair)
ZAC120	One adjustable aircraft cable with canopy 120" [17]
ZACFP120	One adjustable aircraft cable with feed (3 conductor) and canopy, 120" [17]
ZACFPD120	One adjustable aircraft cable with feed (5 conductor) and canopy 120" [18]
ZAC240	One adjustable aircraft cable with canopy 240" [17]
ZACFP240	One adjustable aircraft cable with feed (3 conductor) and canopy, 240" [17]
ZACFPD240	One adjustable aircraft cable with feed (5 conductor) and canopy 240" [18]
SQ_	Swivel stem hanger (specify length in 2" increments up to 48") [17]
THCLX___	Tong hanger (Must specify color) (one pair) [28]
CLXANGBKT ____	Angle bracket, (Must specify color) (one pair) [28]
HC39 M12	Hanger chain, 36" (1 pair)

Sensors & Controls:

LSXR	Sensor Switch * LSXR occupancy sensor [29]
NPP16D	nLight® switching/dimming module
NPP16DER	nLight® switching/dimming module with emergency relay
rPP20D	nLight® air dimming/switching module
XPA CMRBD	XPoint™ Wireless 0-10V relay, external, 55°C max ambient

Reflectors:

CLXRW24___	Wide decorative 24" reflector, (Must specify color) [11]
CLXRW36___	Wide decorative 36" reflector, (Must specify color) [11]
CLXRW48___	Wide decorative 48" reflector, (Must specify color) [11]
CLXRW96___	Two wide decorative 48" reflectors, (Must specify color) [11]
CLXRWU24___	Wide decorative 24" reflector with uplight, (Must specify color) [11]
CLXRWU36___	Wide decorative 36" reflector with uplight, (Must specify color) [11]
CLXRWU48___	Wide decorative 48" reflector with uplight, (Must specify color) [11]
CLXRWU96___	Two wide decorative 48" reflectors with uplight, (Must specify color) [11]
CLXRN24	Narrow 24" reflector, (Must specify color) [11]
CLXRN36	Narrow 36" reflector, (Must specify color) [11]
CLXRN48	Narrow 48" reflector, (Must specify color) [11]
CLXRN96___	Two narrow 48" reflectors, (Must specify color) [11]

Wireguards:

WGCLX24___	24" wireguard, (Must specify color) [12]
WGCLX36___	36" wireguard, (Must specify color) [12]
WGCLX48___	48" wireguard, (XX, (Must specify color) 96" fixture requires two [12]

Notes

1. Not available with OBTCTR option.
2. Not available with HA option.
3. Not available with SEF when ordered in combination with EZ1.
4. Not available with NLTAIR2 REST, NLTAIR2 RESTPDT, or NLTAIR2 RID.
5. Not available with EZ1 when ordered with L24 with 5000LM or L36 with 7500LM.
6. When ordered with L24 only available with 7500LM or 10000LM in combination with SZ10 driver. Not for use with THCLX, CLXANGBKT, CLX reflectors or WGCLX accessories. Not available with RDL lens options.
7. Only available with general distribution.
8. Not available with CLXRN accessories.
9. Available L/LENS only.
10. Not available with PS1050, E10WLCP, or BGTD.
11. Not available with BGTD option.
12. Voltage selected utilizes a step-down transformer. Not available with L24 when ordered with N100.Not available with PS1050, E10WLCP or BGTD option.
13. Requires SFD option.
14. When continuous row mounting, fixtures must all have the same driver selection.
15. Not available with individual controls, nLight wired networking, nLight wireless networking, nLight wireless zone control options.
16. Must specify voltage.
17. Not available with L24 or L36. Not available with L48 in combination with N100.
18. Available with L48 or L96 only. 20 Not available with PS1050 or E10WLCP options. Not available with 208 or 240V. Not available Individual controls, NLight Wired, or NLight Wireless options.
19. Not available DUTINO.
20. Required with PS1050, E10WLCP, BGTD, RAB, or XADP24.
21. Not available with PLR options.
22. Not available with XPoint, Individual controls, NLight Wired, or NLight Wireless options.
23. Sensor housing will be the same color as lens end caps.
24. Not available with L24 in combination with 5000LM, nor available with L36 in combination with 7500LM, not available with L48 in combination with 10000LM, and not available with L96 in combination with 14000LM, 18000LM, or 20000LM. Not available with PLRs containing low voltage dimming wires.
25. Not available with any other control option. Requires EZ1.
26. Requires N100 option.
27. Ships standard as white.
28. Not available with louver, wireguards, wide reflectors.
29. More configurations on LSXR Specification Sheet.
30. L24 reflector is 22.65", L36 reflector is 34.07", L48 reflector is 46.86", L96 comes with two L48 reflectors.
31. For use with L/LENS fixtures only. L24 reflector is 22.75", L36 reflector is 34.20", L48 reflector is 46.85", L96 comes with two L48 reflectors.
32. Not for use with CLX wide reflector accessories.

OPTIONS AND ACCESSORIES

Narrow reflector
Ships separately from fixture.
Order as:
CLXRN24___
CLXRN36___
CLXRN48___
CLXRN96___

Wide decorative reflector
Ships separately from fixture.
Order as:
CLXRW24___
CLXRW36___
CLXRW48___
CLXRW96___

Wireguard
Ships separately from fixture.
96" fixture requires two WGCLX48.
Order as:
WGCLX24___
WGCLX36___
WGCLX48___

Aircraft Cable with Canopy
Available in 120" or 240"
Order as:
ZAC120
ZAC240

HANGER CHAIN
36" chain with Y hanger, ships as a pair
Order as:
HC36

ZACVH HANGER
10' Aircraft cable with Y hanger.
Order as:
ZACVH

Tong hanger
Ships as a pair
Order As:
THCLX___

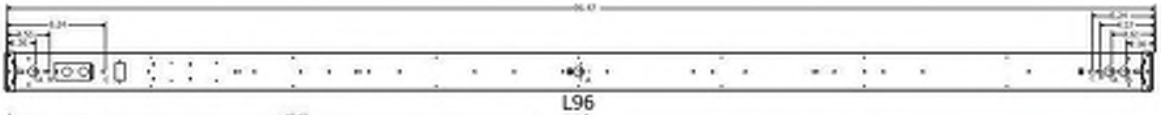
CLX LED Linear

DIMENSIONS

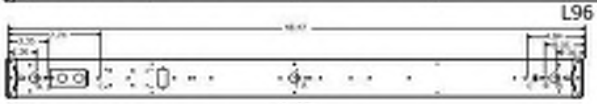
All dimensions are in inches (centimeters) unless otherwise indicated.
Dimensions may vary with options or accessories.

INTEGRATED SENSOR ADDS 2.0 INCHES TO STANDALONE FIXTURE LENGTH
HOUSING END CAP ADDS 0.236 INCHES TO FIXTURE LENGTH PER SIDE. DIMENSIONS BELOW INCLUDE ENDCAPS.

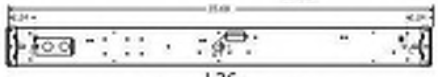
A - 7/8" KNOCK OUT
B - 0.5" by 0.16" SLOT
C - 0.3" DIA HOLE



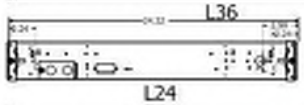
L96



L48



L36



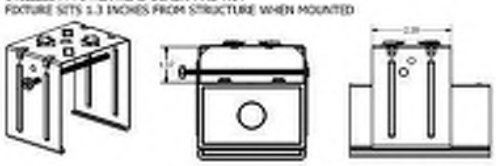
L24

L24 WITH SENSOR

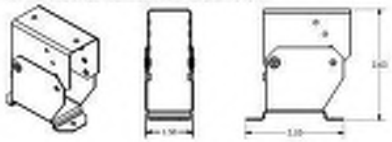
PALLET DIMENSIONS

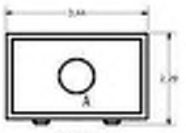
Length	Approx Weight	Fixtures per pallet	Pallet Dims (L X W X H)
L24	4 lb	100	54x46x37
L36	5 lb	80	54x46x37
L48	7.5 lb	64	54x46x37
L96	14 lb	64	98x46x37

THCLX - SHIPS TWO PER ORDER,
UTILIZES A #8 HEX HEAD SCREW AND NUT
FIXTURE SITS 1.3 INCHES FROM STRUCTURE WHEN MOUNTED

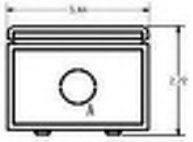


CLXANGBKT - SHIPS TWO PER ORDER
HOLES TO MOUNTING STRUCTURE ARE 0.175" DIA, 2.5" APART
FIXTURE SITS APPROXIMATELY 3.5" FROM STRUCTURE
WHEN MOUNTED HORIZONTAL TO STRUCTURE

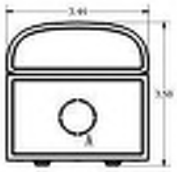




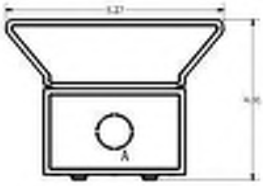
L/LENS



FDL



RDL



MDL

PHOTOMETRICS

See www.lithonia.com.

CLX LED Linear

POWER SENTRY EMERGENCY BATTERY PACKS

		SEF Emergency Lumens	HEF Emergency Lumens
PS1050	Factory installable	1400	1500
E10WLCP	Factory installable	1400	1500
PS1555LCP	Field installable, remote mount only	2000	2100

Note: For emergency lumen output of specific model, please consult factory. One board will be illuminated during emergency operation.

CLX CHARACTERISTICS

Nominal Lumen Package	Length	Wattage								Length	Width	Depth	Comparable Light Source
		Standard efficiency				High efficiency							
		120V	277V	347V	480V	120V	277V	347V	480V	Dimensions are shown in inches			
2500LM	24"	19.9	19.9	25.9	25.9	18.5	18.5	24.5	24.5	24	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
5000LM	24"	41.9	41.9	47.9	47.9	37.9	37.9	43.9	43.9	24	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
3750LM	36"	28.1	28.1	34.1	34.1	27.0	27.0	33.0	33.0	36	3.5	3.75	1-lamp 32WT8, 1-lamp 54W T5HO, 50W HID
7500LM	36"	62.9	62.9	68.9	68.9	56.8	56.8	62.8	62.8	36	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
5000LM	48"	35.4	35.4	41.4	41.4	32.9	32.9	38.9	38.9	48	3.5	3.75	2-lamp 32WT8, 1-lamp 54W T5HO, 70W HID
10000LM	48"	77.1	77.1	83.1	83.1	70.4	70.4	76.4	76.4	48	3.5	3.75	3 -lamp 32WT8, 2-lamp 54W T5HO, 100W HID
10000LM	96"	70.8	70.8	76.8	76.8	65.8	65.8	71.8	71.8	96	3.5	3.75	3 -lamp 32WT8, 2-lamp 54W T5HO, 100W HID
20000LM	96"	154.2	154.2	160.2	160.2	140.8	140.8	146.8	146.8	96	3.5	3.75	6 - lamp 32WT8, 4 -lamp 54T5HO, 200W HID

AMBIENT TEMPERATURE RATINGS

Driver Package		GZ10			EZ1			Any Driver	
Length	Lumen package	Direct Surface	THCLX/ Suspended	HA Option (Direct or Suspended)	Direct Surface	THCLX	Suspended 18"	Xpoint/ BGTD Direct Surface	PS1050 Suspended
L24	1500LM	40C°	40C°	N/A	35C°	35C°	35C°	N/A	N/A
	2000LM	40C°	40C°		35C°	35C°	35C°		
	2500LM	40C°	40C°		35C°	35C°	35C°		
	3500LM	40C°	40C°		40C°	40C°	40C°		
	4500LM	40C°	40C°		35C°	35C°	40C°		
	5000LM	40C°	40C°		25C°	30C°	35C°		
L36	2250LM	40C°	40C°		40C°	40C°	40C°		
	3000LM	40C°	40C°		40C°	40C°	40C°		
	3750LM	40C°	40C°		40C°	40C°	40C°		
	5250LM	40C°	40C°		35C°	35C°	40C°		
	6750LM	30C°	40C°		35C°	35C°	40C°		
	7500LM	30C°	40C°		25C°	30C°	35C°		
L48	3000LM	40C°	40C°	50C°	40C°	40C°	40C°	35C°	25C°
	4000LM	40C°	40C°	50C°	40C°	40C°	40C°		
	5000LM	40C°	40C°	50C°	35C°	35C°	40C°		
	7000LM	30C°	40C°	N/A	35C°	35C°	40C°		
	9000LM	30C°	40C°		25C°	30C°	35C°		
	10000LM	30C°	40C°		25C°	30C°	35C°		
L96	6000LM	40C°	40C°	50C°	35C°	35C°	40C°		
	8000LM	30C°	40C°	50C°	35C°	35C°	40C°		
	10000LM	30C°	40C°	50C°	25C°	30C°	35C°		
	14000LM	40C°	40C°	N/A	35C°	35C°	40C°		
	18000LM	30C°	40C°		25C°	30C°	35C°		
	20000LM	30C°	40C°		25C°	30C°	35C°		

CLX LED Linear

CLX OPERATIONAL DATA

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L24	1500LM	SEF	80	1497	1540	1582	1619	10.85
				90	1305	1333	1371	1441	10.85
			HEF	80	1493	1514	1582	1586	10.39
				90	1220	1237	1301	1301	10.39
		2000LM	SEF	80	2066	2125	2183	2235	14.48
				90	1801	1840	1892	1989	14.48
			HEF	80	2060	2089	2183	2189	13.46
				90	1684	1708	1796	1796	13.46
		2500LM	SEF	80	2616	2689	2763	2829	18.41
				90	2279	2329	2394	2517	18.41
			HEF	80	2607	2644	2763	2771	17.42
				90	2132	2161	2273	2273	17.42
		3500LM	SEF	80	3518	3617	3716	3804	25.83
				90	3065	3132	3220	3385	25.83
			HEF	80	3506	3556	3716	3726	25.04
				90	2867	2907	3057	3057	25.04
		4500LM	SEF	80	5048	5182	5325	5451	38.7
				90	4392	4487	4614	4851	38.7
			HEF	80	5024	5096	5325	5339	34.8
				90	4108	4165	4380	4380	34.8
		5000LM	SEF	80	5355	5506	5657	5791	41.48
				90	4667	4767	4902	5153	41.48
			HEF	80	5338	5414	5657	5672	38.11
				90	4364	4425	4653	4653	38.11
	L36	2250LM	SEF	80	2411	2547	2101	2207	16.36
				90	2479	2607	2146	2320	16.36
			HEF	80	2437	2554	1965	2095	15.47
				90	2547	2403	1992	2095	15.47
		3000LM	SEF	80	3221	3388	2730	3868	20.8
				90	3310	3133	2789	3015	20.8
			HEF	80	3167	3319	2553	2722	19.98
				90	3310	3123	2589	2722	19.98
		3750LM	SEF	80	4123	4337	3495	3671	26.47
				90	4236	4010	3570	3859	26.47
			HEF	80	4054	4248	3268	3485	25.09
				90	4236	3997	3314	3485	25.09
		5250LM	SEF	80	5545	5833	4700	4937	39.9
				90	5698	5393	4801	5190	39.9
			HEF	80	5452	5713	4396	4687	34.3
				90	5698	5376	4457	4687	34.3
		6750LM	SEF	80	7081	7448	6001	6303	54.85
				90	7275	6886	6131	6627	54.85
			HEF	80	6962	7294	5613	5984	47.97
				90	7275	6864	5691	5984	47.97
		7500LM	SEF	80	7756	8158	6574	6905	62.6
				90	7969	7543	6716	7260	62.6
			HEF	80	7626	7991	6148	6555	54.02
				90	7969	7519	6234	6555	54.02

CLX LED Linear

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
L/Lens	L48	3000LM	SEF	80	3019	3134	3190	3265	20.32
				90	2631	2688	2764	2906	20.32
			HEF	80	3010	3052	3190	3198	19.01
				90	2461	2495	2624	2624	19.01
		4000LM	SEF	80	4034	4148	4262	4363	27.58
				90	3515	3591	3693	3882	27.58
			HEF	80	4021	4078	4262	4273	24.75
				90	3288	3334	3505	3505	24.75
		5000LM	SEF	80	5047	5189	5332	5458	34.8
				90	4398	4493	4620	4857	34.8
			HEF	80	5031	5102	5332	5346	31.77
				90	4113	4171	4386	4386	31.77
		7000LM	SEF	80	7311	7517	7724	7907	49.05
				90	6371	6509	6682	7036	49.05
			HEF	80	7288	7391	7724	7744	44.67
				90	5959	6042	6353	6353	44.67
		9000LM	SEF	80	9215	9475	9735	9967	63.99
				90	8031	8294	8435	8869	63.99
			HEF	80	9186	9317	9735	9762	58.58
				90	7511	7615	8008	8008	58.58
		10000LM	SEF	80	10299	10590	10880	11139	73.37
				90	8975	9169	9427	9912	73.37
			HEF	80	10266	10412	10880	10910	66.27
				90	8394	8511	8950	8950	66.27
	L96	6000LM	SEF	80	5942	6110	6278	6427	38.15
				90	5178	5290	5439	5719	38.15
			HEF	80	5923	6008	6278	6294	35.54
				90	4843	4911	5164	5164	35.54
		8000LM	SEF	80	7929	8153	8376	8575	52.32
				90	6910	7059	7258	7631	52.32
			HEF	80	7903	8016	8376	8399	48.5
				90	6462	6552	6890	6890	48.5
		10000LM	SEF	80	9808	10085	10362	10608	66.47
				90	8548	8732	8978	9439	66.47
			HEF	80	9777	9916	10362	10390	60.89
				90	7994	8106	8523	8523	60.89
		14000LM	SEF	80	14323	14727	15131	15491	94.78
				90	12482	12752	13111	13784	94.78
			HEF	80	14277	14480	15131	15172	85.96
				90	11674	11836	12447	12447	85.96
		18000LM	SEF	80	18458	18979	19500	19963	128.98
				90	16086	16433	16896	17764	128.98
			HEF	80	18399	18661	19500	19552	116.92
				90	15044	15254	16040	16040	116.92
		20000LM	SEF	80	20386	20962	21537	22048	146.83
				90	17766	18150	18661	19619	146.83
			HEF	80	20321	20610	21537	21595	131.6
				90	16616	16847	17716	17716	131.6

CLX LED Linear

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L24	1500LM	SEF	80	1359	1397	1436	1470	10.85
				90	1184	1210	1244	1308	10.85
			HEF	80	1355	1374	1436	1439	10.39
				90	1107	1123	1181	1181	10.39
		2000LM	SEF	80	1875	1928	1981	2028	14.48
				90	1634	1670	1717	1805	14.48
			HEF	80	1869	1896	1981	1987	13.46
				90	1528	1550	1630	1630	13.46
		2500LM	SEF	80	2374	2441	2508	2567	18.41
				90	2069	2113	2173	2284	18.41
			HEF	80	2366	2400	2508	2514	17.42
				90	1935	1962	2063	2063	17.42
		3500LM	SEF	80	3192	3282	3372	3452	25.83
				90	2782	2842	2922	3072	25.83
			HEF	80	3182	3227	3372	3381	25.04
				90	2602	2638	2774	2774	25.04
		4500LM	SEF	80	4574	4703	4832	4947	38.7
				90	3986	4072	4187	4402	38.7
			HEF	80	4560	4624	4832	4845	34.8
				90	3728	3780	3975	3975	34.8
		5000LM	SEF	80	4860	4997	5134	5256	41.48
				90	4235	4327	4448	4677	41.48
			HEF	80	4844	4913	5134	5148	38.11
				90	3961	4016	4223	4223	38.11
	L36	2250LM	SEF	80	2188	2250	2311	2366	16.36
				90	1907	1948	2003	2106	16.36
			HEF	80	2181	2212	2311	2318	15.47
				90	1783	1808	1901	1901	15.47
		3000LM	SEF	80	2843	2924	3004	3075	20.8
				90	2478	2531	2603	2736	20.8
			HEF	80	2834	2875	3004	3012	19.98
				90	2317	2350	2471	2471	19.98
		3750LM	SEF	80	3639	3742	3845	3936	26.47
				90	3171	3240	3331	3502	26.47
			HEF	80	3628	3679	3845	3855	25.09
				90	2966	3007	3162	3162	25.09
		5250LM	SEF	80	4895	5033	5171	5294	39.9
				90	4265	4357	4480	4710	39.9
			HEF	80	4879	4948	5171	5185	34.3
				90	3989	4045	4253	4253	34.3
		6750LM	SEF	80	6250	6426	6602	6759	54.85
				90	5446	5564	5721	6014	54.85
			HEF	80	6230	6318	6602	6620	47.97
				90	5094	5165	5431	5431	47.97
		7500LM	SEF	80	6846	7039	7232	7404	62.6
				90	5966	6095	6266	6588	62.6
			HEF	80	6834	6921	7232	7252	54.02
				90	5580	5657	5949	5949	54.02

CLX LED Linear

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
RDL	L48	3000LM	SEF	80	2740	2817	2895	2963	20.32
				90	2388	2439	2588	2637	20.32
			HEF	80	2731	2770	2895	2902	19.01
				90	2233	2264	2381	2381	19.01
		4000LM	SEF	80	3661	3764	3868	3959	27.58
				90	3190	3259	3351	3523	27.58
			HEF	80	3649	3701	3868	3878	24.75
				90	2984	3025	3181	3181	24.75
		5000LM	SEF	80	4580	4710	4839	4954	34.8
				90	3992	4078	4193	4408	34.8
			HEF	80	4566	4631	4839	4852	31.77
				90	3733	3785	3980	3980	31.77
		7000LM	SEF	80	6615	6822	7009	7136	49.05
				90	5782	5907	6073	6385	49.05
			HEF	80	6614	6708	7009	7028	44.67
				90	5408	5483	5766	5766	44.67
		9000LM	SEF	80	8363	8599	8835	9045	63.99
				90	7288	7446	7655	8049	63.99
			HEF	80	8336	8455	8835	8859	58.58
				90	6816	6911	7268	7268	58.58
		10000LM	SEF	80	9347	9611	9874	10109	73.37
				90	8145	8321	8556	8995	73.37
			HEF	80	9317	9450	9874	9901	66.27
				90	7618	7724	8122	8122	66.27
	L96	6000LM	SEF	80	5393	5545	5697	5832	38.15
				90	4700	4801	4936	5190	38.15
			HEF	80	5375	5452	5687	5712	35.54
				90	4395	4457	4686	4686	35.54
		8000LM	SEF	80	7196	7399	7602	7782	52.32
				90	6271	6406	6587	6925	52.32
			HEF	80	7173	7275	7602	7622	48.5
				90	5865	5946	6253	6253	48.5
		10000LM	SEF	80	8902	9153	9404	9627	66.47
				90	7757	7925	8148	8567	66.47
			HEF	80	8873	8999	9404	9429	60.89
				90	7255	7356	7735	7735	60.89
		14000LM	SEF	80	12999	13366	13732	14058	94.78
				90	11328	11573	11899	12510	94.78
			HEF	80	12957	13142	13732	13769	85.96
				90	10594	10742	11296	11296	85.96
		18000LM	SEF	80	16751	17224	17697	18117	128.98
				90	14598	14913	15334	16121	128.98
			HEF	80	16698	16936	17697	17744	116.92
				90	13653	13843	14557	14557	116.92
		20000LM	SEF	80	18501	19023	19545	20009	146.83
				90	16123	16471	16935	17805	146.83
			HEF	80	18442	18705	19545	19598	131.6
				90	16079	15290	16078	16078	131.6

CLX LED Linear

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L24	1500LM	SEF	80	1320	1358	1395	1428	10.85
				90	1151	1175	1208	1271	10.85
			HEF	80	1316	1335	1395	1399	10.39
				90	1076	1091	1147	1147	10.39
		2000LM	SEF	80	1822	1874	1925	1971	14.48
				90	1588	1622	1668	1754	14.48
			HEF	80	1816	1842	1925	1930	13.46
				90	1485	1506	1583	1583	13.46
		2500LM	SEF	80	2306	2371	2436	2494	18.41
				90	2010	2053	2111	2219	18.41
			HEF	80	2299	2332	2436	2443	17.42
				90	1880	1906	2004	2004	17.42
		3500LM	SEF	80	3302	3389	3277	3354	25.83
				90	2703	2761	2839	2985	25.83
			HEF	80	3092	3136	3277	3285	25.04
				90	2528	2563	2685	2685	25.04
		4500LM	SEF	80	4444	4570	4685	4807	38.7
				90	3873	3957	4068	4277	38.7
			HEF	80	4430	4493	4685	4708	34.8
				90	3622	3673	3862	3862	34.8
		5000LM	SEF	80	4722	4855	4988	5107	41.48
				90	4115	4204	4322	4544	41.48
			HEF	80	4707	4774	4988	5002	38.11
				90	3848	3902	4103	4103	38.11
	L36	2250LM	SEF	80	2126	2186	2246	2299	16.36
				90	1852	1892	1946	2046	16.36
			HEF	80	2119	2149	2246	2252	15.47
				90	1732	1757	1847	1847	15.47
		3000LM	SEF	80	2762	2840	2918	2988	20.8
				90	2407	2459	2529	2659	20.8
			HEF	80	2754	2793	2918	2926	19.98
				90	2251	2283	2401	2401	19.98
		3750LM	SEF	80	3536	3636	3735	3824	26.47
				90	3081	3148	3237	3403	26.47
			HEF	80	3525	3575	3735	3745	25.09
				90	2882	2922	3073	3073	25.09
		5250LM	SEF	80	4755	4890	5024	5143	39.9
				90	4144	4234	4353	4577	39.9
			HEF	80	4740	4808	5024	5037	34.3
				90	3876	3930	4132	4132	34.3
		6750LM	SEF	80	6072	6243	6415	6567	54.85
				90	5292	5406	5558	5844	54.85
			HEF	80	6053	6139	6415	6432	47.97
				90	4949	5018	5276	5276	47.97
		7500LM	SEF	80	6651	6839	7027	7194	62.6
				90	5796	5922	6088	6401	62.6
			HEF	80	6630	6725	7027	7046	54.02
				90	5421	5497	5780	5780	54.02

CLX LED Linear

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
FDL	L48	3000LM	SEF	80	2662	2737	2812	2879	20.32
				90	2320	2370	2437	2562	20.32
			HEF	80	2654	2691	2812	2820	19.01
				90	2170	2200	2313	2313	19.01
		4000LM	SEF	80	3557	3657	3758	3847	27.58
				90	3100	3167	3256	3423	27.58
			HEF	80	3546	3596	3758	3768	24.75
				90	2899	2939	3091	3091	24.75
		5000LM	SEF	80	4450	4576	4701	4813	34.8
				90	3878	3962	4073	4283	34.8
			HEF	80	4436	4499	4701	4714	31.77
				90	3627	3678	3867	3867	31.77
		7000LM	SEF	80	6446	6628	6810	6972	49.05
				90	5618	5739	5901	6204	49.05
			HEF	80	6426	6517	6810	6829	44.67
				90	5254	5327	5602	5602	44.67
		9000LM	SEF	80	8126	8355	8584	8788	63.99
				90	7081	7234	7438	7820	63.99
			HEF	80	8100	8215	8584	8667	58.58
				90	6623	6715	7061	7061	58.58
		10000LM	SEF	80	9081	9338	9594	9822	73.37
				90	7914	8085	8313	8740	73.37
			HEF	80	9052	9181	9594	9620	66.27
				90	7402	7505	7882	7882	66.27
	L96	6000LM	SEF	80	5240	5387	5535	5667	38.15
				90	4566	4665	4796	5042	38.15
			HEF	80	5223	5297	5535	5550	35.54
				90	4270	4330	4553	4553	35.54
		8000LM	SEF	80	6991	7189	7386	7561	52.32
				90	6093	6224	6400	6728	52.32
			HEF	80	6869	7068	7386	7486	48.5
				90	5698	5778	6075	6075	48.5
		10000LM	SEF	80	8649	8893	9137	9356	66.47
				90	7537	7700	7917	8323	66.47
			HEF	80	8621	8764	9137	9161	60.89
				90	7049	7147	7516	7516	60.89
		14000LM	SEF	80	12630	12986	13342	13659	94.78
				90	11006	11244	11561	12154	94.78
			HEF	80	12589	12768	13342	13378	85.96
				90	10293	10437	10975	10975	85.96
		18000LM	SEF	80	16276	16735	17194	17602	128.98
				90	14184	14490	14888	15663	128.98
			HEF	80	16223	16454	17194	17240	116.92
				90	13265	13450	14143	14143	116.92
		20000LM	SEF	80	17976	18483	18990	19441	146.83
				90	15665	16004	16454	17300	146.83
			HEF	80	17918	18173	18990	19041	131.6
				90	14651	14855	15621	15621	131.6

CLX LED Linear

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L24	1500LM	SEF	80	1377	1415	1454	1489	10.85
				90	1200	1226	1260	1325	10.85
			HEF	80	1372	1392	1454	1458	10.39
				90	1122	1138	1196	1196	10.39
		2000LM	SEF	80	1900	1953	2007	2055	14.48
				90	1656	1691	1739	1828	14.48
			HEF	80	1894	1921	2007	2012	13.46
				90	1548	1570	1651	1651	13.46
		2500LM	SEF	80	2405	2472	2540	2601	18.41
				90	2095	2141	2201	2314	18.41
			HEF	80	2397	2431	2540	2547	17.42
				90	1960	1987	2090	2090	17.42
		3500LM	SEF	80	3234	3325	3416	3497	25.83
				90	2818	2879	2960	3112	25.83
			HEF	80	3223	3269	3416	3426	25.04
				90	2636	2672	2810	2810	25.04
		4500LM	SEF	80	4634	4765	4895	5012	38.7
				90	4038	4125	4242	4459	38.7
			HEF	80	4619	4685	4895	4908	34.8
				90	3777	3829	4027	4027	34.8
		5000LM	SEF	80	4823	5062	5201	5324	41.48
				90	4290	4383	4506	4738	41.48
			HEF	80	4907	4977	5201	5215	38.11
				90	4012	4068	4278	4278	38.11
	L36	2250LM	SEF	80	2216	2279	2341	2397	16.36
				90	1931	1973	2029	2133	16.36
			HEF	80	2209	2241	2341	2348	15.47
				90	1806	1832	1926	1926	15.47
		3000LM	SEF	80	2880	2962	3043	3115	20.8
				90	2510	2564	2636	2772	20.8
			HEF	80	2871	2912	3043	3051	19.98
				90	2347	2380	2503	2503	19.98
		3750LM	SEF	80	3687	3791	3895	3987	26.47
				90	3213	3282	3375	3548	26.47
			HEF	80	3675	3727	3895	3905	25.09
				90	3005	3047	3204	3204	25.09
		5250LM	SEF	80	4958	5098	5238	5362	39.9
				90	4321	4414	4539	4772	39.9
			HEF	80	4942	5013	5238	5252	34.3
				90	4041	4097	4309	4309	34.3
		6750LM	SEF	80	6331	6510	6688	6847	54.85
				90	5517	5636	5795	6093	54.85
			HEF	80	6311	6401	6688	6706	47.97
				90	5160	5232	5502	5502	47.97
		7500LM	SEF	80	6935	7131	7326	7500	62.6
				90	6044	6174	6348	6674	62.6
			HEF	80	6913	7011	7326	7346	54.02
				90	5652	5731	6027	6027	54.02

CLX LED Linear

CLX OPERATIONAL DATA (continued)

	Length	Nominal lumen package	Performance package	CRI	Delivered Lumens				Wattage
					Color Temperature				
					3000K	3500K	4000K	5000K	
WDL	L48	3000LM	SEF	80	2776	2854	2932	3002	20.32
				90	2419	2471	2541	2671	20.32
			HEF	80	2767	2806	2932	2940	19.01
				90	2262	2294	2412	2412	19.01
		4000LM	SEF	80	3709	3813	3918	4011	27.58
				90	3232	3302	3395	3569	27.58
			HEF	80	3697	3749	3918	3929	24.75
				90	3023	3065	3223	3223	24.75
		5000LM	SEF	80	4640	4771	4902	5018	34.8
				90	4044	4131	4247	4465	34.8
			HEF	80	4625	4691	4902	4915	31.77
				90	3782	3834	4032	4032	31.77
		7000LM	SEF	80	6721	6911	7101	7269	49.05
				90	5857	5984	6152	6469	49.05
			HEF	80	6700	6795	7101	7120	44.67
				90	5478	5554	5841	5841	44.67
		9000LM	SEF	80	8472	8711	8950	9163	63.99
				90	7383	7543	7755	8154	63.99
			HEF	80	8445	8565	8950	8974	58.58
				90	6905	7001	7362	7362	58.58
		10000LM	SEF	80	9469	9736	10003	10240	73.37
				90	8252	8430	8667	9112	73.37
			HEF	80	9438	9573	10003	10030	66.27
				90	7717	7825	8228	8228	66.27
	L96	6000LM	SEF	80	5463	5617	5771	5908	38.15
				90	4761	4864	5001	5258	38.15
			HEF	80	5445	5523	5771	5787	35.54
				90	4452	4515	4747	4747	35.54
		8000LM	SEF	80	7289	7495	7701	7884	52.32
				90	6353	6490	6672	7015	52.32
			HEF	80	7266	7370	7701	7722	48.5
				90	5941	6024	6334	6334	48.5
		10000LM	SEF	80	9017	9272	9526	9752	66.47
				90	7858	8028	8254	8678	66.47
			HEF	80	8988	9117	9526	9552	60.89
				90	7349	7452	7836	7836	60.89
		14000LM	SEF	80	13368	13540	13911	14241	94.78
				90	11476	11723	12054	12673	94.78
			HEF	80	13126	13313	13911	13949	85.96
				90	10732	10882	11443	11443	85.96
		18000LM	SEF	80	16970	17448	17927	18353	128.98
				90	14788	15108	15533	16331	128.98
			HEF	80	16915	17156	17927	17975	116.92
				90	13831	14024	14746	14746	116.92
		20000LM	SEF	80	18742	19271	19800	20270	146.83
				90	16333	16686	17156	18037	146.83
			HEF	80	18682	18948	19800	19853	131.6
				90	15276	15489	16287	16287	131.6

CLX LED Linear

RRL - RELOC®-Ready Luminaire

- RRL connectors can be used with Quick-Flex®, System 820 and OnePass® systems.
- Lead side of connector factory installed to luminaire.
- 4-pole mating connector with push-in terminations allows for simple installation.
- Touch-safe design on both halves meets UL/CSA requirement.
- Wiping contact design allows safe disconnect under load.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative. **Example:** RFLA

Series		Wiring instructions	
RRL	RELOC®-ready luminaire	A	Hot conductor wired to position #1 (phase A)
		B	Hot conductor wired to position #2 (phase B)
		C	Hot conductor wired to position #3 (phase C) [1]

Compatible RELOC® Cables for Industrial Luminaires (ordered and shipped separately)

QCS QCII QD RC FT

Notes

1 C, NBE, and C12S options are not used with Quick Flex QFC, QSFC, QPT, and QD.

PRODUCT INFORMATION

Advanced plug-in system with two-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows. 1, 2, 3 and 4-lamp fixtures. PLR22 (2-circuit) and crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy.

Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G-ground required.

Note: Specifications subject to change without notice.

Wiring

PLR

Advanced 1 or 2-Circuit Plug-In

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Series	Number of hot wires		Branch circuits				Dimming		Ground	
			Circuits to which ballast is connected		Emergency circuit connected					
PLR	(blank)	Not required for 22	(blank)	Not required for 22	(blank)	No emergency circuit	LV	Low-voltage dimming	G	Ground
PLR22	1	Black	A	Black wire	ELA	Emergency circuit wired to black wire				
	2	Black and red	B	Red wire	ELB	Emergency circuit wired to red wire				

Typical Applications

- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits and 2-circuit (PLR 22)
- Multiple circuit with night-lights located along row as desired

LITHONIA LIGHTING

DIGITAL NAVIGATION
Ordering Tree nLight Platform Sensor Switch JOT Photometrics Performance Data

FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available - curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight® controls make each luminaire addressable - allowing it to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless R90, RES7 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intuitive mobile app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR — Integrated sensor (individual control): Sensor Switch MSD7ADCX ()Passive infrared (PIR)(or MSDPDT7ADCX ()PIR/Microphonics Dual Tech (PDT)() integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or MailPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated. DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Catalog Number	
Notes	
Type	

BLT Series LED

2BLT4

ADP Diffuser Option

2' x 4' LED

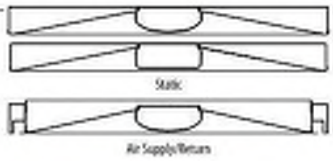
Ribbed Reflector Option

eldoLED

nLIGHT

JOT JUST ONE TOUCH

Specifications
Length: 47-3/4 (121.2)
Width: 23-3/4 (60.3)
Depth: 2-3/8 (6.0)
Depth with Air supply/return: 2-3/4 (6.9)
All dimensions are inches (centimeters) unless otherwise specified.



Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

2BLT Volumetric Recessed Lighting 2'x4'

A– Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT4 40L ADP EZ1 LP840

2BLT4

Series	Fixture Style	Air function	Lumens ‡	Diffuser	Voltage	Driver	Color temperature
2BLT4 2x4 BLT	(blank) Smooth Reflector RB Ribbed Reflector	(blank) Static A Air supply/ return ‡	**Standard efficiency (>100 LPW)** 30L 3000 40L 4000 48L 4800 60L 6000 72L 7200 85L 8500 100L 10000 120L 12000 **High efficiency ‡ (>130 LPW)** 30LHE 3000 40LHE 4000 48LHE 4800 60LHE 6000 72LHE 7200 85LHE 8500	ADP Curved, ribbed ADSM Curved, smooth SDP Square, ribbed SDSM Square, smooth **Includes trim rings to match sensored version** ADPT Curved, ribbed ADSMT Curved, smooth SDPT Square, ribbed SDSMT Square, smooth	(blank) MVOLT 120 120V 277 277V 347 347V ‡	EZ1 eldoLED dims to 1% (0-10 volt dimming) GZ1 Dims to 1% (0-10V dimming) ‡ GZ10 Dims to 10% (0-10V dimming) ‡ SLD Step-level dimming ‡	LP830 82CRI, 3000 K LP835 82CRI, 3500 K LP840 82CRI, 4000 K LP850 82CRI, 5000 K LP930 90CRI, 3000K LP935 90CRI, 3500K LP940 90CRI, 4000K LP950 90CRI, 5000K

nLight Interface

nLight Wired

(blank)	no nLight ® interface
N80	nLight with 80% lumen management
N80EMG	nLight with 80% lumen management For use with generator supply EM power ‡
N100	nLight without lumen management
N100EMG	nLight without lumen management For use with generator supply EM power ‡

nLight Wireless

(blank)	no nLight ® interface
NLTAIR2	nLight AIR Generation 2 enabled ‡

Control ‡

nLight Wired ‡

(blank)	No sensor control
NES7	nLight™ nES 7 PIR integral occupancy sensor
NESPDT7	nLight™ nES PDT 7 dual technology integral occupancy control
NES7ADCX	nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell
NESPDT7ADCX	nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell

nLight Wireless

RES7	nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities
RES7PDT	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell
RID	nLight AIR radio module without sensor
RES7EM	nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RES7PDTEM	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RIDEM	nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡

Individual Control

MSDTADCX	PIR integral occupancy sensor with automatic dimming control photocell ‡
MSDPDT7ADCX	PDT integral occupancy sensor with automatic dimming control photocell ‡
JOE	Wireless room control with "Just One Touch" pairing ‡
JOEVTX15	Wireless occupancy sensor with "Just One Touch" pairing ‡

Standby Mode

NOC	NOC Occupancy sensor disabled ‡

Options

BDP Disconnect Plug

EL7L	700 lumen battery pack (Noncompliant with CA T20) ‡
EL14L	1400 lumen battery pack (Noncompliant with CA T20) ‡
EL14LSD	1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡
E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡

CP	Chicago plenum ‡
BGTD	Bodine Generator Transfer Device ‡
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit
PWS1846 PWSLV	Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡
PWS1856LV	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡

GLR	Fast-blowing fuse ‡
GMF	Slow-blowing fuse ‡
NPLT	Narrow pallet
RRL_	RELOC®-ready luminaire ‡
LATC	Earthquake clip
DWHM	Anti-Microbial paint
JP14	Job packaging ‡
JP18	Job packaging ‡
IPSX	Gasketed diffuser compartment to meet IPSX rating ‡

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

2BLT Volumetric Recessed Lighting 2'x4'

Option Value Ordering Restrictions	
Option value	**Restriction**
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with TD, JOT, JOTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Controls	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JOT & JOTVTX15
EL14LSD, E10WLCP, EL7L, EL14L	When using pre-wire option, use PWS1846 or PWS1846 PWSELK. For more information, please see the PSSD2 specification sheet.
FAO	EZ1 driver required. Not available with USPDM, FAO or lumen packages > 6000LM. FAO restricts use of external Dimming controls. See chart on page 3 for additional details.
GLR, GMF	Must specify voltage. 120 or 277, with GLR and GMF fusing.
IPSX	Not available with air supply/return or Wired Networking (NES_) and Individual Control (NSD_) sensors.
JOT, JOTVTX15	Not available with standard efficiency 85L, 100L or 120L lumen options. Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP14	Only available on fixtures with NES7, NESPDT7, NESPDT7ADCX, MSDT7ADCX, MSDPDT7ADCX, RES7, RES7PDT, R8D, JOT, JOTVTX15. Not available when air supply/return function and sensor options are combined.
JP18	Not available with option: NES7, NESPDT7, NESPDT7ADCX, MSDT7ADCX, MSDPDT7ADCX, RES7, RES7PDT, R8D, JOT, JOTVTX15.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com. Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSDT7ADCX, MSDPDT7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver. Not available with 85L, 100L, or 120L options.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
RES7EM, RES7PDTEM, R8DEM	See UL924 Sequence of Operation chart on page 4. Not available with 72L, 72LHE, or 85LHE lumen packages.
RRL_	For ordering logic consult: RRL_2013.
SLD	Not available with with any nLight Interface or Control options.

Multiple Diffuser Options

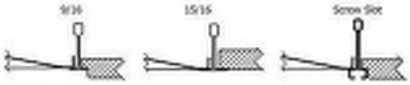
2BLT Volumetric Recessed Lighting 2'x4'

Non-Configurable BLT

Non-Configurable BLT								
Stock/MTO	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT4 40L ADP LP835	00190887470789	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP LP840	00190887470765	4063	31.69	128.23	4000K/82CRI	120-277	28
	2BLT4 46L ADP LP835	00190887468656	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP LP840	00190887468649	5039.18	38	132.58	4000K/82CRI	120-277	28
	2BLT4 40L ADP EL14L LP835	00190887470925	4000	31.69	126.22	3500K/82 CRI	120-277	28
	2BLT4 40L ADP EL14L LP840	00190887470918	4063	31.69	128.23	4000K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP835	00190887468670	4960	38	130.5	3500K/82 CRI	120-277	28
	2BLT4 46L ADP EL14L LP840	00190887468663	5039.18	38	132.58	4000K/82 CRI	120-277	28

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	Appropriate Trim Type
Exposed grid tee (1" and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4" (Tolerance is +1/8", -0").

UL924 Sequence of Operation

For 90 minutes following any complete AC power interruption >200 ms:
- Digital dimming is commanded to high-end trim level.
- Device ignores wireless lighting control commands.

Accessories & Replacement Parts

Accessories: *Order as separate catalog number.*	
DGA24	Drywall grid adapter for 2x4 recessed fixture
2X4SMKSHP PAF	Surface Mount Troffer Kit Post Paint
RK88DP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1
RK88DP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1
RK88DP 2P J10	Disconnect Plug (BDP), 2 Pole, Package of 10
RK88DP 2P J40	Disconnect Plug (BDP), 2 Pole, Package of 40

Replacement Parts: *Order as separate catalog number.*		
*249P2N	2DBLT48 ADP LENS ASSEMBLY	4 ft. replacement lens
*249P2T	2DBLT48 SDP LENS ASSEMBLY	4 ft. replacement lens
*249P30	2DBLT48 ADSM LENS ASSEMBLY	4 ft. replacement lens
*249P33	2DBLT48 SDSM LENS ASSEMBLY	4 ft. replacement lens
*237LT2	2DBLT48 ADPT LENS ASSEMBLY	4 ft. replacement lens
*237LT4	2DBLT48 SDPT LENS ASSEMBLY	4 ft. replacement lens
*237LT6	2DBLT48 ADSMT LENS ASSEMBLY	4 ft. replacement lens
*237LT8	2DBLT48 SDSMT LENS ASSEMBLY	4 ft. replacement lens
*237LTA	2DBLT48 ADPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237M52	2DBLT48 SDPT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237M5A	2DBLT48 ADSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens
*237M5L	2DBLT48 SDSMT SENSOR LENS ASSEMBLY	4 ft. replacement lens

JOT Wireless

JOT

Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

1. **Power:** Install JOT enabled fixtures and controls as instructed.
2. **Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
3. **Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.

LITHONIA LIGHTING® BLT-2X4

COMMERCIAL INDOOR One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com Rev. 01/21/21

2BLT Volumetric Recessed Lighting 2'x4'

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time-of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

nLight Wired Networking

Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

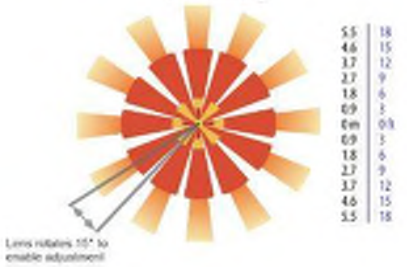
2BLT Volumetric Recessed Lighting 2'x4'

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSDTADCX	X	X			
MSDPDT7ADCX	X		X		
NES7		X		X	
NES7ADCX	X	X		X	
NESPDT7			X	X	
NESPDT7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	X	X	X		X

Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSDTADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

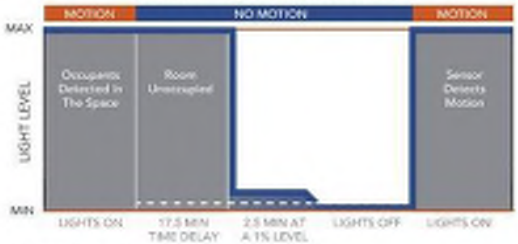
nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nESTADCX includes an integrated photocell, which enables daylight harvesting controls.

For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)



*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)

*The presetting on the automatic dimming photocell is 5fc (NES7) and 10fc (RES7).

2BLT Volumetric Recessed Lighting 2'x4'

Controls Accessories

nLight® Wired Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM 10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD 10BCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT /1
		30' cable	CAT5 30FT /1

nLight® AIR Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

BLT fixtures with integrated rIO devices complement any small office space. Pair them with an nCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.

nCMS[1] Example: NCMS PDT 10 AR G2

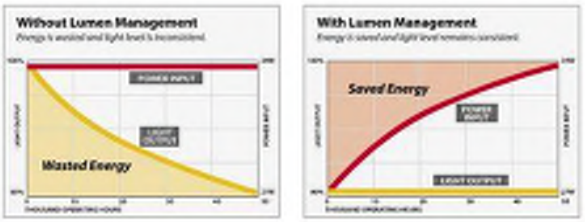
Series / Detection	Power Supply[1]	Occupancy Detection	Lens (Required)	Operating Mode	Generation
NCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately PS 150 Standard 150 mA Power Supply	[blank] PIR Detection PDT Dual Tech PIR/ Microphonics	10 Large Motion/ Extended Range 360° 9 Small Motion/ Extended Range 360° 6 High Bay 360° Lens	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility

Notes
1 NCMS requires low voltage power from either RPP20 DS 24V G2 or PS150.

2BLT Volumetric Recessed Lighting 2'x4'

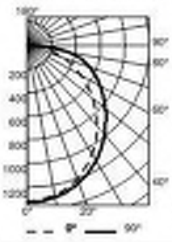
Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system's life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.



PHOTOMETRICS

2BLT4 40L ADP LP835, 4000 delivered lumens, test no. ISF36900P109, tested in accordance to IESNA LM-79



CP Summary

C°	90
0°	1325
5°	1309
15°	1259
25°	1136
35°	981
45°	797
55°	601
65°	406
75°	212
85°	48
90	1

Coefficients of Utilization

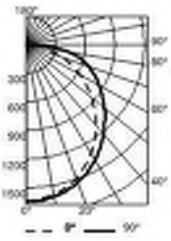
ρc	80%			70%			50%		
ρw	70%	50%	30%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	108	102	97	100	96	92	96	92	89
2	97	88	81	86	80	76	83	77	72
3	88	77	69	76	68	61	72	66	60
4	81	68	59	67	58	52	64	57	51
5	74	61	51	60	51	44	57	50	44
6	68	55	45	54	45	39	52	44	38
7	63	50	40	49	40	34	47	39	34
8	59	45	36	44	36	30	43	36	30
9	55	41	33	41	33	27	40	32	27
10	52	38	30	38	30	25	37	30	25

RCR

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1024	25.6	25.6
0° - 40°	1669	41.7	41.7
0° - 60°	2960	74.0	74.0
0° - 90°	3998	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4000	100.0	100.0

2BLT4 48L ADP LP835, 4960 delivered lumens, test no. ISF 36900P117, tested in accordance to IESNA LM-79



CP Summary

C°	90
0°	1643
5°	1623
15°	1550
25°	1409
35°	1217
45°	988
55°	745
65°	505
75°	263
85°	59
90	1

Coefficients of Utilization

ρc	80%			70%			50%		
ρw	70%	50%	30%	50%	30%	10%	50%	30%	10%
0	119	119	119	116	116	116	111	111	111
1	108	102	97	100	96	92	96	92	89
2	97	88	81	86	80	76	83	77	72
3	88	77	69	76	68	61	72	66	60
4	81	68	59	67	58	52	64	57	51
5	74	61	51	60	51	44	57	50	44
6	68	55	45	54	45	39	52	44	38
7	63	50	40	49	40	34	47	39	34
8	59	45	36	44	36	30	43	36	30
9	55	41	33	41	33	27	40	32	27
10	52	38	30	38	30	25	37	30	25

RCR

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1270	25.6	25.6
0° - 40°	2070	41.7	41.7
0° - 60°	3671	74.0	74.0
0° - 90°	4957	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4960	100.0	100.0

2BLT Volumetric Recessed Lighting 2'x4'

Performance Data

Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT4 30L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	2962	127.31	23.26	Premium	PWTDEMHS
2BLT4 30L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	3009.28	129.34	23.26	Premium	P1E6SGLD
2BLT4 30L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	2969.16	127.62	23.26	Premium	P3MB2936
2BLT4 40L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4000	126.22	31.69	Premium	P0WKYXFD
2BLT4 40L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4061.86	128.23	31.69	Premium	P6YXAZWD
2BLT4 40L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	3946.66	124.53	31.69	Premium	PS63CPK6
2BLT4 40L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4009.67	126.52	31.69	Premium	PK79UB9W
2BLT4 48L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4960	130.5	38	Premium	PJ9CB6C1
2BLT4 48L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	5039.18	132.58	38	Premium	P9W2B5AK
2BLT4 48L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	4893.86	128.76	38	Premium	PYFKZ33U
2BLT4 48L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4971.99	130.82	38	Premium	PC88MCH9
2BLT4 60L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	6016	126.39	47.59	Premium	PSU6QERM
2BLT4 60L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	6112.04	128.4	47.59	Premium	PV3QXPUV
2BLT4 60L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	5955.78	125.7	47.59	Premium	PHT84BW4
2BLT4 60L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	6030.55	126.69	47.59	Premium	P8VS58C8
2BLT4 72L ADP EZ1 (GZ10) LP840 (All Options)	7360.66	125.3	58.74	Premium	PSCZ22C8
2BLT4 72L ADP GZ1 LP835 (All Options)	7345	119.87	60.84	standard	P5HTCTS
2BLT4 72L ADP GZ1 LP840 (All Options)	7360.66	120.97	60.84	standard	PBERALG7
2BLT4 72L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	7148.4	117.48	60.84	standard	PDQS3CYK
2BLT4 72L ADPT EZ1 (GZ10) LP840 (All Options)	7262.52	123.63	58.74	Premium	P2KKMMVN
2BLT4 72L ADPT GZ1 LP840 (All Options)	7262.52	119.36	60.84	standard	P1KKUPC0
2BLT4 85L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	8567	116.43	73.58	standard	PYEQG66V
2BLT4 85L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	8703.77	118.28	73.58	standard	P8ZMVKX
2BLT4 85L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	8452.77	114.87	73.58	standard	PTZEW3QM
2BLT4 85L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	8587.72	116.71	73.58	standard	P0YDMER9
2BLT4 100L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	9837	103.14	95.36	standard	PGDES20R
2BLT4 100L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	9994.04	104.79	95.36	standard	P0C7CHGX
2BLT4 100L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	9705.84	101.77	95.36	standard	PSTUQY7M
2BLT4 100L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	9860.79	103.39	95.36	standard	P6V9X8HY
2BLT4 120L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	11709	118.18	99.07	standard	PGAMY7DP
2BLT4 120L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	11895.9	120.07	99.07	standard	P0D0DCG2
2BLT4 120L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	11552.9	116.61	99.07	standard	PXM0F509
2BLT4 120L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	11737.3	118.47	99.07	standard	PJ4GEBZM

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLO.

HE Performance Data

Model Number	Lumens	LPW	Watts	DLC Listing	DLC ID
2BLT4 30LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	3107	135.17	22.98	Premium	P7XTCNPS
2BLT4 30LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	3156.6	137.33	22.98	Premium	PD0N06BH
2BLT4 30LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	3065.57	133.37	22.98	Premium	P7P2AJ02
2BLT4 30LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	3114.51	135.5	22.98	Premium	P2N21E8P
2BLT4 40LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4085	138.56	29.48	Premium	P6TP6S5Y
2BLT4 40LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4150.21	140.77	29.48	Premium	P9SUQD66
2BLT4 40LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	4030.53	136.71	29.48	Premium	PC15DDEC
2BLT4 40LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4094.88	138.89	29.48	Premium	PGHCSJ2Y
2BLT4 48LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4770	138.16	34.52	Premium	PX8U8GN8
2BLT4 48LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4846.15	140.37	34.52	Premium	P5PQ5R8X
2BLT4 48LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	4706.4	136.32	34.52	Premium	P2MK2H33
2BLT4 48LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4781.53	138.5	34.52	Premium	PKBC1321
2BLT4 60LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	5894	135.12	43.61	Premium	PQEN1368
2BLT4 60LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	5988.09	137.28	43.61	Premium	PGSC1UUC
2BLT4 60LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	5815.41	133.32	43.61	Premium	PZ72FAWM
2BLT4 60LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	5908.25	135.45	43.61	Premium	PRC4W728
2BLT4 72LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	7149	135.94	52.58	Premium	PU838EEQ
2BLT4 72LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	7263.13	138.11	52.58	Premium	PJGDHZTN
2BLT4 72LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	7053.68	134.12	52.58	Premium	PSCCZVKV
2BLT4 72LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	7166.29	136.26	52.58	Premium	P6P188DM
2BLT4 85LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	8158	128.96	63.25	Premium	PRTW68DW
2BLT4 85LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	8288.24	131.02	63.25	Premium	P6MV2D6
2BLT4 85LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	8049.22	127.24	63.25	Premium	P3VE67A3
2BLT4 85LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	8177.73	129.27	63.25	Premium	PNSBKJ6E

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLO.

How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Delivered Lumens = 1.25 x P x LPW
P = Ouput power of emergency driver, P = 10W for E10WJCP option.
LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumen per watt rating of the luminaire. LPW information available in Performance Data section.

LITHONIA LIGHTING®

DIGITAL NAVIGATION
Ordering Tree   nLight Platform   Sensor Switch JOT   Photometrics   Performance Data

Catalog Number	
Notes	
Type	

BLT Series LED

2BLT2

ADP Diffuser Option

2' x 2' LED

Ribbed Reflector Option

eldoLED

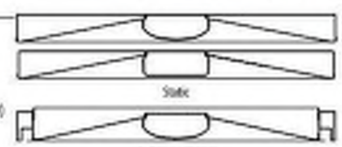
nLIGHT

JOT

Specifications

Length: 23-3/4 (60.3)
Width: 23-3/4 (60.3)
Depth: 2-3/8 (6.0)
Depth with Air supply/return: 2-3/4 (6.9)

All dimensions are inches (centimeters) unless otherwise specified.



FEATURES & SPECIFICATIONS

INTENDED USE — The BLT Best-in-Value Low Profile LED luminaire features a popular center basket design that offers a clean, versatile style and volumetric distribution. High efficacy LED light engines deliver energy savings and low maintenance compared to traditional sources. An extensive selection of configurations and options make the BLT the perfect choice for many lighting applications including schools, offices and other commercial spaces, retail, hospitals and healthcare facilities. The low profile BLT design (2-3/8") also makes it an excellent choice for renovation projects.

CONSTRUCTION — Prior to fabrication, BLT components are coated with a proprietary paint blend and die-formed for dimensional consistency.

The BLT reflector is available in both smooth and ribbed finishes. Choose RB from the fixture style section below for a ribbed finish.

End plates contain easy-to-position integral T-bar clips for securely attaching the luminaire to the T-grid. For additional T-grid security, optional screw on T-bar clips are available.

Diffusers are extruded from impact modified acrylic for increased durability.

LED boards and drivers are accessible from the plenum.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to walls, partitions and vertical and horizontal work surfaces – rendering the interior space, objects and occupants in a more balanced, complimentary luminous environment. High performance extruded acrylic diffusers conceal LEDs and efficiently deliver light in a volumetric distribution. Four diffuser choices available - curved and square designs with ribbed or a smooth frosted finish.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. 80% LED lumen maintenance at 60,000 hours (L80/60,000). Color Variation within 3-step MacAdam ellipse (3SDCM).

Non-Configurable BLT: Generic 0-10 volt dimming driver. Dims to 10%

Configurable BLT: available in High Efficiency (HE) versions for applications where a lower wattage (over the standard product) is required. The High Efficiency versions deliver >130 LPW and can be specified via the Lumen Package designations in the Ordering Information below.

eldoLED driver options deliver choice of dimming range, and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.

Optional integrated nLight® controls make each luminaire addressable - allowing them to digitally communicate with other nLight enabled controls such as dimmers, switches, occupancy sensors and photocontrols. Connection to nLight is simple. It can be accomplished with integrated nLight AIR wireless rIO and rES7 sensors, or through standard Cat-5 cabling. nLight offers unique plug-and-play convenience as devices and luminaires automatically discover each other and self-commission. nLight AIR is commissioned easily through an intuitive model app.

Lumen Management: Unique lumen management system (option N80) provides on board intelligence that actively manages the LED light source so that constant lumen output is maintained over the system life, preventing the energy waste created by the traditional practice of over-lighting.

Step-level dimming option allows system to be switched to 50% power for compliance with common energy codes while maintaining fixture appearance.

SENSOR— Integrated sensor (individual control): Sensor Switch MSD7ADCX ()Passive infrared (PIR)) or MSDPDT7ADCX ()PIR/Microphonics Dual Tech (PDT)) integrated occupancy sensor/automatic dimming photocell allows the luminaire to power off when the space is unoccupied or enough ambient light is entering the space. See page 4 for more details on the integrated sensor.

Integrated Sensor (nLight Wired Networking): This sensor is nLight-enabled, meaning it has the ability to communicate over an nLight network. When wired, using CAT-5 cabling, with other nLight-enabled sensors, power packs, or WallPods, an nLight control zone is created. Once linked to a Gateway, directly or via a Bridge, the zone becomes capable of remote status monitoring and control via SensorView software. See page 4 for the nLight sensor options.

Integrated Smart Sensor (nLight Air Wireless Platform): The RES7 sensor is nLight AIR enabled, meaning it has the ability to communicate over the wireless nLight control platform. It is available with an automatic dimming photocell, and either a digital PIR or a microphonics (PDT) dual technology occupancy sensor. It pairs to other luminaires and wall switches through our mobile app, CLAIRITY, which allows for simple sensor adjustment. See page 4 for more details on the Integrated Smart Sensor.

Integrated Wireless Sensor (single room control): Sensor Switch VERTEX JOT or JOTVTX15 luminaire-embedded occupancy and ambient light sensor allows the luminaire to power off when the space is unoccupied or when enough ambient light is entering the space. See page X for more details on the integrated wireless sensor.

INSTALLATION — The BLT's low profile design of only 2-3/8" provides increased installation flexibility especially in restrictive plenum applications. The BLT fits into standard 15/16" and narrow 9/16" T-grid ceiling systems.

Suitable for damp location.

For recessed mounting in hard ceiling applications, Drywall Grid Adapters (DGA) are available as an accessory. See Accessories section.

LISTINGS — CSA Certified to meet U.S. and Canadian standards. IC rated.

DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/support/warranty/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.
Specifications subject to change without notice.

Embed nLight controls today. Prepare for tomorrow.

Now	Tomorrow
User-friendly install	Scalability
Enhanced energy savings	Space configuration
Code compliance	Future-ready

A+ Capable Luminaire

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details

2BLT Volumetric Recessed Lighting 2'x2'

A– Capable options indicated by this color background.

ORDERING INFORMATION Lead times will vary depending on options selected. Consult with your sales representative.

Example: 2BLT2 33L ADP EZ1 LP835

2BLT2

Series	Fixture Style	Air function	Lumens ‡	Diffuser	Voltage	Driver	Color temperature
2BLT2 2X2 BLT	(blank) Smooth Reflector RB Ribbed Reflector	(blank) Static A Air supply/return ‡	**Standard efficiency ‡ (>125 LPW)** 20L 2000 33L 3300 40L 4000 48L 4800 **High efficiency ‡ (>130 LPW)** 20LHE 2000 33LHE 3300 40LHE 4000 48LHE 4800	ADP Curved, ribbed ADSM Curved, smooth SDP Square, ribbed SDSM Square, smooth **Includes trim rings to match sensored version** ADPT Curved, ribbed ADSMT Curved, smooth SDPT Square, ribbed SDSMT Square, smooth	(blank) MVOLT 120 120V 277 277V 347 347V ‡	EZ1 eldoLED dims to 1% (0-10 volt dimming) GZ1 Dims to 1% (0-10V dimming) ‡ GZ10 Dims to 10% (0-10V dimming) ‡ SLD Step-level dimming ‡	LP830 82CRI, 3000 K LP835 82CRI, 3500 K LP840 82CRI, 4000 K LP850 82CRI, 5000 K LP930 90CRI, 3000K LP935 90CRI, 3500K LP940 90CRI, 4000K LP950 90CRI, 5000K

nLight Interface

nLight Wired

(blank)	no nLight ® interface
N80	nLight with 80% lumen management
N80EMG	nLight with 80% lumen management For use with generator supply EM power ‡
N100	nLight without lumen management
N100EMG	nLight without lumen management For use with generator supply EM power ‡

nLight Wireless

(blank)	no nLight ® interface
NLTAIR2	nLight AIR Generation 2 enabled ‡

Control ‡

nLight Wired

(blank)	No sensor control
NES7	nLight™ nES 7 PIR integral occupancy sensor ‡
NESPDT7	nLight™ nES PDT 7 dual technology integral occupancy control ‡
NES7ADCX	nLight™ nES 7 ADCX PIR integral occupancy sensor with automatic dimming photocell ‡
NESPDT7ADCX	nLight™ nES PDT 7 dual technology integral occupancy sensor with automatic dimming photocell ‡

nLight Wireless

NES7	nLight AIR PIR integral occupancy sensor with automatic dimming photocell for Networking Capabilities
NESTPDT	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell
RID	nLight AIR radio module without sensor
NES7EM	nLight AIR PIR integral occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
NES7PDTEM	nLight AIR microphonics dual technology occupancy sensor with automatic dimming photocell and UL924 Emergency Operation, via power interrupt detection ‡
RIDEM	nLight AIR radio module less sensor, with UL924 Emergency Operation, via power interrupt detection ‡

Individual Control

MSDT7ADCX	PIR integral occupancy sensor with automatic dimming control photocell ‡
MSDPDT7ADCX	PDT integral occupancy sensor with automatic dimming control photocell ‡
JOI	Wireless room control with "Just One Touch" pairing ‡
JOIVTX15	Wireless occupancy sensor with "Just One Touch" pairing ‡

Standby Mode

NOC	NOC Occupancy sensor disabled ‡

Options

BBP Disconnect Plug

EL7L	700 lumen battery pack (Noncompliant with CA T20) ‡
EL14L	1400 lumen battery pack (Noncompliant with CA T20) ‡
EL14LSD	1400 lumen battery pack with self-diagnostic testing feature (Noncompliant with CA T20) ‡
E10WLCP	EM Self-Diagnostic battery pack, 10W Constant Power, Certified in CA Title 20 MAEDBS ‡

CP	Chicago plenum ‡
BGTD	Bodine Generator Transfer Device ‡
PWS1836	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit
PWS1846	6' pre-wire, 3/8" diameter, 18 gauge, 2 circuit
PWS1846 PWSLV	Two cables: one 6' pre-wire, 3/8" diameter, 18 gauge, 2 circuits; one 6' pre-wire, 3/8" diameter, 18 gauge ‡
PWS18S6LV	6' pre-wire, 3/8" diameter, 18 gauge, 1 circuit w/low voltage wires ‡

GLR	Fast-blowing fuse ‡
GMF	Slow-blowing fuse ‡
NPLT	Narrow pallet
RRL_	RELOC®-ready luminaire ‡
LATC	Earthquake clip
DWAM	Anti-Microbial paint
JP28	Job packaging ‡
JP36	Job packaging
IPSX	Gasketed diffuser compartment to meet IPSX rating ‡

NOTE: ‡ indicates option value has ordering restrictions. Please reference the Option Value Ordering Restrictions chart on the next page. Options are sorted alphanumerically.

LITHONIA LIGHTING 2BLT-292

2BLT Volumetric Recessed Lighting 2'x2'

‡ Option Value Ordering Restrictions	
Option value	**Restriction**
347	Not available with SLD, EL7L, EL14L, or E10WLCP options.
A	Not available with RB fixture style, consult factory for air flow data.
BGTD	Not available with JDT, JDTVTX15 sensor options or emergency battery options. Must specify voltage. Requires BSE labeling, voltage specific. Consult factory for options. Example: BGTD BSE10.
Control	Must specify diffuser with trim rings.
CP	Not available with N80, N80EMG, N100, or N100EMG.
GZ1, GZ10	Not available with any Control or Sensor options except JDT & JDTVTX15
EL7L, EL14L, EL14LSD, E10WLCP	When using pre-wire option, use PWS1846 or PWS1846 PWSLV. For more information on the EL14LSD, please see the PSSD2 specification sheet.
GLR, GMF	Must specify voltage: 120 or 277, with GLR and GMF fusing.
IPSX	Not available with air supply/return or Wired Networking (NES_) and Individual Control (NSD_) sensors.
JDT, JDTVTX15	Not available with SLD, nLight, NLTAIR2, NOC, or BGTD options.
JP28	Only available with options: NES7, NESPDT7, NES7ADCX, NESPDT7ADCX, MSDTADCX, MSDPDT7ADCX, RES7, RES7PDT, R80. Not available when sensor options combined with air supply return option.
Lumens	Approximate lumen output. For high Efficiency, all versions may not achieve 130+ LPW. Refer to photometry on www.acuitybrands.com. Air supply/return option, 90 CRI, and versions with integral sensor trim rings may not achieve 130 LPW.
MSDTADCX, MSDPDT7ADCX	Only available with EZ1 driver option. 0-10v dimming wires not accessible via access plate.
NES7, NESPDT7, NES7ADCX, NESPDT7ADCX	Requires N80, N80EMG, N100, or N100EMG. Only available with EZ1 driver.
NLTAIR2	Must order with nLight Wireless option from Control section. Only available with EZ1 driver.
NOC	Can only be ordered in conjunction with EZ1, NLTAIR2, RES7/RES7PDT. Occupancy sensor disabled at factory but can be re-enabled upon commissioning.
N80EMG, N100EMG	nLight EMG option requires a connection to existing nLight network. Power is provided from a separate N80 or N100 enabled fixture.
PWS1846 PWSLV, PWS18560V	Not available with nLIGHT wired network or individual controls.
RES7EM, RES7PDTEM, R80EM	See UL924 Sequence of Operation chart on page 3.
RRL_	For ordering logic consult: RRL_2015.
SLD	Not available with with any nLight Interface or Control options.

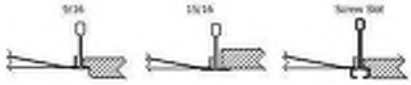
Multiple Diffuser Options

Non-Configurable BLT

Stock/MTO	Catalog Description *	UPC	Lumens	Wattage	LPW	Color Temperature	Voltage	Pallet Qty
Stock	2BLT2 33L ADP LP835	190887529708	3332	26.67	124.92	3500K/82 CRI	120-277	56
	2BLT2 33L ADP LP840	190887529739	3385	26.67	126.91	4000K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP835	190887529890	3332	26.67	124.92	3500K/82CRI	120-277	56
	2BLT2 33L ADP EL14L LP840	190887529937	3385	26.67	126.91	4000K/82CRI	120-277	56

*Generic 0-10V Dimming to 10%.

MOUNTING DATA	
Ceiling Type	**Appropriate Trim Type**
Exposed grid tee (1" and 9/16")	G
Concealed grid tee	G
Plaster or plasterboard	G*



*DGA accessory available to provide ceiling trim flange and fixture support for plaster or plasterboard ceiling. Recommended rough-in dimensions for DGA installation is 24-3/4" x 24-3/4". (Tolerance is +1/8", -0").

UL924 Sequence of Operation
For 90 minutes following any complete AC power interruption >200 ms:
• Digital dimming is commanded to high-end trim level.
• Device ignores wireless lighting control commands.

LITHONIA LIGHTING® BLT-292

COMMERCIAL INDOOR One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com Rev. 01/21/21

2BLT Volumetric Recessed Lighting 2'x2'

Accessories & Replacement Parts

Accessories: Order as separate catalog number.	
DGA22	Drywall grid adapter for 2x2 recessed fixture
2K2SMKSHP PAF	Surface Mount Troffer Kit Post Paint
RK88DP 2P U	Disconnect Plug (BDP), 2 Pole, Package of 1
RK88DP 3P U	Disconnect Plug (BDP), 3 Pole, Package of 1
RK88DP 2P 10	Disconnect Plug (BDP), 2 Pole, Package of 10
RK88DP 2P 40	Disconnect Plug (BDP), 2 Pole, Package of 40

Replacement Parts: Order as separate catalog number.		
*247WJV	2DBLT24 ADP LENS ASSEMBLY	2 ft. replacement lens
*249P2P	2DBLT24 SDP LENS ASSEMBLY	2 ft. replacement lens
*249P2W	2DBLT24 ADSM LENS ASSEMBLY	2 ft. replacement lens
*249P3J	2DBLT24 SDSM LENS ASSEMBLY	2 ft. replacement lens
*237LT1	2DBLT24 ADPT LENS ASSEMBLY	2 ft. replacement lens
*237LT3	2DBLT24 SDPT LENS ASSEMBLY	2 ft. replacement lens
*237LT5	2DBLT24 ADSMT LENS ASSEMBLY	2 ft. replacement lens
*237LT7	2DBLT24 SDSMT LENS ASSEMBLY	2 ft. replacement lens
*237LT9	2DBLT24 ADPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*2379B4Y	2DBLT24 SDPT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*2379B5Y	2DBLT24 ADSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens
*2379B5H	2DBLT24 SDSMT SENSOR LENS ASSEMBLY	2 ft. replacement lens

JOT Wireless

JOT

Sensor Switch JOT Enabled Wireless Solution

Designed with contractors in mind, the Sensor Switch JOT enabled wireless solution offers a straightforward approach to the installation and pairing of lighting fixtures and controls. Absolutely no 0-10V control wires and no mobile apps are needed with JOT enabled products, allowing for lightning speed installation right out of the box.

1. **Power:** Install JOT enabled fixtures and controls as instructed.
2. **Pair:** Insert the pairing tool into the pinhole on the wall switch; press and hold any button for 6 seconds.
3. **Play:** Once paired, each fixture will individually dim down to 10% brightness. All products will be fully functional.

2BLT Volumetric Recessed Lighting 2'x2'

nLight Platform

nLight embedded fixtures offer:	Customers get:
Manual Dimming	Convenience and visual comfort for occupants
Motion Sensing and/or Daylight Harvesting	Energy savings and code compliance
Fixture or Group Level Control	Ability to configure lighting to the space requirements
Flexibility	Ease of fixture moves, adds and changes
Wireless Wall Switch (nLight AIR Only)	Ease and flexibility of placement
Astronomical and Time of Day Scheduling	Energy savings and building security
Scalable Solution	nLight controls to grow with your business
Future-Ready	nLight platform to set foundation for future upgrades and capabilities

nLight Air Wireless

Simple as 1,2,3

1. Install the nLight® AIR fixtures with embedded smart sensor
2. Install the wireless battery-powered wall switch
3. With CLAIRITY app, pair the fixtures with the wall switch and if desired, customize the sensor settings for the desired outcome

nLight Wired Networking

Simple as 1,2,3

1. Install the nLight® Wired fixtures with embedded control
2. Install the nLight Wired wall switch
3. Connect the fixtures using standard CAT5e cables and the devices will automatically discover each other and work (plug and play)

LITHONIA LIGHTING® BLT-202

COMMERCIAL INDOOR One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com Rev. 01/21/21

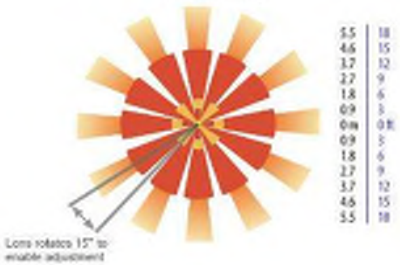
2BLT Volumetric Recessed Lighting 2'x2'

Sensor Options					
Option	Automatic Dimming Photocell	Occupancy Sensing		nLight Wired Networking	nLight AIR Networking
		PIR	PDT		
MSDTADCX	X	X			
MSDPDT7NDCX	X		X		
NES7		X		X	
NESTADCX	X	X		X	
NESPDT7			X	X	
NESPDT7ADCX	X		X	X	
RES7	X	X			X
RESPDT7	X	X	X		X

Sensor Coverage Pattern
Mini 360° Lens

- Recommended for walking motion detection from mounting heights between 8 ft (2.44 m) and 20 ft (6.10 m)
- Initial detection of walking motion along sensor axes at distances of 2x the mounting height up to 15 ft (4.57 m) and
- 1.75x up to 20 ft (6.10 m).
- Provides 12 ft (3.66 m) radial detection of small motion when mounted at 9 ft (2.74 m)
- Initial detection will occur earlier when walking across sensor's field of view than when walking directly at sensor

9 FT Mounting



Integrated Sensor with Individual Control

The MSDTADCX PIR occupancy sensor/automatic dimming photocell is ideal for areas without obstructions and where daylight harvesting may be desired. Suggested applications include, but not limited to, hallways, corridors, storage rooms, and breakrooms or other areas where people are typically moving.

The MSDPDT7ADCX PIR/Microphonics Dual Tech occupancy sensor/automatic dimming photocell is ideal for areas with obstructions and where daylight harvesting is desired. Suggested applications include, but not limited to, open offices, private offices, classrooms, public restrooms, and conference rooms.

nLight AIR Wireless

nLight AIR is the ideal solution for retrofit or new construction spaces where adding additional wiring can be labor intensive and nLight AIR is available with or without an integral sensor. The integrated rES7 or rES7PDT smart sensors are part of each luminaire in the nLight AIR network, which can be grouped to control multiple luminaires. The granularity of control with the digital PIR occupancy detection and daylight sensing makes a great solution for any application.

nLight Wired Networking

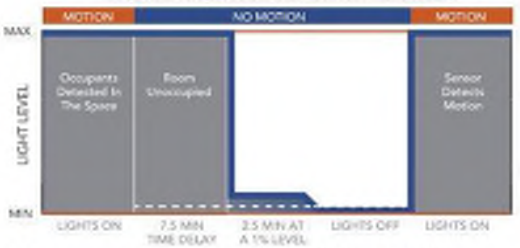
The nES 7 is ideal for small rooms without obstructions or areas with primarily walking motion. Ideal areas include hallways, corridors, storage rooms, and breakrooms. Additionally, the nESTADCX includes an integrated photocell, which enables daylight harvesting controls.

For areas like restrooms, private offices, open offices, conference rooms or any space with obstructions, the nES PDT 7 dual technology sensor is recommended. The nES PDT 7 utilizes both PIR (passive infrared) and Microphonics technologies to detect occupancy. Additionally, the nESPDT7ADCX includes an integrated photocell, which enables daylight harvesting controls which is ideal for areas where windows are present.

Sequence of Operation (MSD7 Sensor)

*The presetting on the automatic dimming photocell is 5fc.

Sequence of Operation (nES7 and rES7 and Sensor)



*The presetting on the automatic dimming photocell is 5fc (NES7) and 10fc (RES7).

2BLT Volumetric Recessed Lighting 2'x2'

Controls Accessories

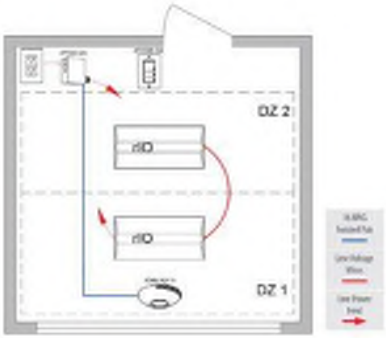
nLight® Wired Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlight.

WallPod stations	Model number	Occupancy sensors	Model number
On/Off	nPODMA [Color]	Small motion 360°, ceiling (PIR / dual tech)	nCM 9 RJB / nCM PDT 9 RJB
On/Off & raise/lower	nPODMA DX [Color]	Large motion 360°, ceiling (PIR / dual tech)	nCM 10 RJB / nCM PDT 10 RJB
Graphic touchscreen	nPOD TOUCH [Color]	Wall switch with raise/lower	nWSX PDT LV DX [color]
Photocell controls	**Model number**	**Cat-5 cable (plenum rated)**	**Model number**
Full range dimming	nCM ADCX RJB	10' cable	CAT5 10FT J1
		30' cable	CAT5 30FT J1

nLight® AIR Control Accessories:
Order as separate catalog number. Visit www.acuitybrands.com/products/controls/nlightair.

Wall switches	Model number
On/Off single pole	rPODBA [color] G2
On/Off two pole	rPODB A2P [color] G2
On/Off & raise/lower single pole	rPODBA DX [color] G2
On/Off & raise/lower two pole	rPODBA 2P DX [color] G2

2BLT fixtures with integrated rIO devices complement any small office space. Pair them with an rCMS occupancy sensor and the space now has wireless occupancy sensing and dimming capability. For additional configuration options please consult with Tech Support.



rCMS[1] Example: RCMS PDT 10 AR G2

Series / Detection	Power Supply[1]	Occupancy Detection	Lens (Required)	Operating Mode	Generation
RCMS nLight AIR occupancy and daylight sensor	[blank] Power Supply ordered separately PS 150 Standard 150 mA Power Supply	[blank] PIR Detection PDT Dual Tech PIR/ Microphonics	10 Large Motion/ Extended Range 360° 9 Small Motion/ Extended Range 360° 6 High Bay 360° Lens	[BLANK] None AR Auxiliary Relay	G2 Generation 2 compatibility

Notes
1 RCMS requires low voltage power from either RPP20 ES 24V G2 or PS150.

LITHONIA LIGHTING® 2BLT-292

COMMERCIAL INDOOR One Lithonia Way Conyers, GA 30012 Phone: 800-705-SERV (7378) www.lithonia.com Rev. 01/21/21

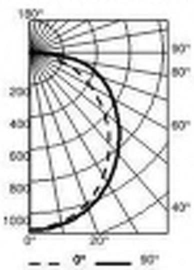
2BLT Volumetric Recessed Lighting 2'x2'

Constant Lumen Management

Enabled by the embedded nLight control, the BLT actively tracks its run-time and manages its light source such that constant lumen output is maintained over the system life. Referred to as lumen management, this feature eliminates the energy waste created by the traditional practice of over-lighting.

PHOTOMETRICS

2BLT2 33L ADP LP835, 3332 delivered lumens, test no. ISF36900P19, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1103	1103
5°	1090	1104
15°	1042	1064
25°	946	989
35°	817	881
45°	664	757
55°	500	634
65°	340	517
75°	177	383
85°	40	164
90	1	14

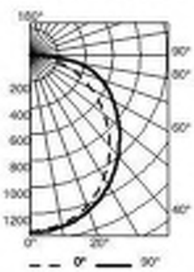
Coefficients of Utilization

pf	20%								
pc	80%			70%			50%		
pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
RCR 0	119	119	119	116	116	116	111	111	111
1	108	102	97	100	96	92	96	92	89
2	97	88	81	86	80	74	83	77	72
3	88	77	69	76	68	61	72	66	60
4	81	68	59	67	58	52	64	57	51
5	74	61	51	60	51	44	57	50	44
6	68	55	45	54	45	39	52	44	38
7	63	50	40	49	40	34	47	39	34
8	59	45	36	44	36	30	43	36	30
9	55	41	33	41	33	27	40	32	27
10	52	38	30	38	30	25	37	30	25

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	853	25.6	25.6
0° - 40°	1390	41.7	41.7
0° - 60°	2466	74.0	74.0
0° - 90°	3330	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	3332	100.0	100.0

2BLT2 40L ADP LP835, 4041 delivered lumens, test no. ISF36900P35, tested in accordance to IESNA LM-79



CP Summary

	0°	90
0°	1338	1338
5°	1322	1339
15°	1263	1291
25°	1148	1199
35°	991	1069
45°	805	918
55°	607	769
65°	412	627
75°	214	465
85°	48	199
90	1	17

Coefficients of Utilization

pf	20%								
pc	80%			70%			50%		
pw	70%	50%	30%	50%	30%	10%	50%	30%	10%
RCR 0	119	119	119	116	116	116	111	111	111
1	108	102	97	100	96	92	96	92	89
2	97	88	81	86	80	74	83	77	72
3	88	77	69	76	68	61	72	66	60
4	81	68	59	67	58	52	64	57	51
5	74	61	51	60	51	44	57	50	44
6	68	55	45	54	45	39	52	44	38
7	63	50	40	49	43	34	47	39	34
8	59	45	36	44	38	30	43	36	30
9	55	41	33	41	33	27	40	32	27
10	52	38	30	38	30	25	37	30	25

Zonal Lumen Summary

Zone	Lumens	% Lamp	% Fixture
0° - 30°	1035	25.6	25.6
0° - 40°	1686	41.7	41.7
0° - 60°	2991	74.0	74.0
0° - 90°	4039	100.0	100.0
90° - 120°	2	0.0	0.0
90° - 130°	2	0.0	0.0
90° - 150°	2	0.0	0.0
90° - 180°	2	0.0	0.0
0° - 180°	4041	100.0	100.0

2BLT Volumetric Recessed Lighting 2'x2'

Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT2 20L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	2665.45	124.06	16.64	Premium	PMR21964
2BLT2 20L ADP EZ1 (GZ10) LP835 (All Options)	2653	126.58	16.06	Premium	P644SUVD
2BLT2 20L ADP GZ1 LP835 (All Options)	2653	122.11	16.64	standard	P1X86M38
2BLT2 20L ADPT EZ1 (GZ10) LP840 (All Options)	2637.91	126.89	16.06	Premium	PY3150EQ
2BLT2 20L ADPT GZ1 LP835 (All Options)	2805.89	120.49	16.64	standard	P40HOGLB
2BLT2 20L ADPT GZ1 LP840 (All Options)	2637.91	122.41	16.64	standard	P83HB9AK
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	3332	124.92	26.67	Premium	PHSDHE8F
2BLT2 33L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	3385.19	126.91	26.67	Premium	PD18OXD8
2BLT2 33L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	3348.05	125.22	26.67	Premium	PFN8CZ2H
2BLT2 33L ADPT EZ1 (GZ10) LP835 (All Options)	3287.57	125.14	26.27	Premium	PTKZR9WQ
2BLT2 33L ADPT GZ1 LP835 (All Options)	3287.57	123.25	26.67	standard	PTN50234
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4041	127.35	31.73	Premium	P1UWW9GV
2BLT2 40L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4105.51	129.38	31.73	Premium	PHCD2COF
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	3987.12	125.65	31.73	Premium	PWBRMMJ4
2BLT2 40L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4058.77	127.65	31.73	Premium	PSYYDAA8
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4800	109.9	43.67	standard	P5RHYR1G
2BLT2 48L ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4876.63	111.66	43.67	standard	P8E93YDK
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	4756	108.44	43.67	standard	PITU9N6X
2BLT2 48L ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4811.61	110.17	43.67	standard	PSR2X0T6

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLO.

HE Performance Data					
Model Number	**Lumens**	**LPW**	**Watts**	**DLC Listing**	**DLC ID**
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	1948	130.59	14.91	Premium	PJQCZWQ1
2BLT2 20LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	1979.1	132.67	14.91	Premium	PJCZRW21
2BLT2 20LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	1952.71	130.9	14.91	Premium	PLC4RF4L
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	3392	137.3	24.7	Premium	PXXZV6PW
2BLT2 33LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	3446.15	139.5	24.7	Premium	PKPJYYRF
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	3346.77	135.47	24.7	Premium	PZC8B2S5
2BLT2 33LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	3400.2	137.64	24.7	Premium	PM5G8AFU
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4118	133.71	30.79	Premium	PJSSRFFP
2BLT2 40LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4183.74	135.85	30.79	Premium	PEGFHPZD
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	4063.09	131.93	30.79	Premium	PBE16E9B
2BLT2 40LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4127.96	134.04	30.79	Premium	PFRSSSYG
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP835 (All Options)	4845	128	37.85	Premium	PSSXRUZP
2BLT2 48LHE ADP EZ1 (GZ1, GZ10) LP840 (All Options)	4922.35	130.04	37.85	Premium	P1B63H56
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP835 (All Options)	4780.4	126.29	37.85	Premium	PHPYGSM8
2BLT2 48LHE ADPT EZ1 (GZ1, GZ10) LP840 (All Options)	4856.71	128.31	37.85	Premium	P8KV9542

DLC information is subject to change, for the most up-to-date information please refer to www.dlc.org. Above listings do not cover 347v or SLO.

How to Estimate Delivered Lumens in Emergency Mode
Use the formula below to estimate the delivered lumens in emergency mode
Delivered Lumens = 1.25 x P x LPW
P = Ouput power of emergency driver. P = 10W for E10WLCP option.
LPW = Lumens per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet. LPW = Lumens per watt rating of the luminaire. LPW information available in Performance Data section.

Manufacturer: GOTHAM Specified Catalog #: EVO6-35/20-AR-MWD-LD-MVOLT-GZ10

gotham | E V O
Multiple Layers of Light

Luminaire Type:
Catalog Number:

General Illumination Round Downlight 6"


250 - 8,000 lumens


10,000 - 17,500 lumens

OVERVIEW

Feature Set

- Bounding Ray™ optical design
- Unitized optics mechanically attach the light engine to the lower reflector for complete optical alignment.
- 45° cutoff to source and source image
- Fully serviceable and upgradeable lensed LED light engine
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- Fixtures are wet location, covered ceiling
- Available with 10% dimming, 1% dimming, or dim to dark
- Batwing distribution with feathered edges provides even illumination on horizontal and vertical surfaces
- ENERGY STAR® certified product

Distribution

very narrow 0.5 S:MH | narrow 0.7 S:MH | medium 0.9 S:MH | medium wide 1.0 S:MH | wide 1.2 S:MH

Superior Performance

Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000	4500	5000	6000	8000	10,000	12,000	15,000	17,500
Delivered Lumens	297	519	776	994	1471	2006	2537	3077	3542	4027	4533	5256	6371	8247	10637	12332	15776	17801
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0	47.3	48.7	57.6	74.9	97.1	115.0	150.9	175.3
Lumens per Watt	87.4	83.7	94.6	103.5	100.1	101.8	102.7	104.3	104.8	103.3	95.8	107.9	110.6	110.1	109.5	107.2	104.5	101.5

COMPLIMENTARY PRODUCTS

Coordinated Apertures | Multiple Layers of Light


General Illumination Layer | EVO


High Center Beam Layer | Incito


EVO + Incito — Multiple Layers of Light

Core: Downlight, Adjustable, Open Wallwash, Lensed Wallwash, Cylinder, Pinhole, Bevel, Hyperbolic

Healthcare: MRI, Surgical Suite, Patient Room

Special Applications: Dynamic, Food Service, Vandal/Tamper, Clean Room, Shower, Steam Room

me engineers

STEAMBOAT BASE AREA
GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L4

gotham | EVO

6" General Illumination Round Downlight

ORDERING INFORMATION

A+ Capable options indicated by this color background.

DesignToShip Quick Ship Program: Options in green text qualify for DesignToShip — 5 business days from order entry to ship. Refer to DesignToShip flowchart for complete program details. Maximum Order Quantity: 100 units; 50 for Chicago Plenum.

Luminaire Type:

Catalog Number:

EXAMPLE: EVO6 35/150 AR MWD LSS MVOLT EZ1

Series	Color Temperature	Nominal Lumen Values	Reflector & Flange Color	Trim Style	Distribution
EVO6	27/ 2700 K 30/ 3000 K 35/ 3500 K 40/ 4000 K 50/ 5000 K	02 250 lumens 05 500 lumens 07 750 lumens 10 1000 lumens 15 1500 lumens 20 2000 lumens 25 2500 lumens 30 3000 lumens 35 3500 lumens 40 4000 lumens 45 4500 lumens 50 5000 lumens 60 6000 lumens 80 8000 lumens 100 10000 lumens 120 12000 lumens 150 15000 lumens 175 17500 lumens	AR Clear PR Pewter WTR Wheat GR Gold WR[1] White BR[1] Black WRAMF[1] White Anti-microbial	(blank) Self-flanged FL Flangeless	VND Very Narrow (0.5 s/mh) ND Narrow (0.7 s/mh) MD Medium (0.9 s/mh) MWD Medium Wide (1.0 s/mh) WD Wide (1.2 s/mh)

Finish	Voltage	Driver[4]
LSS Semi-specular LO Matte-diffuse LS Specular	MVOLT 120 277 347[2,5]	GZ10 0-10V driver dims to 10% GZ1 0-10V driver dims to 1% EZ10 eldoLED 0-10V ECOdrive. Linear dimming to 10% min. EZ1 eldoLED 0-10V ECOdrive. Linear dimming to 1% min. EZB eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%. EDAB[3] eldoLED SOLOdrive DALI. Logarithmic dimming to <1%. EDXB[3] eldoLED POWERdrive DMX with RDM (remote device management). Square Law dimming to <1%. Includes termination resistor. Refer to DMXR Manual. Minimum 1000 lumens/Maximum 15000 lumens. ECOS2[6] Lutron® Hi-Lume® 2-wire forward-phase driver. Minimum dimming level 1%, 120V only. Minimum 1000 lumens/Maximum 4000 lumens. ECO0[3] Lutron Ecosystem digital Hi-Lume 1% soft-on, fade to black. Max. 4000LM.

Control Interface		Options			
NLT[3]	nLight® dimming pack controls	SF	Single fuse. Specify 120V or 277V.	N80[7,8]	nLight® Lumen Compensation
NLTER[2,4,5]	nLight® dimming pack controls emergency circuit	TRW[7]	White painted flange	BSTD	Bodine generator transfer device. Specify 120V or 277V.
NLTAIR2[2,5]	nLight® AIR enabled	TRBL[8]	Black painted flange	90CRI	High CRI (90+)
NLTAIRE2[2,4,5]	nLight® AIR enabled emergency	EL	Emergency battery pack, 10W, with integral test switch	CP[11]	Chicago Plenum. Specify 120V or 277V for 5000lm and above.
EXA1	XPoint Wireless, eldoLED driver. Linear dimming to 1%.	ELR	Emergency battery pack, 10W, with self-diagnostics, with remote test switch	HAO[12]	HAO High Ambient Option (40°C)
EXAB	XPoint Wireless, eldoLED driver. Logarithmic dimming to dark.	ELSD	Emergency battery pack, 10W, with self-diagnostics, integral test switch	RRL_	RELOC®-ready luminaire connectors enable a simple and consistent factory installed option across all ABL luminaire brands. Refer to RRL for complete nomenclature.
		ELRSD	Emergency battery pack, 10W, with self-diagnostics, remote test switch		
		E10WCP	Emergency battery pack, 10W Constant Power, CA Title 20 compliant with integral test switch		
		E10WCPR	Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch		

ACCESSORIES – order as separate catalog numbers (shipped separately)

SCA6	Sloped ceiling adapter. Degree of slope must be specified (50, 100, 150, 200, 250, 300). Ex: SCA6 100. Refer to TECH-190.
CTA4-8 YKRL	Ceiling thickness adapter for 10,000LM and above (extends mounting frame to accommodate ceiling thickness up to 5"). Adds ~4" to fixture height.
CTA4-8 YK	Ceiling thickness adapter for 8,000LM and below (extends mounting frame to accommodate ceiling thickness up to 5"). Adds ~4" to fixture height.
GVRT	Vandal-resistant trim accessory. Refer to TECH-200.
ISD BC	0-10V wall box dimmer. Refer to ISD-BC.

ORDERING NOTES

1. Not available with finishes.
2. Not available with emergency battery pack options.
3. Supplied with factory installed step down transformer.
4. Refer to TECH-240 for compatible dimmers.
5. Not available with nLight® and XPoint options.
6. Specify voltage.
7. For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not applicable with WR (white reflector) or FL (flangeless) option.
8. For use with different reflector finish only (i.e. AR, PR, WTR, GR options). Not applicable with BR (black reflector) or FL (flangeless) option.
9. ER for use with generator supply power. Will require an emergency hot feed and normal hot feed.
10. Fixture begins at 80% light level. Must be specified with NLT or NLTER. Only available with EZ10 and EZ1 drivers.
11. 12,000LM max with EL or nLight® options. 5,000LM max with Lutron drivers combined with EL. Not available with ELR, HAO, EXA1, or EXAB options.
12. Only available 5000LM - 15,000LM with eldoLED drivers.
13. Not available DALI or DMX drivers. Not available with CP or N80 options. Not recommended for metal ceiling installations.

gotham

gotham | EVO

6" **General Illumination Round Downlight**

SPECIFICATIONS

Optical Assembly
Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling.
Optical design is a Bounding Ray™ design with 45° cutoff to source and source image. Top-down flash characteristic for superior glare control.
Unitized optics shall have mechanical attachment of the light engine to the lower reflector for complete optical alignment.

Electrical
The luminaire shall operate from a 50 or 60 Hz ±3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.
Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.
Input wires shall be 18AWG, 300V minimum, solid copper.

Controls
Luminaire shall be equipped with interface for nLight wired or wireless network with integral power supply as per specification.

Dimming
The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.
eldoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.
Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction
Luminaire housing shall be constructed of 16-gauge galvanized steel and have preinstalled telescopic mounting bars with maximum 32" and minimum 15" extension and 4" vertical adjustment.
Luminaires shall be suitable for installation in ceilings up to 1½" thick. (specify ceiling thickness adapter to extend frame to accommodate ceiling thickness up to 5").
Tool-less adjustments shall be possible after installation.
The assembly and manufacturing process for the luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.
25°C ambient temperature standard (1/2" clearance on all sides from non-combustible materials in non-IC applications, unless marked spacing noted otherwise). For use in insulated ceilings, a 3" clearance on all sides from insulation is required (unless marked spacing noted otherwise). 40°C high ambient optional.

Listings
Fixtures are CSA certified to meet US and Canadian Standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, wet location covered ceiling. Luminaire configurations are Energy Star certified through testing in EPA–recognized laboratories, with the results reviewed by an independent, accredited certification organization. Visit www.energystar.gov for specific configurations listed.

Photometrics
LEDs tested to LM-80 standards. Measured by IESNA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.
Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by a point at the intersection of the CCT line and the black body locus line in CIE chromaticity space.

Warranty
5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

Note:
Actual performance may differ as a result of end user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.
- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight® control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.
*See ordering tree for details

GOTHAM ARCHITECTURAL DOWNLIGHTING | 1400 Lester Road Conyers, GA 30012 | P 800-705-SERV (7378) | gothamlighting.com

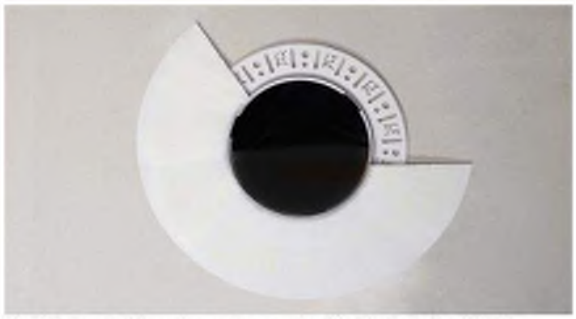
gotham

gotham | EVO

6" General Illumination Round Downlight

Flangeless

Partially finished mud ring, showing cross-section detail.



An EVO downlight requires only approximately 3" of plaster to finish.

EVO with flangeless trim

Flangeless Installation

Gotham's flangeless option utilizes a micro-thin polymer mud ring that minimizes the amount of drywall compound required to finish the ceiling. The end result is a virtually undetectable flangeless downlight installation.

The polymer mud ring is installed independent of the of the recessed frame, therefore floating with the ceiling. This innovation minimizes any surface cracks during reflector installation, ceiling movement and any future service to the recessed frame, wiring, electronics, etc.

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6" General Illumination Round Downlight

Tables of Use

Marked Spacing in Inches 25°C Ambient			
Lumen Package	Fixed Center to Center MIN	Fixture Center to Building Member MIN	Space Above Fixture
500-5000	None	None	None
6000	24	12	5
8000	36	18	11
10000			9
12000			
15000			
17500	72	36	

Marked Spacing in Inches 40°C Ambient			
Lumen Package	Fixed Center to Center MIN	Fixture Center to Building Member MIN	Space Above Fixture
5000	24	12	5
6000			
8000	48	24	9
10000			
12000			
15000	72	36	9

Marked Spacing Chicago Plenum Open Frame in Inches 25°C Ambient			
Lumen Package	Fixed Center to Center MIN	Fixture Center to Building Member MIN	Space Above Fixture
250-5000	None	None	None
6000	24	12	5
8000	36	18	11
10000			9
12000			
15000			
17500	72	36	

Marked Spacing Chicago Plenum Enclosure in Inches 25°C Ambient			
Lumen Package	Fixed Center to Center MIN	Fixture Center to Building Member MIN	Space Above Fixture
250-6000	None	None	None
8000	36	18	6
10000	48	24	3
12000			

EVO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EXA1	1%	Linear	Linear/Logarithmic
EZB	<1%	Logarithmic	Linear
EDA8	<1%	Logarithmic	Linear
EXA8	<1%	Logarithmic	Linear
EDA8	<1%	Square	Linear

Lumen Output Multiplier		
CRI	CCT	Multiplier
80	2700K	0.96
	3000K	1.00
	3500K	1.00
	4000K	1.01
	5000K	1.07
90	2700K	0.80
	3000K	0.83
	3500K	0.85
	4000K	0.87
	5000K	0.91

Reflector Finish Multiplier	
Reflector Finish	Multiplier
LS - Specular	1
LSS - Semi Specular	0.956
WR - White	0.87
LD - Matte Diffuse	0.85
BR - Black	0.73

Distributions		
Nomenclature	Beam Angle	Field Angle
VND	30	64
ND	44	69
MD	54	82
MWD	67	89
WD	71	92

Driver		Control Provided (note: 347V/UVOLT versions provided with 347 option selected)			
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIRER2
GZ10	0-10V driver dims to 10%	nPP06 D EFP	nPP06 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
GZ1	0-10V driver dims to 1%	nPP06 D EFP	nPP06 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZB	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2

How to Estimate Delivered Lumens in Emergency Mode

Delivered Lumens = 1.25 x P x LPW

P = Output power of emergency driver. P = 10W for PS1055CP

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet.

gotham

Manufacturer: GOTHAM Specified Catalog #: EVO6-35/20-AR-MWD-LD-MVOLT-GZ10

gotham | EVO

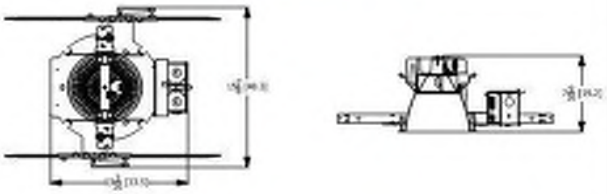
6" **General Illumination Round Downlight**

DIMENSIONAL DATA

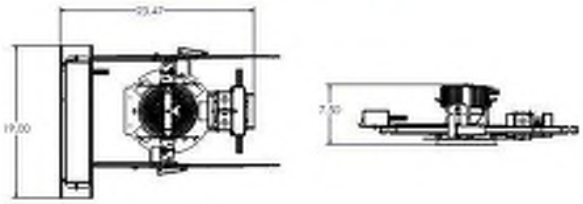
*Dimensions in inches [centimeters]

Aperture: 6 1/4" [15.9]	Ceiling Opening: 7 1/8" [18.1] self-flanged
Overlap Trim: 7 1/2" [19.1]	7 1/4" [18.4] flangeless

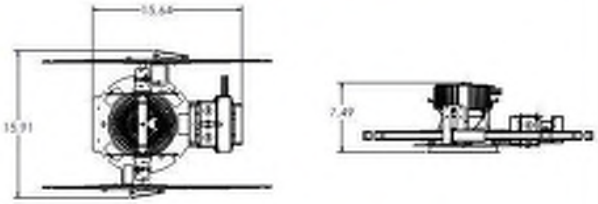
1000LM-4500LM Standard



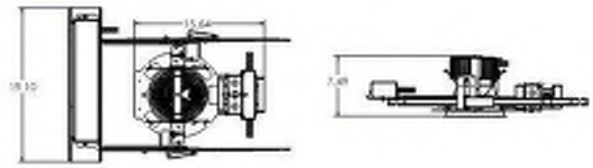
1000LM-4500LM Battery Pack



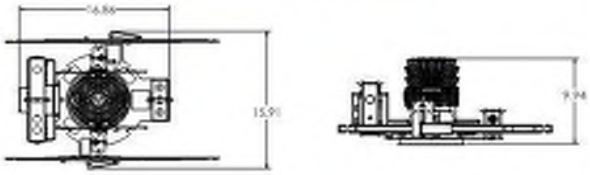
5000LM-8000LM Standard



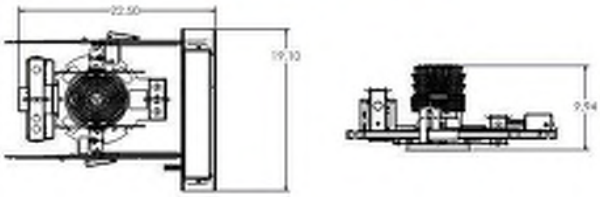
5000LM-8000LM Battery Pack



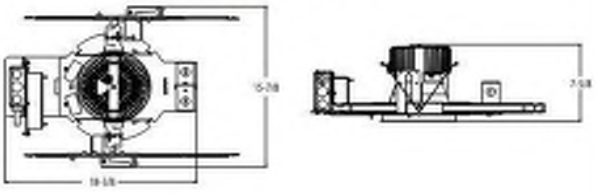
10,000LM-17,500LM Standard



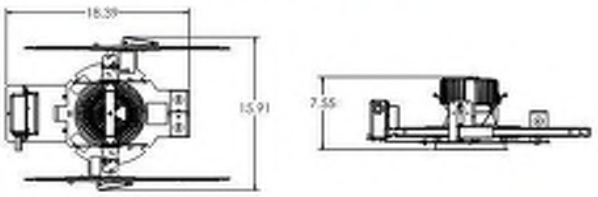
10,000LM-17,500LM Battery Pack



1000LM-4500LM CP



5000 Lumen ECO/SOLO Drive Open Frame CP



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GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L4

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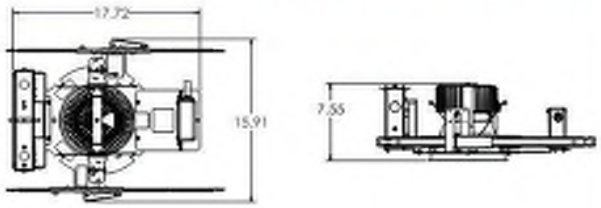
6" General Illumination Round Downlight

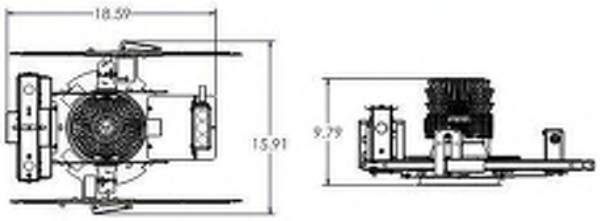
DIMENSIONAL DATA

*Dimensions in inches [centimeters]

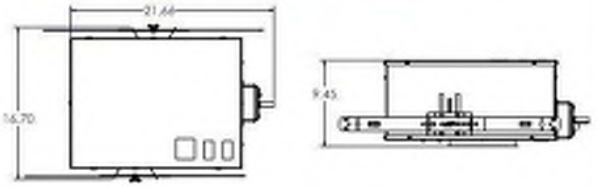
5000 (Lutron & POWER Drive Only), 6000 & 8000 Lumen Open Frame CP



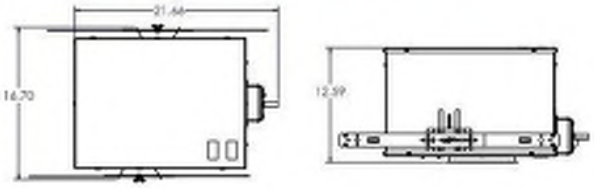
10000 - 17,500 Lumen Open Frame CP



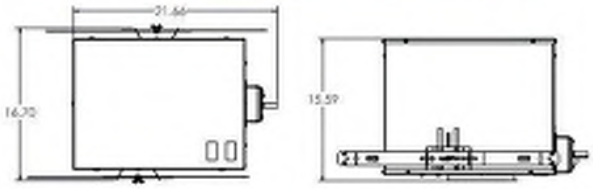
250 - 6000 Lumen CP for nLight® or Battery Pack



8,000LM Enclosed CP for nLight or Battery Pack



10,000LM-12,000LM Enclosed CP for nLight or Battery Pack



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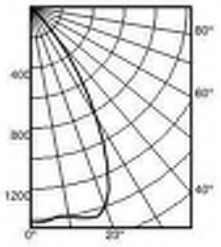
6" General Illumination Round Downlight

Photometry

EVO6 35/15 AR MWD LS INPUT WATTS: 14.7, DELIVERED LUMENS: 1471LM, LPW= 100, 1.03 S/MH, TEST NO. LTL27783P1505



Ave	Lumens
0	1431
5	1410
15	1442
25	1161
35	540
45	78
55	3
65	1
75	0
85	0
90	0

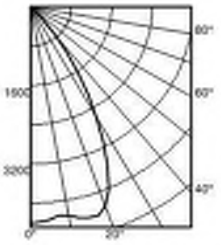
Zone	Lumens	% Lamp
0° - 30°	1061.4	72.2
0° - 40°	1383.5	94.7
0° - 60°	1469.5	99.9
0° - 90°	1470.9	100.0
90° - 180°	0.0	0.0
0° - 180°	1470.9	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	96	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	73	69	77	72	68
7	74	68	64	74	68	64	72	67	63
8	70	64	60	69	64	60	68	63	59
9	66	60	56	65	60	56	64	59	56
10	62	56	52	62	56	52	61	56	52

Mounting Height	Initial FC Center Beam	50% beam - 54.4° Diameter	50% beam - 54.4° FC	10% beam - 77.9° Diameter	10% beam - 77.9° FC
8.0	47.3	5.7	23.7	8.9	4.7
10.0	25.4	7.7	12.7	12.1	2.5
12.0	15.9	9.6	7.9	15.3	1.6
14.0	10.8	11.8	5.4	18.6	1.1
16.0	7.9	13.9	3.9	21.8	0.8

EVO6 35/45 AR MWD LS INPUT WATTS: 47.3, DELIVERED LUMENS: 4532.7LM, LPW= 95.8, 1.03 S/MH, TEST NO. LTL27783P1649



Ave	Lumens
0	4411
5	4346
15	4443
25	3578
35	1665
45	242
55	8
65	2
75	1
85	0
90	0

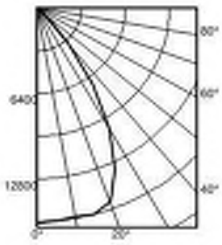
Zone	Lumens	% Lamp
0° - 30°	3270.7	72.2
0° - 40°	4294.2	94.7
0° - 60°	4528.3	99.9
0° - 90°	4532.7	100.0
90° - 180°	0.0	0.0
0° - 180°	4532.7	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	96	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	73	69	77	72	68
7	74	68	64	74	68	64	72	67	63
8	70	64	60	69	64	60	68	63	59
9	66	60	56	65	60	56	64	59	56
10	62	56	52	62	56	52	61	56	52

Mounting Height	Initial FC Center Beam	50% beam - 54.4° Diameter	50% beam - 54.4° FC	10% beam - 77.9° Diameter	10% beam - 77.9° FC
8.0	140.8	5.7	72.9	8.9	14.6
10.0	78.4	7.7	39.2	12.1	7.8
12.0	48.9	9.8	24.4	15.3	4.9
14.0	33.4	11.8	16.7	18.6	3.3
16.0	24.2	13.9	12.1	21.8	2.4

EVO6 35/175 AR MWD LS INPUT WATTS: 175.3, DELIVERED LUMENS: 17801LM, LPW=101.5, 1.06 S/MH, TEST NO. ISF 34035P268



Ave	Lumens
0	16546
5	15998
15	16606
25	13362
35	7018
45	1473
55	190
65	37
75	13
85	2
90	0

Zone	Lumens	% Lamp
0° - 30°	12002.3	67.4
0° - 40°	16291.0	91.5
0° - 60°	17746.3	99.7
0° - 90°	17801.0	100.0
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.0	0.0
90° - 180°	0.0	0.0
0° - 180°	17801.0	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	105	106	104	104	103	101
2	103	98	95	101	97	94	98	95	92
3	95	90	86	94	89	86	91	87	84
4	89	83	79	88	82	78	85	81	77
5	83	77	72	82	76	72	80	75	71
6	77	71	67	77	71	67	75	70	66
7	73	66	62	72	66	62	71	65	61
8	68	62	58	67	62	57	66	61	57
9	64	58	54	63	58	54	62	57	53
10	60	54	50	60	54	50	59	54	50

Mounting Height	Initial FC Center Beam	50% beam - 55.7° Diameter	50% beam - 55.7° FC	10% beam - 79.8° Diameter	10% beam - 79.8° FC
8.0	533.7	5.8	266.9	9.2	53.4
10.0	287.0	7.9	143.5	12.5	28.7
12.0	178.9	10.0	89.4	15.9	17.9
14.0	122.1	12.1	61.0	19.2	12.2
16.0	88.6	14.3	44.3	22.6	8.9

gotham

Manufacturer: GOTHAM Specified Catalog #: EVO6-35/20-AR-MWD-LD-MVOLT-GZ10

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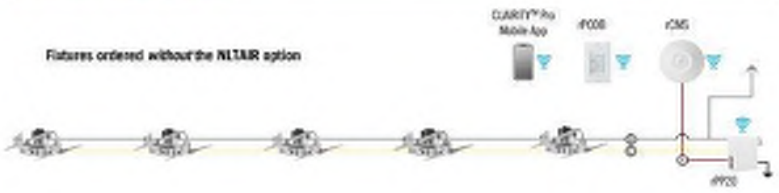
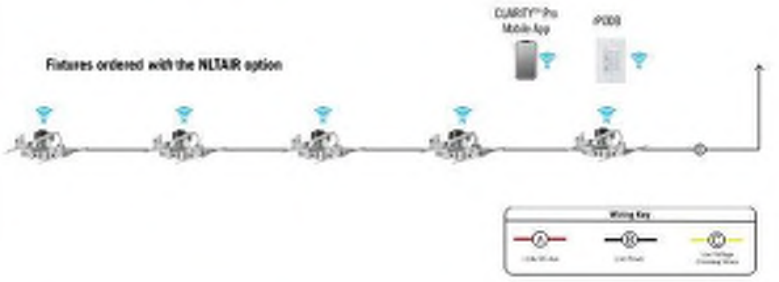
6" General Illumination Round Downlight

NLIGHT AIR

nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR nPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

Possibilites for nLight® AIR





nLight® AIR Control Accessories
Order as separate catalog number. Visit nLight AIR.

Wall Switches	Model Number
On/Off single pole	nPODB (color) G2
On/Off two pole	nPODB 2P (color) G2
On/Off & raise/lower single pole	nPODB DX (color) G2
On/Off & raise/lower two pole	nPODB 2P DX (color) G2

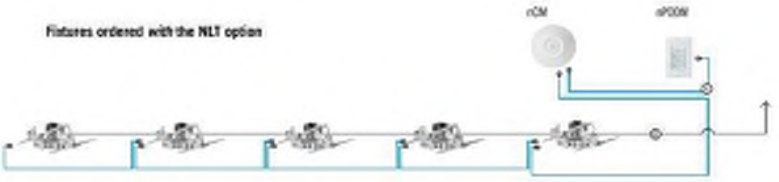
nLight® AIR Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	rCMS 9 / rCMS PDT 9
Large motion 360°, ceiling	rCMS 10 / rCMS PDT 10

NLIGHT

nLight® The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

Possibilites for nLight® wired



nLight® Wired Control Accessories
Order as separate catalog number. Visit nLight.

Wall Switches	Model Number
On/Off single pole	nPODM (color)
On/Off two pole	nPODM 2P (color)
On/Off & raise/lower single pole	nPOD DX (color)
On/Off & raise/lower two pole	nPODM 2P DX (color)
Graphic touchscreen	nPOD GFX (color)
Photocell Controls	
Dimming	nCM ADCX

nLight® Wired Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

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STEAMBOAT BASE AREA
GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L4

Manufacturer: GOTHAM Specified Catalog #: EVO6SH-35/20-DFR-SOL-MVOLT-GZ10

gotham | EVO
Multiple Layers of Light

Luminaire Type:
Catalog Number:

General Illumination Shower Downlight 6"

OVERVIEW

Feature Set

- Wipe down flush or regressed lens
- NSF2 Splash/Non-food Zone
- Fully serviceable and upgradeable lensed LED light engine
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- IP66 rated room-side, Fixtures are wet location, covered ceiling
- Anti-microbial paint finish, optional
- Non-conductive dead-front trim
- Suitable for steam room application

Distribution

Superior Performance (Flush, Clear Lens)

Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	219	437	656	857	1274	1729	2187	2634	3062	3499
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	64.4	70.5	80.0	89.3	86.7	87.8	88.5	88.9	90.6	89.7

*Lumen output for 80CRI - 3500K

COMPLIMENTARY PRODUCTS

Coordinated Apertures | Multiple Layers of Light

General Illumination Layer | EVO

High Center Beam Layer | Incito

EVO + Incito — Multiple Layers of Light

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L4B

gotham | EVO

6" **General Illumination Shower Downlight**

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Luminaire Type:

Catalog Number:

EXAMPLE: EVO6SH 35/20 DFF SOL MVOLT EZ10

Series	Color Temperature	Nominal Lumen Values	Lens Setting	Lens	Voltage
EVO6SH	27/ 2700 K 30/ 3000 K 35/ 3500 K 40/ 4000 K 50/ 5000 K	02 250 lumens 05 500 lumens 07 750 lumens 10 1000 lumens 15 1500 lumens 20 2000 lumens 25 2500 lumens 30 3000 lumens 35 3500 lumens 40 4000 lumens	DFR Regressed lensed white painted trim DFF Flush lensed white painted trim DFRBR Regressed lensed black painted trim DFFBR Flush lensed black painted trim DFRAMF Regressed lensed trim with anti-microbial finish DFFAMF Flush lensed trim with anti-microbial finish	SOL Textured Lens SMO Smooth Clear Lens	MVOLT 120 277

Driver[1]	Control Interface	Options
EZ10 eldoLED 0-10V ECOdrive. Linear dimming to 10% min. EZ1 eldoLED 0-10V ECOdrive. Linear dimming to 1% min. EZB eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%. EDAB eldoLED SOLOdrive DALI. Logarithmic dimming to <1%.	NLT[2] nLight dimming pack controls NLTER[2,3] nLight dimming pack controls emergency circuit	SF Single fuse. Specify 120V or 277V. ELR[4] Emergency battery pack, 10W, with remote test switch. E10WCPR[4] Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch BGTD Bodine generator transfer device. Specify 120V or 277V. 90CRI High CRI (90+). CP Chicago Plenum.

ACCESSORIES — order as separate catalog numbers (shipped separately)

SCA6	Sloped ceiling adapter. Degree of slope must be specified (5D, 10D, 15D, 20D, 25D, 30D). Ex: SCA6 10D. Refer to TECH-150.
CTA4-8 YK	Ceiling thickness adapter for 8,000lm and below (extends mounting frame to accommodate ceiling thickness up to 5"). Adds ~4" to fixture height.
ISD BC	0-10V wallbox dimmer. Refer to ISD-BC.

ORDERING NOTES

1. Refer to TECH-240 for compatible dimmers.
2. Specify voltage.
3. For use with generator supply EM power. Will require an emergency hot feed and normal hot feed.
4. Not available with CP option.

GOTHAM ARCHITECTURAL DOWNLIGHTING | 1400 Lester Road Conyers, GA 30012 | P 800-705-SERV (7378) | gothamlighting.com

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Manufacturer: GOTHAM Specified Catalog #: EVO6SH-35/20-DFR-SOL-MVOLT-GZ10

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6" **General Illumination Shower Downlight**

SPECIFICATIONS

Optical Assembly
Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling.
Unitized optics shall have mechanical attachment of the light engine to the lower reflector for complete optical alignment.

Electrical
The luminaire shall operate from a 50 or 60 Hz ±3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. The fluctuations of line voltage shall have no visible effect on the luminous output.
The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.
Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.
Input wires shall be 18AWG, 300V minimum, solid copper.

Controls
Luminaire shall be equipped with interface for nLight wired network with integral power supply as per specification.

Dimming
The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.
eldoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.
Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction
Luminaire housing shall be constructed of 16-gauge galvanized steel and have preinstalled telescopic mounting bars with maximum 32" and minimum 15" extension and 4" vertical adjustment.
Luminaires shall be suitable for installation in ceilings up to 1½" thick. (specify ceiling thickness adapter to extend frame to accommodate ceiling thickness up to 5").
Tool-less adjustments shall be possible after installation.
The assembly and manufacturing process for the luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.
25°C ambient temperature standard (1/2" clearance on all sides from non-combustible materials in non-IC applications, unless marked spacing noted otherwise). For use in insulated ceilings, a 3" clearance on all sides from insulation is required (unless marked spacing noted otherwise).

Listings
Fixtures are CSA certified to meet US and Canadian standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, wet location covered ceiling.

Photometrics
LEDs tested to LM-80 standards. Measured by IES/NA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.
Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by a point at the intersection of the CCT line and the black body locus line in CIE chromaticity space.

Warranty
5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

Note:
Actual performance may differ as a result of end user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.
- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight® control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.
*See ordering tree for details

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Tables of Use

DFF SMD - Flush Clear										
Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	219	437	656	857	1274	1729	2187	2634	3062	3499
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	64.4	70.5	80.0	89.3	86.7	87.8	88.5	88.9	90.6	89.7

*Lumen output for 80CRI - 3500K

DFF SOL - Flush Textured										
Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	214	428	642	839	1247	1693	2141	2583	2997	3426
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	62.9	69.0	78.3	87.4	84.8	85.9	86.7	87.1	88.7	87.8

*Lumen output for 80CRI - 3500K

DFR SMD - Flush Clear										
Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	168	336	505	659	980	1330	1682	2038	2355	2651
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	49.4	54.2	61.6	68.6	66.7	67.5	68.1	68.4	69.7	68.0

*Lumen output for 80CRI - 3500K

DFR SOL - Regressed Textured										
Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000
Delivered	162	325	487	636	946	1283	1623	1948	2272	2557
Wattage	3.4	6.2	8.2	9.6	14.7	19.7	24.7	29.5	33.8	39.0
Efficacy	47.6	52.4	59.4	66.3	64.4	65.1	65.7	66.0	67.2	66.6

*Lumen output for 80CRI - 3500K

EVO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EXA1	1%	Linear	Linear/Logarithmic
EZ0	<1%	Logarithmic	Linear
EDAB	<1%	Logarithmic	Linear
EXAB	<1%	Logarithmic	Linear
EDXB	<1%	Square	Linear

Lumen Output Multiplier		
CRI	CCT	Multiplier
80	2700K	0.96
	3000K	1.00
	3500K	1.00
	4000K	1.01
	5000K	1.07
90	2700K	0.80
	3000K	0.83
	3500K	0.85
	4000K	0.87
	5000K	0.91

Driver		Control Provided (note: 347V/UVOLT versions provided with 347 option selected)			
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIRER2
EZ10	0-10V driver dims to 10%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ1	0-10V driver dims to 1%	nPP16 D EFP	nPP16 D ER EFP	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ0	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2

How to Estimate Delivered Lumens in Emergency Mode

Delivered Lumens = 1.25 x P x LPW

P = Output power of emergency driver. P = 10W for PS10S5CP

LPW = Lumen per watt rating of the luminaire. This information is available on the ABL luminaire spec sheet.

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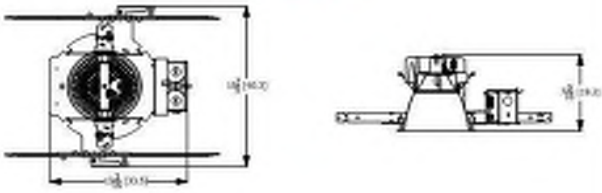
6" General Illumination Shower Downlight

DIMENSIONAL DATA

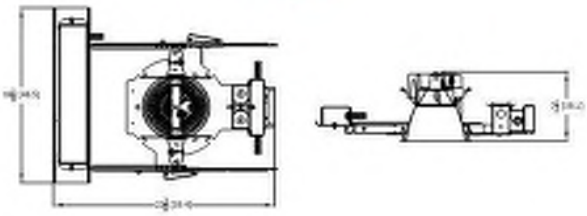
*Dimensions in inches [centimeters]

Aperture: 61/4" [15.9]	Ceiling Opening: 71/8" [18.1] self-flanged
Overlap Trim: 71/2" [19.1]	71/4" [18.4] flangeless

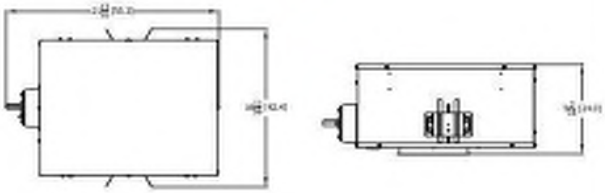
Standard



Battery Pack



CP



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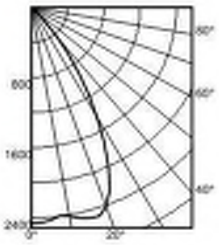
6" General Illumination Shower Downlight

Photometry

EVO6SH 35/25 AR MWD LS 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 2536.7LM, LPW = 102.7, 1.03 S/MH, TEST NO: LTL27783P2461



Avg	Lumens
0	2468
5	2432
15	2487
25	2302
35	932
45	135
55	4
65	1
75	1
85	0
90	0

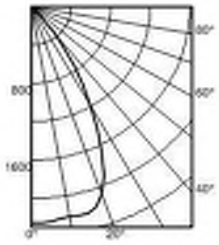
Zone	Lumens	% Lamp
0° - 30°	1830.5	72.2
0° - 40°	2403.3	94.7
0° - 60°	2534.3	99.9
0° - 90°	2536.7	100.0
90° - 180°	0.0	0.0
0° - 180°	2536.7	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	73	69	77	72	68
7	74	68	64	74	68	64	72	67	63
8	70	64	60	69	64	60	68	63	59
9	66	60	56	65	60	56	64	59	56
10	62	56	52	62	56	52	61	56	52

Mounting Height	Initial FC Center Beam	50% beam - 56.4° Diameter	50% beam - 56.4° FC	10% beam - 77.9° Diameter	10% beam - 77.9° FC
8.0	81.6	5.7	40.8	8.9	8.2
10.0	43.9	7.7	21.9	12.1	4.4
12.0	27.4	9.8	13.7	15.3	2.7
14.0	18.7	11.8	9.3	18.6	1.9
16.0	13.5	13.9	6.8	21.8	1.4

EVO6SH 35/25 DFF SMO 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 2186.6LM, LPW = 88.5, 1 S/MH, TEST NO: LTL29886P477



Avg	Lumens
0	2259
5	2248
15	2231
25	1577
35	745
45	121
55	14
65	6
75	3
85	0
90	0

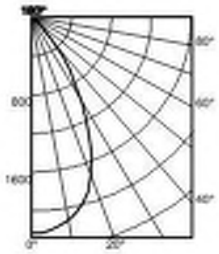
Zone	Lumens	% Lamp
0° - 30°	1590.7	72.7
0° - 40°	2053.0	93.9
0° - 60°	2175.1	99.5
0° - 90°	2186.6	100.0
90° - 180°	0.0	0.0
0° - 180°	2186.6	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	85	80	89	84	80	87	82	79
5	84	79	74	83	78	74	82	77	73
6	79	73	69	78	73	69	77	72	68
7	74	68	64	74	68	64	72	67	64
8	70	64	60	70	64	60	68	63	60
9	66	60	56	66	60	56	65	60	56
10	63	57	53	62	57	53	61	56	53

Mounting Height	Initial FC Center Beam	50% beam - 52.4° Diameter	50% beam - 52.4° FC	10% beam - 76.8° Diameter	10% beam - 76.8° FC
8.0	74.7	5.4	37.3	8.7	7.5
10.0	40.2	7.4	20.1	11.9	4.0
12.0	25.0	9.3	12.5	15.1	2.5
14.0	17.1	11.3	8.5	18.2	1.7
16.0	12.4	13.3	6.2	21.4	1.2

EVO6SH 35/25 DFF SOL 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 2140.5LM, LPW = 86.6, 0.9 S/MH, TEST NO: LTL29885P477



Avg	Lumens
0	2235
5	2207
15	1991
25	1380
35	652
45	212
55	82
65	50
75	31
85	8
90	0

Zone	Lumens	% Lamp
0° - 30°	1386.4	64.8
0° - 40°	1797.0	84.0
0° - 60°	2046.6	95.6
0° - 90°	2138.9	99.9
90° - 120°	0.0	0.0
90° - 130°	0.0	0.0
90° - 150°	0.7	0.0
90° - 180°	1.8	0.1
0° - 180°	2140.5	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	110	107	104	107	105	103	103	101	99
2	101	96	93	99	95	92	96	92	89
3	93	88	83	92	87	83	89	85	81
4	87	81	76	85	80	75	83	78	74
5	81	74	70	80	74	69	78	73	69
6	75	69	64	74	68	64	73	68	64
7	71	64	60	70	64	59	69	63	59
8	66	60	56	66	60	55	65	59	55
9	62	56	52	62	56	52	61	55	52
10	59	53	49	59	53	49	58	52	49

Mounting Height	Initial FC Center Beam	50% beam - 47.8° Diameter	50% beam - 47.8° FC	10% beam - 76.7° Diameter	10% beam - 76.7° FC
8.0	73.9	4.9	36.9	8.7	7.4
10.0	39.7	6.8	19.9	11.9	4.0
12.0	24.8	8.4	12.4	15.0	2.5
14.0	16.9	10.2	8.5	18.2	1.7
16.0	12.3	12.0	6.1	21.4	1.2

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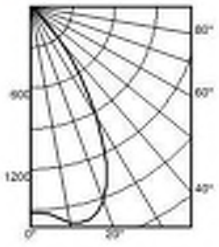
6" General Illumination Shower Downlight

Photometry

EVO6SH 35/25 DFR SM0 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 1682LM, LPW = 68, 1.08 S/MH, TEST NO: LTL29888P477



Avg	Lumens
0	1524
5	1538
15	1624
25	1278
35	614
45	117
55	11
65	5
75	2
85	1
90	0

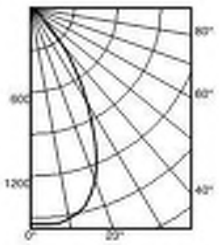
Zone	Lumens	% Lamp
0° - 30°	1176.6	69.9
0° - 40°	1558.9	92.7
0° - 60°	1673.7	99.5
0° - 90°	1682.1	100.0
90° - 180°	0.0	0.0
0° - 180°	1682.1	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	108	106	104	104	103	101
2	103	99	95	101	97	94	98	95	92
3	96	91	87	94	90	86	92	88	85
4	89	84	79	88	83	79	86	82	78
5	83	78	73	83	77	73	81	76	72
6	78	72	68	77	72	68	76	71	67
7	73	67	63	73	67	63	71	66	62
8	69	63	59	68	63	59	67	62	58
9	65	59	55	64	59	55	63	58	55
10	61	55	51	61	55	51	60	55	51

Mounting Height	Intal FC Center Beam	50% beam - 55.3° Diameter	50% beam - 55.3° FC	10% beam - 79.5° Diameter	10% beam - 79.5° FC
8.0	50.4	5.8	25.2	9.2	5.0
10.0	27.1	7.9	13.5	12.5	2.7
12.0	16.9	10.0	8.4	15.8	1.7
14.0	11.5	12.1	5.8	19.1	1.2
16.0	8.4	14.2	4.2	22.5	0.8

EVO6SH 35/25 DFR SOL 80CRI INPUT WATTS: 24.7W, DELIVERED LUMENS: 1623.2LM, LPW = 66.7, 0.97 S/MH, TEST NO: LTL29887P477



Avg	Lumens
0	1546
5	1549
15	1460
25	1061
35	538
45	177
55	60
65	34
75	16
85	2
90	0

Zone	Lumens	% Lamp
0° - 30°	1033.2	63.7
0° - 40°	1369.7	84.4
0° - 60°	1570.9	96.8
0° - 90°	1623.2	100.0
90° - 180°	0.0	0.0
0° - 180°	1623.2	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	113	107	105	108	105	103	104	102	100
2	105	97	93	99	95	92	96	93	90
3	94	88	84	92	87	83	89	85	82
4	87	81	78	86	80	78	83	78	75
5	81	74	70	80	74	69	78	73	69
6	75	69	64	74	68	64	73	67	63
7	70	64	59	70	64	59	68	63	59
8	66	60	55	65	59	55	64	59	55
9	62	56	52	62	56	51	61	55	51
10	59	52	48	58	52	48	57	52	48

Mounting Height	Intal FC Center Beam	50% beam - 50.6° Diameter	50% beam - 50.6° FC	10% beam - 79.3° Diameter	10% beam - 79.3° FC
8.0	51.1	5.2	25.6	9.1	5.1
10.0	27.5	7.1	13.7	12.4	2.7
12.0	17.1	9.0	8.6	15.7	1.7
14.0	11.7	10.9	5.8	19.1	1.2
16.0	8.5	12.8	4.2	22.4	0.8

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L4B

Manufacturer: GOTHAM Specified Catalog #: EVO6SH-35/20-DFR-SOL-MVOLT-GZ10

gotham | E V O

6" **General Illumination Shower Downlight**

NLIGHT AIR

nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR nPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

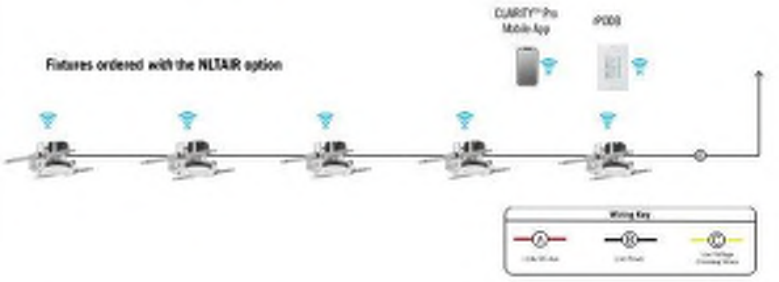
Possibilites for nLight® AIR

nLight® AIR Control Accessories
Order as separate catalog number. Visit nLight AIR.

Wall Switches	Model Number
On/Off single pole	nPD8 (color) G2
On/Off two pole	nPD8 2P (color) G2
On/Off & raise/lower single pole	nPD8 DX (color) G2
On/Off & raise/lower two pole	nPD8 2P DX (color) G2

nLight® AIR Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM5 9 / nCM5 PDT 9
Large motion 360°, ceiling	nCM5 10 / nCM5 PDT 10



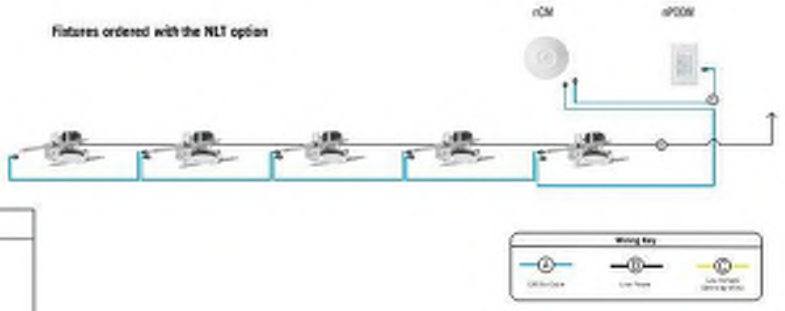
NLIGHT

nLight® Wired The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

Possibilites for nLight® wired

nLight® Wired Control Accessories
Order as separate catalog number. Visit nLight.

Wall Switches	Model Number
On/Off single pole	nPODM XX
On/Off two pole	nPODM 2P XX
On/Off & raise/lower single pole	nPOD DX XX
On/Off & raise/lower two pole	nPODM 2P DX XX
Graphic touchscreen	nPOD GFX XX
Photocell Controls	
Dimming	nCM ADCX



nLight® Wired Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

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www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L4B

Manufacturer: GOTHAM Specified Catalog #: EVO4CC-35/20-AR-LD-MVOLT-GZ10

gotham | EVO
Multiple Layers of Light

Luminaire Type:
Catalog Number:

Buy American

General Illumination Pendant Stem Cylinder 4"

OVERVIEW

Feature Set

- Batwing distribution with feathered edges provides even illumination on horizontal and vertical surfaces
- Bounding Ray™ optical design
- 45° cutoff to source and source image
- Fully serviceable lensed LED light engine
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- Fixtures are damp location standard; wet location option (WL)
- 20 standard colors in textured and gloss finish; custom or RAL colors also available
- Field cuttable 1/2" stems with concealed couplers.
- Multiple recessed or surface j-box mounting configurations available
- ENERGY STAR® Certified product

Distribution

Superior Performance

Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000	4500	5000
Delivered Lumens	271	573	838	1001	1527	1994	2580	3110	3612	4120	4584	5045
Wattage	3.1	7.2	7.9	8.8	13.7	19.5	25.7	31.2	38.4	35.4	40.1	44.7
Lumens per Watt	87.4	79.6	102.3	113.8	111.5	102.3	100.4	99.7	94.1	116	114	113

COMPLEMENTARY PRODUCTS

Coordinated Apertures | Multiple Layers of Light

General Illumination Layer | EVO

High Center Beam Layer | Incito

EVO + Incito — Multiple Layers of Light

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5

gotham | EVO

4" General Illumination Pendant Stem Cylinder

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Luminaire Type:

Catalog Number:

EXAMPLE: EVD4PC 35/15 AR MWD LSS MVOLT EZ1 /BXCC PCAN S12 DWHG

Series		Color Temperature		Lumens		Reflector Color		Distribution		Reflector Finish		Voltage	
EVD4PC	EVO 4 in Pendent Stem Round Cylinder Open Downlight	27/	2700 K	02	250 lumens	AR	Clear	MD	Medium (0.9 s/mh)	LSS	Semi-specular	MVOLT	120V - 277V
		30/	3000 K	05	500 lumens	PR	Pewter	MWD	Medium wide (1.0 s/mh)	LO	Matte diffuse	120	120V
		35/	3500 K	07	750 lumens	WTR	Wheat	WD	Wide (1.2 s/mh)	LS	Specular	277	277V
		40/	4000 K	10	1000 lumens	GR	Gold					347[7]	347V
		50/	5000 K	15	1500 lumens	WR[1]	White painted						
				20	2000 lumens	BR[1]	Black						
				25	2500 lumens	WRAMF[1]	White Anti-microbial						
				30	3000 lumens	BZR[1]	Dark Bronze painted						
				35	3500 lumens								
				40	4000 lumens								
				45	4500 lumens								
				50	5000 lumens								

Driver[1]		Mounting		Canopy Type		Stem Length[2]	
GZ10	0-10V driver dims to 10%	IBX	Integral driver, Recessed or Surface J-Box	PCAN	5" Stem canopy with "hang straight" swivel	S2	2 foot 1/2" stem
GZ1	0-10V driver dims to 1%	IBXCC	Integral driver, Surface J-Box with Conduit Covers	PCAN45[3]	45° Stem canopy with "hang straight" swivel	S4	4 foot 1/2" stem
EZ10	eldoLED 0-10V ECOdrive. Linear dimming to 10% min.	SGB[1]	Surface Gear Box, Recessed Or Surface J-Box			S6	6 foot 1/2" stem
EZ1	eldoLED 0-10V ECOdrive. Linear dimming to 1% min.	SGBCC[2]	Surface Gear Box, Surface J-Box With Conduit Covers			S8	8 foot 1/2" stem
EZB	eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%.	RGH	Recessed Gear Housing			S10	10 foot 1/2" stem
EDAB[4]	eldoLED SOLOdrive DALI. Logarithmic dimming to <1%.					S12	12 foot 1/2" stem
EDXB[4,5,6]	eldoLED POWERdrive DMX with RDM (remote device management). Square Law dimming to <1%. Min: 1000LM; Max: 4000LM.						
ECOS2[4]	Lutron® Hi-Lume® 2-wire forward-phase driver. 120V Only. Minimum dimming level 1%. Min: 1000LM; Max: 2500LM.						
ECOB[4]	Lutron® EcoSystem® digital Hi-Lume 1% soft-on, fade to black. Max: 4000LM.						
ELV[8]	Electronic line voltage (120V only)						

Control Interface[9]		Options		Architectural Colors - Powder Paint[11]			
(blank)	No controls	SF	Single fuse. Specify 120V or 277V.	DDB	Gloss Dark Bronze	DDBT	Textured Dark Bronze
NLT	nLight® dimming pack. Specify 120V or 277V	90CRI	High CRI (90+)	DBL	Matte Black	DBLB	Textured Black
NLTER[10]	nLight® dimming pack for fixtures on emergency circuit. Specify 120V or 277V	NBO	nLight Lumen Compensation	DWH	Gloss White	DWHG	Textured White
NLTAIR2	nLight® AIR dimming pack. Specify 120V or 277V	HA3[12]	HAO High Ambient Option (40°C)	DBM	Matte Medium Bronze	DBNH	Textured Bronze
NLTAIRER2[10]	nLight® AIR dimming pack for fixtures on emergency circuit. Specify 120V or 277V	WL[13]	Wet Location	DNA	Gloss Natural Aluminum	DNAT	Textured Natural Aluminum
		E10WCPR	Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch (requires RGH)	DSS	Gloss Sandstone	DSST	Textured Sandstone
		CP[11]	Chicago Plenum. Specify 120V or 277V (requires RGH)	DGC	Gloss Charcoal Grey	DSPD	Textured Dark Grey
		GTD	IOTA Generator Transfer Device, Specify 120V or 277V (requires RGH)	DTG	Gloss Tennis Green	DSPE	Textured Green
				DBR	Gloss Bright Red	DSPH	Textured Light Red
				DSB	Gloss Steel Blue	DWHMF	Gloss White with Anti-microbial finish

ACCESSORIES — order as separate catalog numbers (shipped separately)	
EGBLORS KIT	Architectural colors chip kit, consisting of powder-coat and plated finishes
CYLBOXADPT 4SQ2OCT __	4in Square J-box to 4in Octagonal J-box adaptor. Replace __ with Architectural Color or PRM for primed ready for field painting
CYLSTBL KIT	Stabilization Kit for securing pendant stem fixtures

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www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5

gotham | EVO

4" General Illumination Pendant Stem Cylinder

ORDERING INFORMATION

ORDERING NOTES

1. Not Available with Finishes.
2. Factory supplied step down transformer must be remote mounted. Access required to location of remote mounted device.
3. Refer to Tech 240 for compatible dimmers.
4. Not Available with Control Interfaces.
5. Requires SGB, or SGBCC mounting option.
6. Includes terminator resistor.
7. Only available with DMX driver (ED8B).
8. Not available with SGB or SGBCC; these mountings require a flat ceiling.
9. Stem section adjacent to cylinder can be cut in field to achieve non-uniform lengths (i.e. for a field cut 3' length, order 4' stem).
10. Factory installed with RGH option otherwise field installed. Access required to location of remote mounted device.
11. ER for use as UL924 Emergency Operation via power sense lead. Will require an emergency hot feed and normal hot feed. EM for use as UL924 Emergency Operation via power interrupt detection.
12. Only available up to 2500 lumens; not available with WL or ECOS2.
13. Not available with JBXCC, SGB, or SGBCC. Max: 3000LM.
14. For details on RAL and Custom colors please see Architectural colors.
15. CP not valid with NLTAIRR2, NLTAIRER2 or E10WCPR.

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www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5

Manufacturer: GOTHAM Specified Catalog #: EVO4CC-35/20-AR-LD-MVOLT-GZ10

gotham | E V O

4" General Illumination Pendant Stem Cylinder

SPECIFICATIONS

Optical Assembly
Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling.
Optical design is a Bounding Ray™ design with 45° cutoff to source and source image. Top down flash characteristic for superior glare control.

Electrical
The luminaire shall operate from a 50 or 60 Hz ±3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. Support 347V via remote-mounted stepdown transformer. The fluctuations of line voltage shall have no visible effect on the luminous output.
The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.
Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.
Input wires shall be 18AWG, 300V minimum solid copper.

Controls
Luminaire shall be equipped with interface for nLight wired or nLight AIR networks with integral power supply as per specification.

Emergency
Luminaires supplied with a battery pack comply with NFPA 101 (Life Safety code) and deliver constant light output throughout the 90 minutes of code required emergency operation period when there is a normal AC power loss.
Luminaires equipped with a generator transfer device work in conjunction with an auxiliary generator or a central inverter system to power fixtures for safe egress lighting.

Dimming
The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.
eldoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.
Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction
Heavy-gauge aluminum construction. Extruded cylinder body with flangeless reflector allows flow-through passive thermal management. Canopy matches cylinder in finish and diameter.
Pendant stem mount for installation to 4" recessed or surface octagonal junction box with integral driver.
Recessed gear box available for driver above ceiling, nLight, battery pack, CP, and GTD options.
Surface gear box available for driver at ceiling installation.
Optional field configurable conduit covers available. Conduit covers match cylinder in finish and diameter.
WARNING: All pendant fixtures exposed to wind require tethering – contact factory.

Listings
Fixtures are CSA Certified to meet US and Canadian Standards: All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, damp location standard; wet location covered ceiling optional (WL).
Luminaire configurations are Energy Star certified through testing in EPA–recognized laboratories, with the results reviewed by an independent, accredited certification organization. Visit www.energystar.gov for specific configurations listed.

Photometrics
LEDs tested to LM-80 standards. Measured by IESNA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.
Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by the center of the quadrangles defined in ANSI C78.377-2015.

Buy American
This product is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT. Please refer to www.acuitybrands.com/buy-american for additional information.

Warranty
5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Note:
Actual performance may differ as a result of end user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.
- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight® control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.
*See ordering tree for details

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Type: L5

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4" General Illumination Pendant Stem Cylinder

Tables of Use

EVO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EZ8	<1%	Logarithmic	Linear
EDAB	<1%	Logarithmic*	Linear
EDXB	<1%	Square	Linear

*Changable through DALI controller

Lumen Output Multiplier		
CRI	CCT	Multiplier
80	2700K	0.906
	3000K	0.948
	3500K	1
	4000K	1.032
	5000K	1.1
90	2700K	0.748
	3000K	0.8
	3500K	0.838
	4000K	0.845
	5000K	0.945

Reflector Finish Multiplier	
Reflector Finish	Multiplier
LS - Specular	1
LSS - Semi Specular	0.956
WR - White	0.87
LD - Matte Diffuse	0.85
BR - Black	0.73
BZR - Bronze	0.73

Distributions		
Nomenclature	Beam Angle	Field Angle
MD	54	82
MWD	67	89
WD	71	92

Driver		Control Provided (note: 347V/UVOLT versions provided with 347 option selected)			
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIRER2
GZ10	0-10V driver dims to 10%	nPP16 D EZP	nPP16 D ER EZP	RPP20 D 24V C2	RPP20 D 24V ER C2
GZ1	0-10V driver dims to 1%	nPP16 D EZP	nPP16 D ER EZP	RPP20 D 24V C2	RPP20 D 24V ER C2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V C2	RPP20 D 24V ER C2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V C2	RPP20 D 24V ER C2
EZ8	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V C2	RPP20 D 24V ER C2

J-box Compatibility Matrix		Cylinder Configurations					
		JBX	SQB	SQBCC	SQB w/EDXB Driver	SQBCC w/EDXB Driver	JBXCC
Recommended J-box (by others)	4" Octagonal 4x4x1.5 deep*	✓	✓	✓	✓	✓	✓
	4" Octagonal 4x4x2.125 deep	✓	✓	✗	✓	✗	✗
	4" Square 4x4x1.5 deep	✓ *with adaptor plate accessory	✓ *with adaptor plate accessory	✗	✓ *with adaptor plate accessory	✗	✗

Standard Architectural Color Options for Cylinder Bodies

NOTE: These colors were carefully reproduced to give as true a depiction as possible of finished product color. Some colors, however, may vary slightly from actual appearance due to display/printing variations and limitations. Please always contact a Gotham representative for an accurate paint chip sample.

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5

gotham | EVO

4" General Illumination Pendant Stem Cylinder

SPECIFICATIONS

Stabilization Kit (CYLSTBL KIT) Accessory
The Stabilization Kit offers additional support for applications where wind may be a factor and the pendant stem cylinder needs to be secured.

Cables
Three (3) 20 ft. 304 grade stainless steel aircraft cables with outer diameters of 1/16" are attached to anchoring mechanisms in the mounting surface at one end and the provided stem collar around the pendant stem at the other end.
Cables should be anchored 120° +/- 10° from each other radially and positioned at 45° or greater from the stem for optimal support of the fixture.

Clamps and Stem Collars
The stem collar consists of two (2) half stem collars made of 304 stainless steel. Both stem collar halves are attached around the pendant stem with 304 stainless steel socket head cap screws.
Six (6) cable clamps made of 304 stainless steel are used in the stabilization kit with two (2) clamps per cable attached to each anchoring point and the stem collar.
The cable tension can be adjusted from either end.

Wind Load
The Stabilization Kit is designed to withstand 90mph winds for 3 seconds comparable to ASCE 7-10, MRI 50-year (fixture EPA is 0.2 sq ft)

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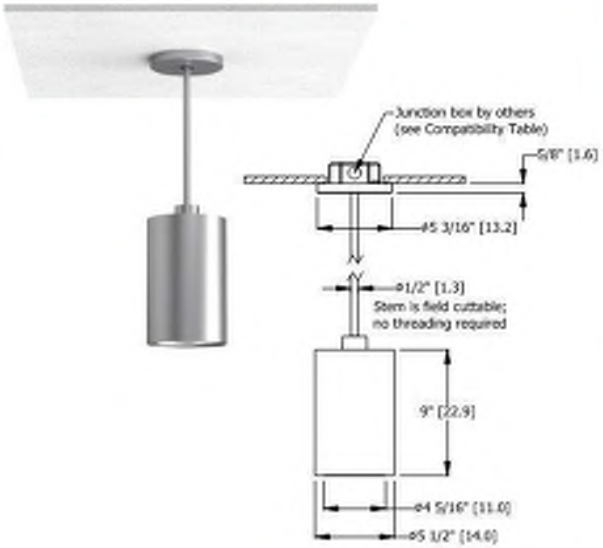
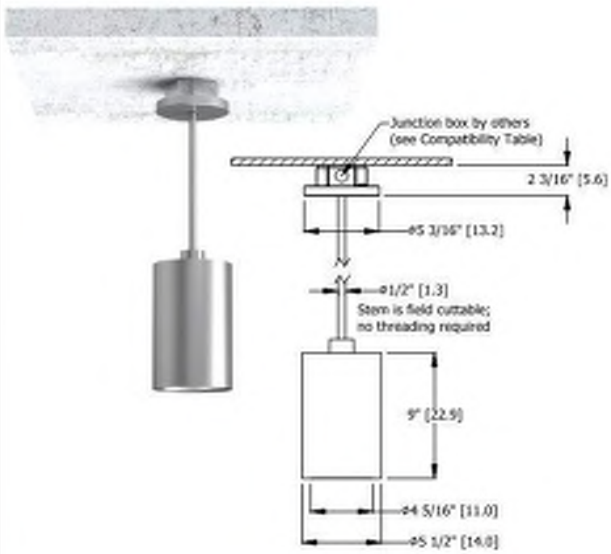
4" General Illumination Pendant Stem Cylinder

DIMENSIONAL DATA

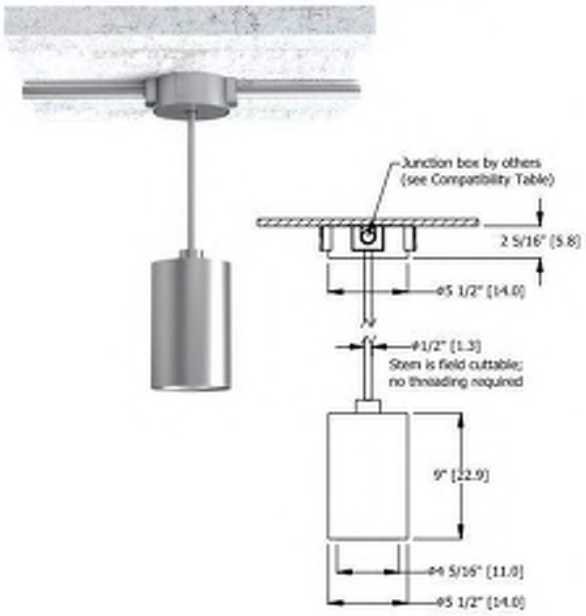
JBX Recessed J-Box



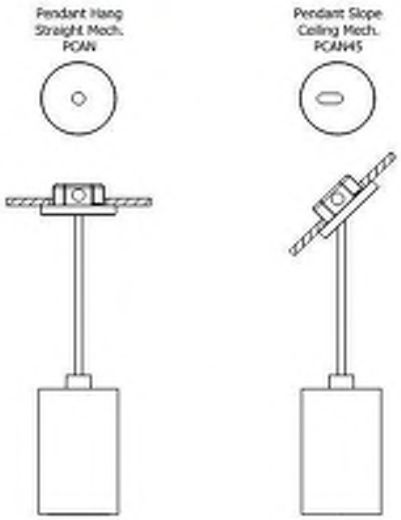
JBX Surface J-Box



JBXCC Surface J-Box with Conduit Covers



Stem_PCAN vs PCAN45



*Dimensions in inches (centimeters)

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GONDOLA SQUARE INTERIORS (A/C/F) & KVC

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

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www.me-engineers.com

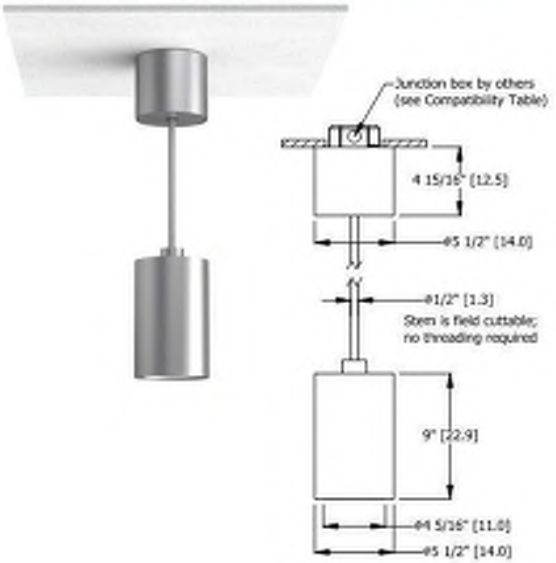
Type: L5

gotham | EVO

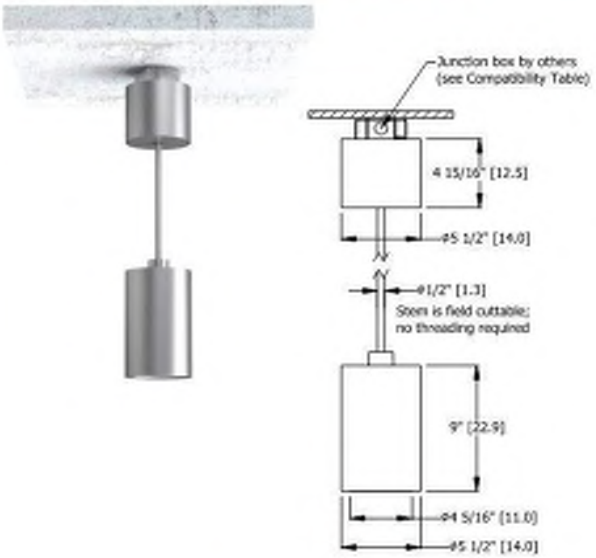
4" General Illumination Pendant Stem Cylinder

DIMENSIONAL DATA

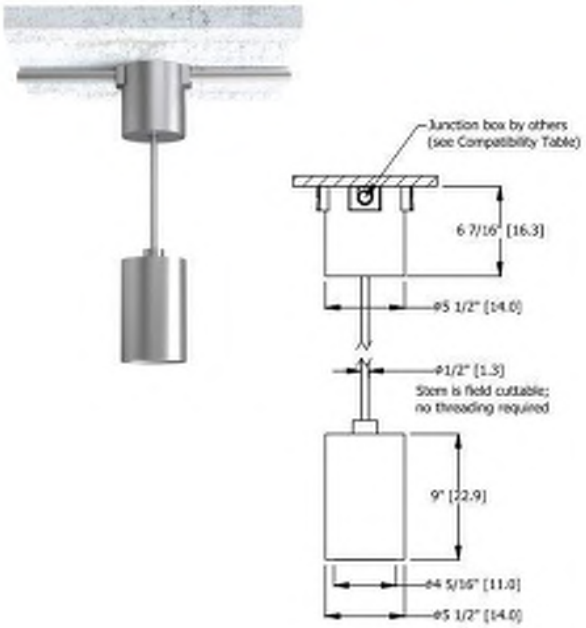
SGB Surface Gear Box for EDXB recessed J-box



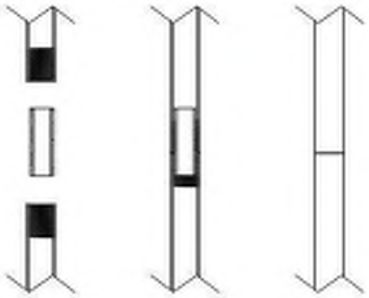
SGB Surface Gear Box for EDXB surface J-box



SGBCC Surface Gear Box for EDXB with Conduit Covers



Stem Connection Method



*Dimensions in inches (centimeters)

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

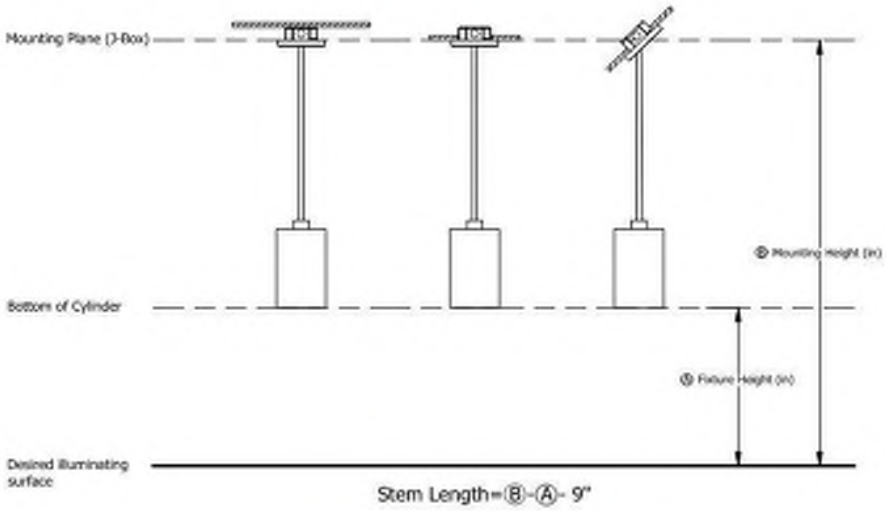
Type: L5

gotham | E V O

4" General Illumination Pendant Stem Cylinder

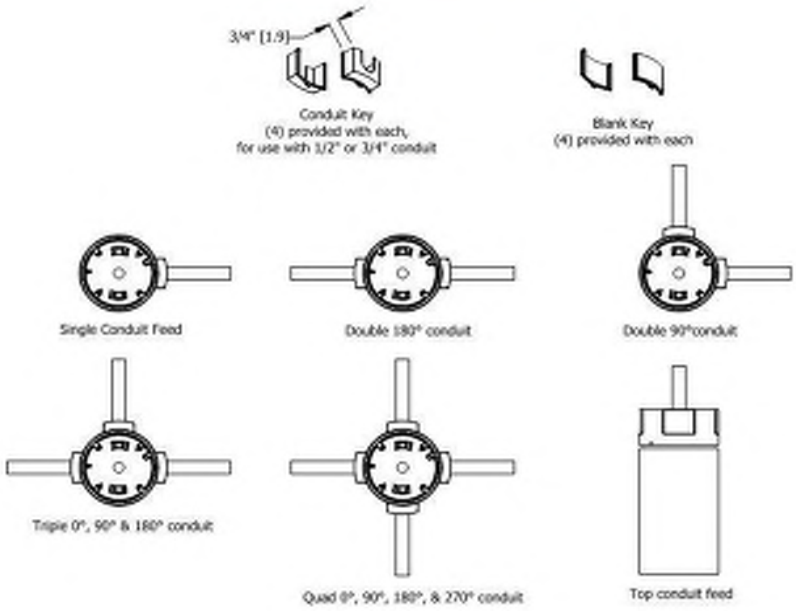
DIMENSIONAL DATA

Stem Cutting Formulas for JBX/JBXCC



Stem Length=Ⓑ-Ⓐ- 9"

Conduit Feed Examples and Keys



*Dimensions in inches (centimeters)

gotham

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

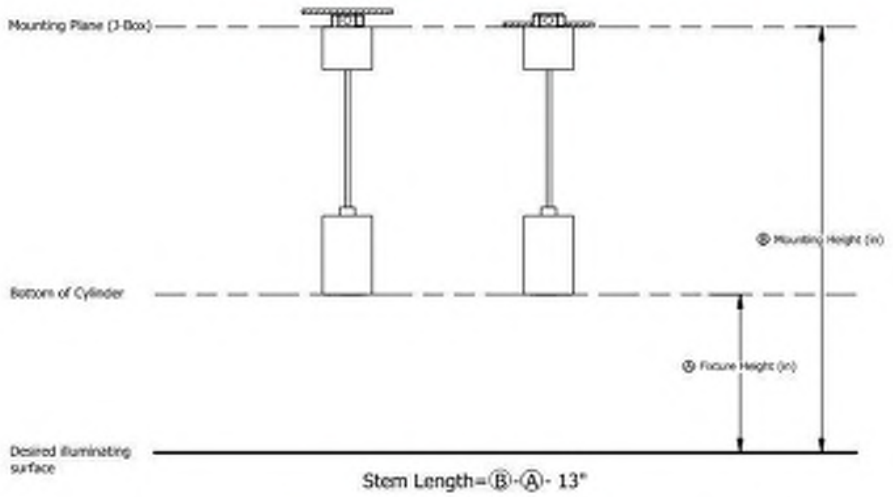
Type: L5

gotham | EVO

4" General Illumination Pendant Stem Cylinder

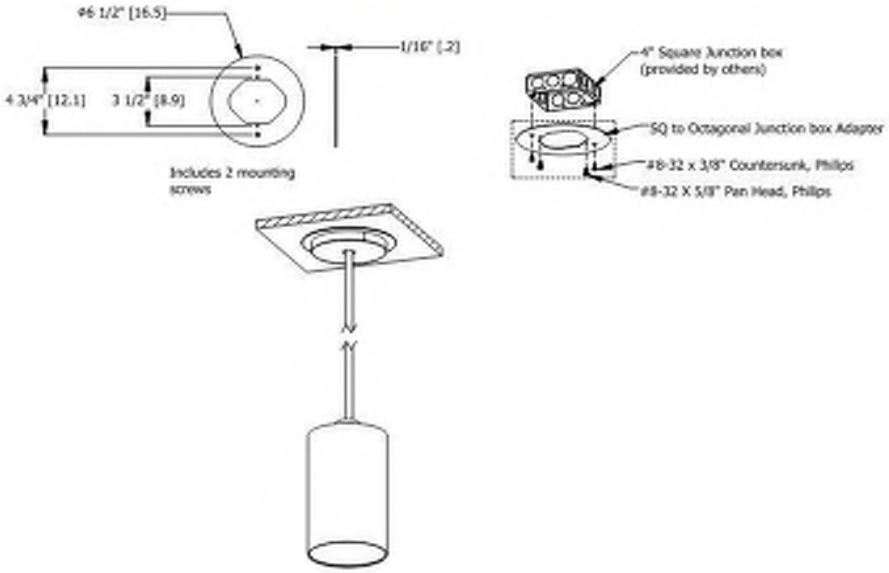
DIMENSIONAL DATA

Stem Cutting Formulas for SGB



Stem Length=Ⓑ-Ⓐ- 13"

Cylinder Adaptor Plate



*Dimensions in inches (centimeters)

gotham

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GONDOLA SQUARE INTERIORS (A/C/F) & KVC

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

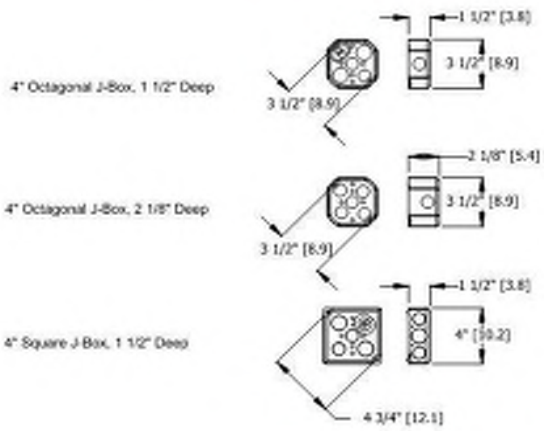
Type: L5

gotham | EVO

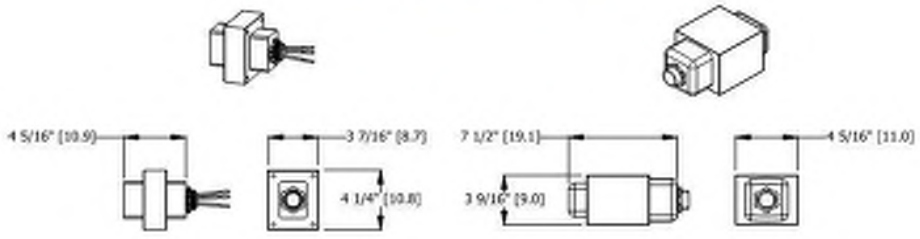
4" General Illumination Pendant Stem Cylinder

DIMENSIONAL DATA

Junction Box Dimensions (by others)



347V Stepdown Transformer



347 Transformer:
Up to 6000LM
Install to accessible
junction box by others

347 Transformer:
8000LM and up
Install to accessible
junction box by others

*Dimensions in inches (centimeters)

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GONDOLA SQUARE INTERIORS (A/C/F) & KVC

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

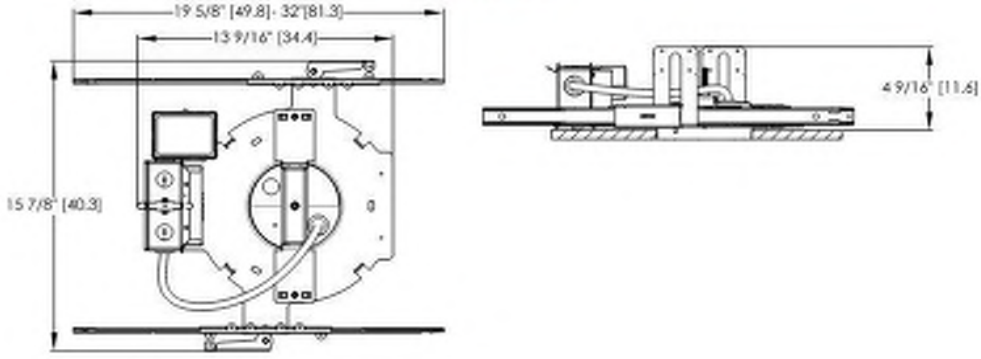
Type: L5

gotham | E V O

4" General Illumination Pendant Stem Cylinder

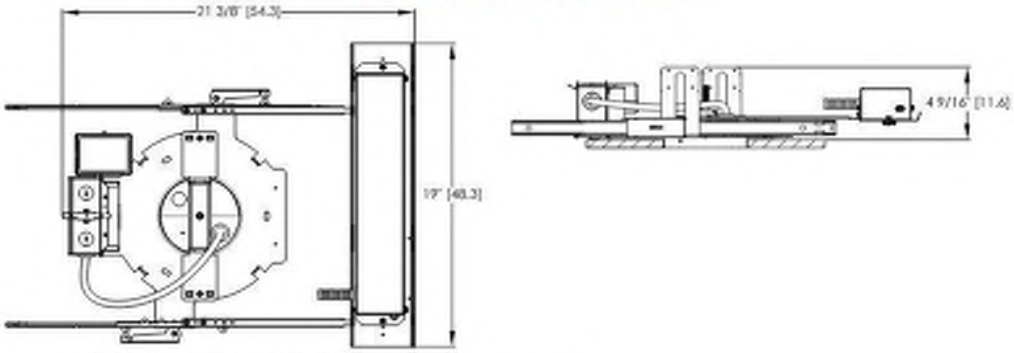
DIMENSIONAL DATA

RGH Standard



Ceiling thickness range: 1/2"[1.3] to 3"[7.6]
Ceiling cutout: 5 1/16"[12.9]

RGH with Battery Backup (E10WCPR) Standard



With Emergency Battery or GTD option
Minimum plenum height for emergency batteries in non-accessible ceilings: 12 1/2"[31.8]
Ceiling thickness range: 1/2"[1.3] to 3"[7.6]
Ceiling cutout: 5 1/16"[12.9]

*Dimensions in inches [centimeters]

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GONDOLA SQUARE INTERIORS (A/C/F) & KVC

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

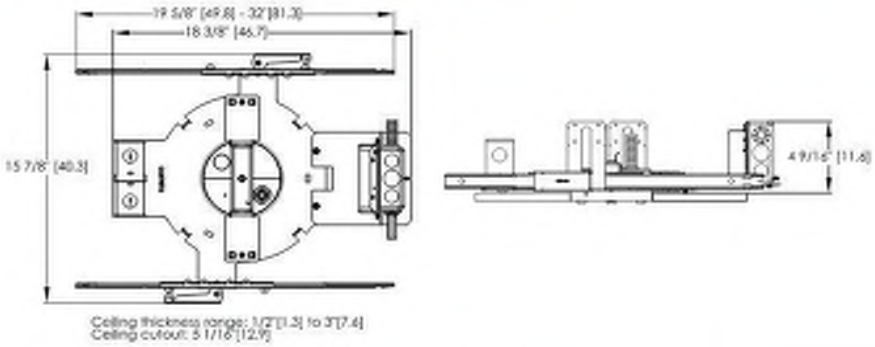
Type: L5

gotham | E V O

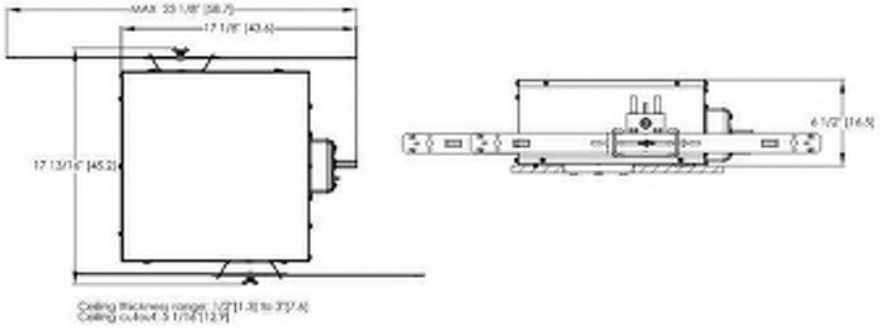
4" General Illumination Pendant Stem Cylinder

DIMENSIONAL DATA

RGH CP Standard



RGH with Chicago Plenum (CP) for use with nLight Enclosed



*Dimensions in inches [centimeters]

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5

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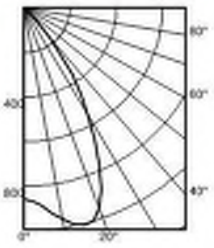
4" General Illumination Pendant Stem Cylinder

Photometry

CONSULT WWW.GOTHAMLIGHTING.COM FOR ADDITIONAL PHOTOMETRY.

EVO4PC 35/10 MWD LS INPUT WATTS: 8.8W, DELIVERED LUMENS: 1001.7LM, LPW = 113.8, 1.08 S/MH, TEST NO. LTL27786P



Ave	Lumens
0	856
5	886
15	1010
25	775
35	363
45	61
55	2
65	1
75	0
85	0
90	0

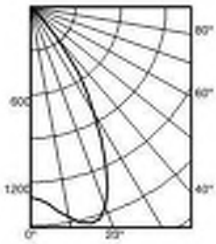
Zone	Lumens	% Lamp
0° - 30°	717.4	71.6
0° - 40°	942.0	94.0
0° - 60°	1000.8	99.9
0° - 90°	1001.7	100.0
90° - 180°	0.0	0.0
0° - 180°	1001.7	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	98	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Inital FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	29.3	5.9	14.1	9.2	2.8
10.0	15.2	8.1	7.6	12.5	1.5
12.0	9.5	10.3	4.7	15.9	0.9
14.0	6.5	12.4	3.2	19.2	0.6
16.0	4.7	14.6	2.3	22.5	0.5

EVO4PC 35/15 MWD LSS INPUT WATTS: 13.7W, DELIVERED LUMENS: 1527.3LM, LPW = 111.4, 1.08 S/MH, TEST NO. LTL27786P



Ave	Lumens
0	1305
5	1354
15	1539
25	1181
35	553
45	93
55	2
65	1
75	0
85	0
90	0

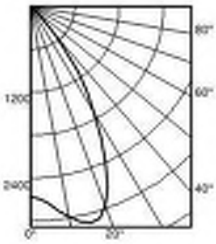
Zone	Lumens	% Lamp
0° - 30°	1093.9	71.6
0° - 40°	1436.2	94.0
0° - 60°	1525.8	99.9
0° - 90°	1527.3	100.0
90° - 180°	0.0	0.0
0° - 180°	1527.3	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Inital FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	43.2	5.9	21.6	9.2	4.3
10.0	23.2	8.1	11.6	12.5	2.3
12.0	14.5	10.3	7.2	15.9	1.4
14.0	9.9	12.4	4.9	19.2	1.0
16.0	7.2	14.6	3.6	22.5	0.7

EVO4PC 35/30 MWD LSS INPUT WATTS: 31.2W, DELIVERED LUMENS: 3110.6LM, LPW = 99.6, 1.08 S/MH, TEST NO. LTL27786P



Ave	Lumens
0	2659
5	2758
15	3135
25	2406
35	1126
45	189
55	5
65	2
75	0
85	0
90	0

Zone	Lumens	% Lamp
0° - 30°	2227.9	71.6
0° - 40°	2925.0	94.0
0° - 60°	3107.6	99.9
0° - 90°	3110.6	100.0
90° - 180°	0.0	0.0
0° - 180°	3110.6	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Inital FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	67.9	5.9	43.9	9.2	6.8
10.0	47.3	8.1	23.6	12.5	4.7
12.0	29.5	10.3	14.7	15.9	2.9
14.0	20.1	12.4	10.1	19.2	2.0
16.0	14.8	14.6	7.3	22.5	1.5

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5

Manufacturer: GOTHAM Specified Catalog #: EVO4CC-35/20-AR-LD-MVOLT-GZ10

gotham | E V O

4" General Illumination Pendant Stem Cylinder

NLIGHT AIR

nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR nPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

nLight® AIR Control Accessories

Order as separate catalog number. Visit nLight AIR.

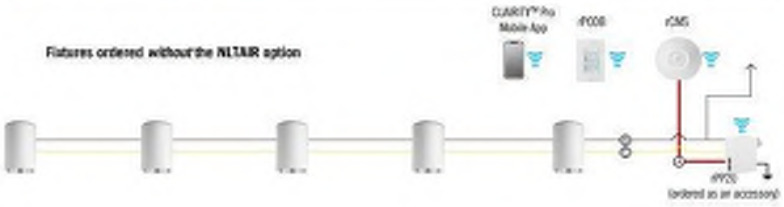
Wall Switches	Model Number
On/Off single pole	nPD8B (color) G2
On/Off two pole	nPD8B 2P (color) G2
On/Off & raise/lower single pole	nPD8B DX (color) G2
On/Off & raise/lower two pole	nPD8B 2P DX (color) G2

nLight® AIR Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCMS 9 / nCMS PDT 9
Large motion 360°, ceiling	nCMS 10 / nCMS PDT 10

Possibilites for nLight® AIR

Fixtures ordered without the NLTAIR option



Fixtures ordered with the NLTAIR option

NLIGHT

nLight® Wired The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

nLight® Wired Control Accessories

Order as separate catalog number. Visit nLight.

Wall Switches	Model Number
On/Off single pole	nPD8M (00)
On/Off two pole	nPD8M 2P (00)
On/Off & raise/lower single pole	nPD8 DX (00)
On/Off & raise/lower two pole	nPD8M 2P DX (00)
Graphic touchscreen	nPD8 GFX (00)
Photocell Controls	
Dimming	nCM ADCX

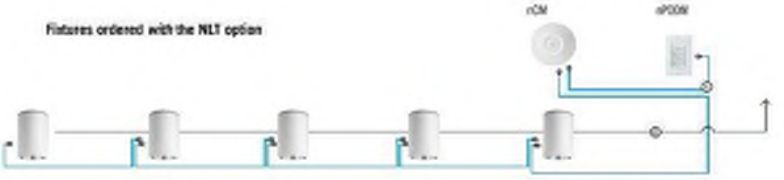
nLight® Wired Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

Possibilites for nLight® wired

Fixtures ordered without the NLT option

Fixtures ordered with the NLT option



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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5

Manufacturer: GOTHAM Specified Catalog #: EVO4CC-35/20-AR-LD-MVOLT-GZ10

gotham | E V O
Multiple Layers of Light

Luminaire Type:
Catalog Number:

Buy American | 66 IP RATED

General Illumination Surface Ceiling Cylinder 4"

OVERVIEW

Feature Set

- Batwing distribution with feathered edges provides even illumination on horizontal and vertical surfaces
- Bounding Ray™ optical design
- 45° Cutoff to source and source image
- Fully serviceable lensed LED light engine
- 70% lumen maintenance at 60,000 hours
- 2.5 SDCM; 85 CRI typical, 90+ CRI optional
- Fixtures are damp location standard; wet location option (WL), covered ceiling, IP66 option available, covered ceiling not required.
- Multiple recessed or surface j-box mounting configurations available
- 20 standard colors in textured and gloss finish; custom or RAL colors also available
- Field configurable surface junction box conduit covers available
- ENERGY STAR® Certified product

Distribution

Superior Performance

Nominal Lumens	250	500	750	1000	1500	2000	2500	3000	3500	4000	4500	5000
Delivered Lumens	271	573	808	1001	1527	1994	2580	3110	3612	4120	4584	5045
Wattage	3.1	7.2	7.9	8.8	13.7	19.5	25.7	31.2	38.4	35.4	40.1	44.7
Lumens per Watt	87.4	79.6	102.3	113.8	111.5	102.3	100.4	99.7	94.1	116	114	113

COMPLEMENTARY PRODUCTS

Coordinated Apertures | Multiple Layers of Light

General Illumination Layer | EVO

High Center Beam Layer | Incito

EVO + Incito — Multiple Layers of Light

Core

Healthcare

Special Applications

EVO4SC
page 1 of 10

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www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5B

Manufacturer: GOTHAM Specified Catalog #: EVO4CC-35/20-AR-LD-MVOLT-GZ10

gotham | EVO

4" **General Illumination Surface Ceiling Cylinder**

ORDERING INFORMATION

A+ Capable options indicated by this color background.

Luminaire Type:

Catalog Number:

EXAMPLE: EVD4SC 35/15 AR MWD LSS MVOLT EZ1 JBXCC DWHG

Series		Color Temperature		Lumens		Reflector Color		Distribution		Reflector Finish		Voltage	
EVD4SC	EVO 4in Surface Ceiling Round Cylinder Open Downlight	27/	2700 K	02	250 lumens	AR	Clear	MD	Medium (0.9 s/mh)	LSS	Semi-specular	MVOLT	120V - 277V
		30/	3000 K	05	500 lumens	PR	Pewter	MWD	Medium wide (1.0 s/mh)	LD	Matte diffuse	120	120V
		35/	3500 K	07	750 lumens	WTR	Wheat	WD	Wide (1.2 s/mh)	LS	Specular	277	277V
		40/	4000 K	10	1000 lumens	GR	Gold					347[7]	347V
		50/	5000 K	15	1500 lumens	WR[1]	White painted						
				20	2000 lumens	BR[1]	Black						
				25	2500 lumens	WRAMF[1]	White Anti-microbial						
				30	3000 lumens	BZR[1]	Dark Bronze painted						
				35	3500 lumens								
				40	4000 lumens								
				45	4500 lumens								
				50	5000 lumens								

Driver[2]		Mounting		Control Interface[4]	
GZ10	0-10V driver dims to 10%	JBX	Integral driver, Recessed or Surface J-box	(blank)	No controls
GZ1	0-10V driver dims to 1%	JBXCC	Integral driver, Surface J-box with Conduit Covers	NLT	nLight® dimming pack. Specify 120V or 277V.
EZ10	eldoLED 0-10V ECOdrive. Linear dimming to 10% min.	RGH	Recessed Gear Housing	NLTER[1]	nLight® dimming pack for fixtures on emergency circuit. Specify 120V or 277V.
EZ1	eldoLED 0-10V ECOdrive. Linear dimming to 1% min.			NLTAIR2	nLight® AIR dimming pack. Specify 120V or 277V.
EZB	eldoLED 0-10V SOLOdrive. Logarithmic dimming to <1%.			NLTAIRER2[1]	nLight® AIR dimming pack for fixtures on emergency circuit. Specify 120V or 277V.
EDAB[4]	eldoLED SOLOdrive DALI. Logarithmic dimming to <1%.				
EDXB[4,5]	eldoLED POWERdrive DMX with RDM (remote device management). Square Law dimming to <1%. Min: 1000LM; Max: 4000LM.				
ECOS2[1]	Lutron® Hi-Lume® 2-wire forward-phase driver. 120V Only. Minimum dimming level 1%. Min: 1000LM; Max: 2500LM.				
ECOD[1]	Lutron® EcoSystem® digital Hi-Lume 1% soft-on, fade to black. Max: 4000LM.				
ELV[6]	Electronic line voltage (120V only)				

Options		Architectural Colors - Powder Paint[10]			
SF	Single fuse. Specify 120V or 277V.	DDB	Gloss Dark Bronze	DDBT	Textured Dark Bronze
90CRI	High CRI (90+)	DBL	Matte Black	DBLB	Textured Black
NBO	nLight Lumen Compensation	DWH	Gloss White	DWHG	Textured White
HAO[1]	High Ambient Option (40°C)	DMB	Matte Medium Bronze	DBNH	Textured Bronze
WL[1]	Wet Location	DNA	Gloss Natural Aluminum	DNAT	Textured Natural Aluminum
IP66[1]	Lensed, IP66 rated	DSS	Gloss Sandstone	DSST	Textured Sandstone
E10WCPR	Emergency battery pack, 10W Constant Power, CA Title 20 compliant with remote test switch (requires RGH)	DGC	Gloss Charcoal Grey	DSPD	Textured Dark Grey
CP[11]	Chicago Plenum. Specify 120V or 277V (requires RGH)	DTG	Gloss Tennis Green	DSPE	Textured Green
GTD	IOTA Generator Transfer Device. Specify 120V or 277V (requires RGH)	DBR	Gloss Bright Red	DSPR	Textured Light Red
		DSB	Gloss Steel Blue	DWHMF	Gloss White with Anti-microbial finish

ACCESSORIES — order as separate catalog numbers (shipped separately)

6COLORS KIT	Architectural colors chip kit, consisting of powder-coat and plated finishes
CYLJBOXADPT 4SQ2OCT __	4in Square J-box to 4in Octagonal J-box adapter. Replace __ with Architectural Color or PRM for primed ready for field painting

ORDERING NOTES

1. Not Available with Finishes.
2. Factory installed with RGH option otherwise field installed. Access required to location of remote mounted device.
3. Refer to Tech 200 for compatible dimmers.
4. Not Available with Control Interfaces.
5. Includes terminator resistor.
6. Field installed. Access required to location of remote mounted device.
7. ER for use as UL924 Emergency Operation via power sense lead. Will require an emergency hot feed and normal hot feed. EM for use as UL924 Emergency Operation via power interrupt detection.
8. Only available up to 2500 lumens; not available with wet location or ECOS2.
9. Not available with JBXCC. Max: 3000LM.
10. For details on RAL and Custom colors please see Architectural colors.
11. CP not valid with NLTAIR2, NLTAIRER2 or E10WCPR.

GOTHAM ARCHITECTURAL DOWNLIGHTING | 1400 Lester Road Conyers, GA 30012 | P 800-705-SERV (7378) | gothamlighting.com

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

me engineers
14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Type: L5B

gotham | E V O

4" General Illumination Surface Ceiling Cylinder

SPECIFICATIONS

Optical Assembly
Fully serviceable and upgradeable lensed LED light engine suitable for field maintenance or service from below the ceiling.
Optical design is a Bounding Ray™ design with 45° cutoff to source and source image. Top down flash characteristic for superior glare control.

Electrical
The luminaire shall operate from a 50 or 60 Hz ±3 Hz AC line over a voltage ranging from 120 VAC to 277 VAC. Support 347V via remote-mounted stepdown transformer. The fluctuations of line voltage shall have no visible effect on the luminous output.
The luminaire shall have a power factor of 90% or greater at all standard operating voltages and full luminaire output.
Sound Rated A+. Driver shall be >80% efficient at full load across all input voltages.
Input wires shall be 18AWG, 300V minimum solid copper.

Controls
Luminaire shall be equipped with interface for nLight wired or nLight AIR networks with integral power supply as per specification.

Emergency
Luminaires supplied with a battery pack comply with NFPA 101 (Life Safety code) and deliver constant light output throughout the 90 minutes of code required emergency operation period when there is a normal AC power loss.
Luminaires equipped with a generator transfer device work in conjunction with an auxiliary generator or a central inverter system to power fixtures for safe egress lighting.

Dimming
The luminaire shall be capable of continuous dimming without perceivable stroboscopic flicker as measured by flicker index (ANSI/IES RP-16-10) over a range of 100 – 10%, 100 – 1.0% or 100 – 0.1% of rated lumen output with a smooth shut off function to step to 0%.
eldoLED LED drivers shall conform to IEEE P1789 standards. Alternatively, manufacturers must demonstrate conformance with product literature and testing which demonstrates this performance. Systems that do not meet IEEE P1789 will not be considered.
Driver is inaudible in 24dB environment, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment.

Construction
Heavy-gauge aluminum construction.
Extruded body with flangeless reflector allows flow-through passive thermal management.
Surface ceiling mount for direct installation to 4" recessed or surface octagonal or square junction box.
Optional field configurable conduit covers available. Conduit covers match cylinder in finish and diameter.
Recessed gear box available for driver above ceiling, nLight, CP, GTD or battery pack options.

Listings
Fixtures are CSA Certified to meet US and Canadian Standards. All fixtures manufactured in strict accordance with the appropriate and current requirements of the "Standards for Safety" to UL, damp location standard; wet location covered ceiling optional (WL); IP66 rating optional (IP66).
Luminaire configurations are Energy Star certified through testing in EPA-recognized laboratories, with the results reviewed by an independent, accredited certification organization. Visit www.energystar.gov for specific configurations listed.

Photometrics
LEDs tested to LM-80 standards. Measured by IES/NA Standard LM-79-08 in an accredited lab. Lumen output shall not decrease by more than 30% over the minimum operational life of 60,000 hours.
Color appearance from luminaire to luminaire of the same type and in all configurations, shall be consistent both initially and at 6,000 hours and operate within a tolerance of <2.5 MacAdam ellipse as defined by the center of the quadrangles defined in ANSI C78.377-2015.

Buy American
This product is assembled in the USA and meets the Buy America(n) government procurement requirements under FAR, DFARS and DOT. Please refer to www.acuitybrands.com/buy-american for additional information.

Warranty
5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/warranty/terms-and-conditions

Note:
Actual performance may differ as a result of end user environment and application.
All values are design or typical values, measured under laboratory conditions at 25 °C.

A+ Capable Luminaire
This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.
- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background*
- This luminaire is part of an A+ Certified solution for nLight® control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background*

To learn more about A+, visit www.acuitybrands.com/aplus.
*See ordering tree for details

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5B

gotham | E V O

4" General Illumination Surface Ceiling Cylinder

Tables of Use

EVO - eldoLED Driver Default Dimming Curve			
Nomenclature	Min Dimming	Driver Dim Curve	Control Dim Curve
EZ10	10%	Linear	Linear/Logarithmic
EZ1	1%	Linear	Linear/Logarithmic
EZ0	<1%	Logarithmic	Linear
EDAB	<1%	Logarithmic*	Linear
EDXB	<1%	Square	Linear

*Changable through DALI controller

Lumen Output Multiplier		
CRI	CCT	Multiplier
80	2700K	0.906
	3000K	0.948
	3500K	1
	4000K	1.032
	5000K	1.1
90	2700K	0.748
	3000K	0.8
	3500K	0.838
	4000K	0.845
	5000K	0.945

Reflector Finish Multiplier	
Reflector Finish	Multiplier
LS - Specular	1
LSS - Semi Specular	0.956
WR - White	0.87
LD - Matte Diffuse	0.85
BR - Black	0.73
BZR - Bronze	0.73

Distributions		
Nomenclature	Beam Angle	Field Angle
IND	54	82
MWD	67	89
WD	71	92

Driver		Control Provided (note: 347V/UVOLT versions provided with 347 option selected)			
Nomenclature	Description	NLT	NLTER	NLTAIR2	NLTAIRER2
GZ10	0-10V driver dims to 10%	nPP16 D EZP	nPP16 D ER EZP	RPP20 D 24V G2	RPP20 D 24V ER G2
GZ1	0-10V driver dims to 1%	nPP16 D EZP	nPP16 D ER EZP	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ10	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ1	eldoLED 0-10V ECOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2
EZ0	eldoLED 0-10V SOLOdrive	nPS 80 EZ	nPS 80 EZ ER	RPP20 D 24V G2	RPP20 D 24V ER G2

J-box Compatibility Matrix		Cylinder Configurations		
		JBX	JBX w/EDXB Driver	JBXCC
Recommended J-box Position(s)	4" Octagonal 4x4x1.5 deep*	✓	✗	✓
	4" Octagonal 4x4x2.125 deep	✓	✓	✗
	4" Square 4x4x1.5 deep	✓ *with adaptor plate accessory	✗	✗

Standard Architectural Color Options for Cylinder Bodies

NOTE: These colors were carefully reproduced to give as true a depiction as possible of finished product color. Some colors, however, may vary slightly from actual appearance due to display/printing variations and limitations. Please always contact a Gotham representative for an accurate paint chip sample.

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

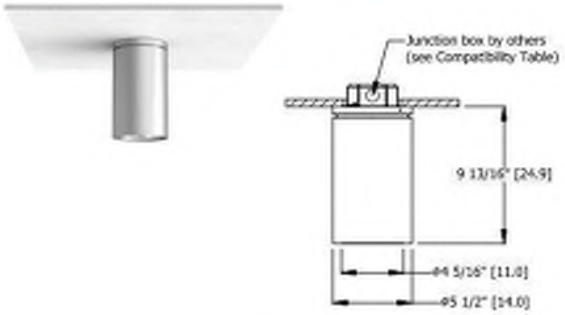
Type: L5B

gotham | EVO

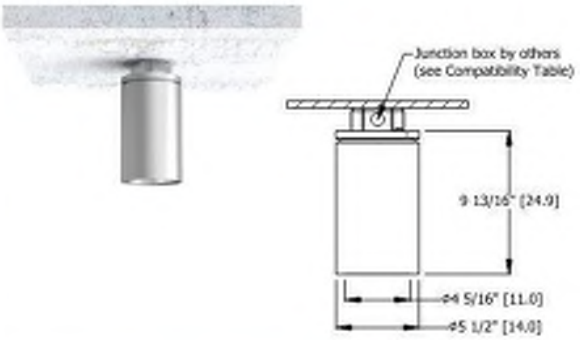
4" General Illumination Surface Ceiling Cylinder

DIMENSIONAL DATA

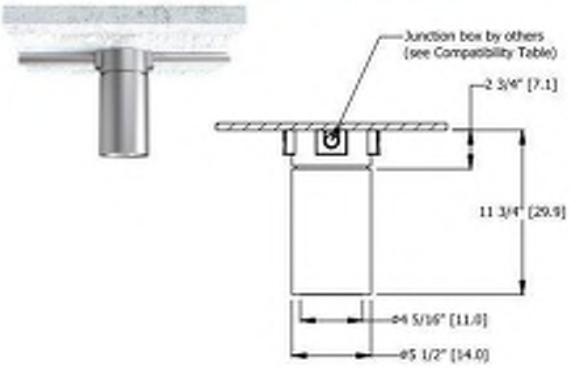
JBX Recessed J-Box



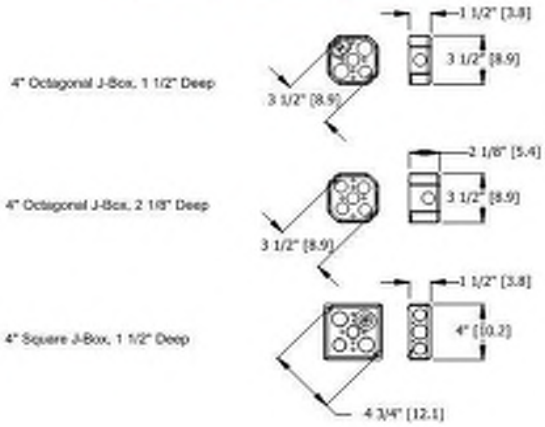
JBX Surface J-Box



JBXCC Surface J-Box with Conduit Covers



Junction Box Dimensions (by others)



Cylinder Adapter Plate

*Dimensions in inches [centimeters]

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

Type: L5B

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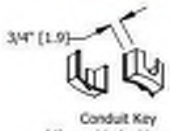
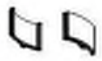
4" General Illumination Surface Ceiling Cylinder

DIMENSIONAL DATA

Conduit Feed Examples and Keys



Conduit Key
(4) provided with each,
for use with 1/2" or 3/4" conduit



Blank Key
(4) provided with each

Single Conduit Feed

Double 180° conduit

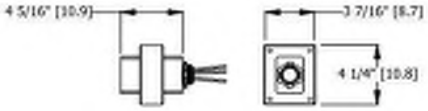
Double 90°conduit

Triple 0°, 90° & 180° conduit

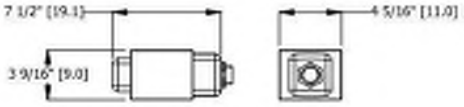
Quad 0°, 90°, 180°, & 270° conduit

Top conduit feed

347V Stepdown Transformer



347 Transformer:
Up to 6000LM
Install to accessible
junction box by others



347 Transformer:
8000LM and up
Install to accessible
junction box by others

*Dimensions in inches [centimeters]

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5B

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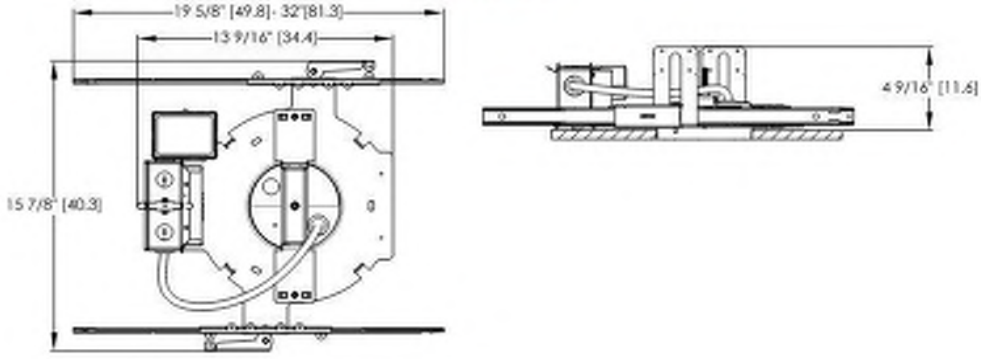
4" General Illumination Surface Ceiling Cylinder

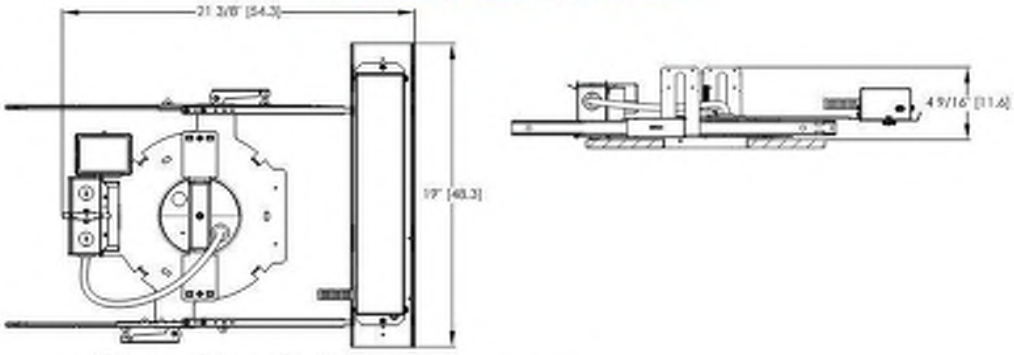
DIMENSIONAL DATA

RGH Standard



Ceiling thickness range: 1/2"[1.3] to 3"[7.6]
Ceiling cutout: 5 1/16"[12.9]

RGH with Battery Backup (E10WCPR) Standard



With Emergency Battery or GTD option
Minimum plenum height for emergency batteries in non-accessible ceilings: 12 1/2"[31.8]
Ceiling thickness range: 1/2"[1.3] to 3"[7.6]
Ceiling cutout: 5 1/16"[12.9]

*Dimensions in inches [centimeters]

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5B

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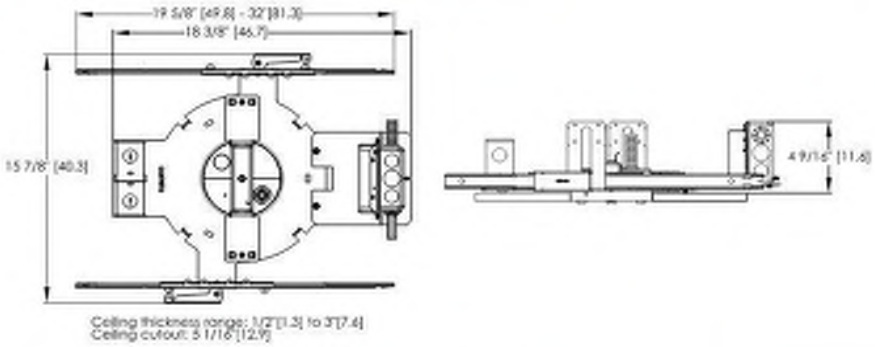
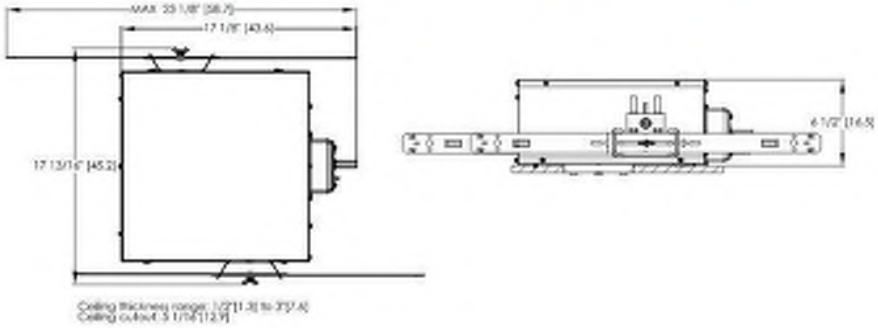
4" General Illumination Surface Ceiling Cylinder

DIMENSIONAL DATA

RGH CP Standard



RGH with Chicago Plenum (CP) for use with nLight Enclosed



*Dimensions in inches [centimeters]

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5B

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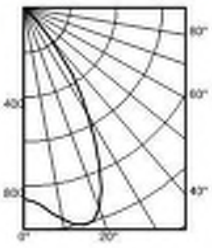
4" General Illumination Surface Ceiling Cylinder

Photometry

CONSULT WWW.GOTHAMLIGHTING.COM FOR ADDITIONAL PHOTOMETRY.

EVO4SC 35/10 MWD LS INPUT WATTS: 8.8W, DELIVERED LUMENS: 1001.7LM, LPW = 113.8, 1.08 S/MH, TEST NO. LTL27786P



Ave	Lumens
0	856
5	886
15	1010
25	775
35	363
45	61
55	2
65	1
75	0
85	0
90	0

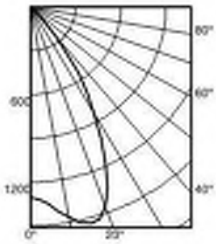
Zone	Lumens	% Lamp
0° - 30°	717.4	71.6
0° - 40°	942.0	94.0
0° - 60°	1000.8	99.9
0° - 90°	1001.7	100.0
90° - 180°	0.0	0.0
0° - 180°	1001.7	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Inital FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	29.3	5.9	14.1	9.2	2.8
10.0	15.2	8.1	7.6	12.5	1.5
12.0	9.5	10.3	4.7	15.9	0.9
14.0	6.5	12.4	3.2	19.2	0.6
16.0	4.7	14.6	2.3	22.5	0.5

EVO4SC 35/15 MWD LSS INPUT WATTS: 13.7W, DELIVERED LUMENS: 1527.3LM, LPW = 111.4, 1.08 S/MH, TEST NO. LTL27786P



Ave	Lumens
0	1305
5	1354
15	1539
25	1181
35	553
45	93
55	2
65	1
75	0
85	0
90	0

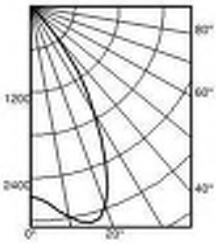
Zone	Lumens	% Lamp
0° - 30°	1093.9	71.6
0° - 40°	1436.2	94.0
0° - 60°	1525.8	99.9
0° - 90°	1527.3	100.0
90° - 180°	0.0	0.0
0° - 180°	1527.3	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Inital FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	43.2	5.9	21.6	9.2	4.3
10.0	23.2	8.1	11.6	12.5	2.3
12.0	14.5	10.3	7.2	15.9	1.4
14.0	9.9	12.4	4.9	19.2	1.0
16.0	7.2	14.6	3.6	22.5	0.7

EVO4SC 35/30 MWD LSS INPUT WATTS: 31.2W, DELIVERED LUMENS: 3110.6LM, LPW = 99.6, 1.08 S/MH, TEST NO. LTL27786P



Ave	Lumens
0	2659
5	2758
15	3135
25	2406
35	1126
45	189
55	5
65	2
75	0
85	0
90	0

Zone	Lumens	% Lamp
0° - 30°	2227.9	71.6
0° - 40°	2925.0	94.0
0° - 60°	3107.6	99.9
0° - 90°	3110.6	100.0
90° - 180°	0.0	0.0
0° - 180°	3110.6	*100.0

*Efficiency

pf / pc / pw	80% 50%	80% 30%	80% 10%	70% 50%	70% 30%	70% 10%	50% 50%	50% 30%	50% 10%
0	119	119	119	116	116	116	111	111	111
1	111	108	106	109	106	104	105	103	101
2	103	99	96	101	98	95	98	95	93
3	96	91	87	95	90	87	92	88	85
4	90	84	80	89	84	80	87	82	79
5	84	78	74	83	78	74	81	77	73
6	79	73	69	78	72	68	76	72	68
7	74	68	64	73	68	64	72	67	63
8	70	64	59	69	63	59	68	63	59
9	66	60	56	65	59	56	64	59	55
10	62	56	52	61	56	52	61	56	52

Mounting Height	Inital FC Center Beam	50% beam - 56.7° Diameter	50% beam - 56.7° FC	10% beam - 79.7° Diameter	10% beam - 79.7° FC
8.0	67.9	5.9	43.9	9.2	6.8
10.0	47.3	8.1	23.6	12.5	4.7
12.0	29.5	10.3	14.7	15.9	2.9
14.0	20.1	12.4	10.1	19.2	2.0
16.0	14.8	14.6	7.3	22.5	1.5

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

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www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5B

gotham | EVO

4" General Illumination Surface Ceiling Cylinder

NLIGHT AIR

Possibilites for nLight® AIR

nLight® AIR is the ideal solution for retrofit or new construction spaces where adding communication wiring is cost prohibitive. The integrated nLight AIR nPP20 Power Pack is part of each EVO Luminaire ordered with the NLTAIR option. These individually addressable controls offer the ultimate in flexibility during initial setup and for space repurposing.

Fixtures ordered without the NLTAIR option

nLight® AIR Control Accessories
Order as separate catalog number. Visit nLight AIR.

Wall Switches	Model Number
On/Off single pole	nPODB (color) G2
On/Off two pole	nPODB 2P (color) G2
On/Off & raise/lower single pole	nPODB DX (color) G2
On/Off & raise/lower two pole	nPODB 2P DX (color) G2

nLight® AIR Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCMS 9 / nCMS PDT 9
Large motion 360°, ceiling	nCMS 10 / nCMS PDT 10

Fixtures ordered with the NLTAIR option

NLIGHT

Possibilites for nLight® wired

nLight® Wired The nLight® solution is a digital networked lighting control system that provides both energy savings and increased user configurability by cost effectively integrating time-based, daylight-based, sensor-based and manual lighting control schemes.

Fixtures ordered without the NLT option

nLight® Wired Control Accessories
Order as separate catalog number. Visit nLight.

Wall Switches	Model Number
On/Off single pole	nPODM (00)
On/Off two pole	nPODM 2P (00)
On/Off & raise/lower single pole	nPOD DX (00)
On/Off & raise/lower two pole	nPODM 2P DX (00)
Graphic touchscreen	nPOD GFX (00)
Photocell Controls	
Dimming	nCM ADCX

Fixtures ordered with the NLT option

nLight® Wired Control Accessories *(cont.)*

Occupancy Sensors (PIR/dual tech)	Model Number
Small motion 360°, ceiling	nCM 9 / nCM PDT 9
Large motion 360°, ceiling	nCM 10 / nCM PDT 10
Wide View	nWV 16 / nWV PDT 16
Wall switch with raise/lower	nWSX LV DX / nWSX PDT LV DX
Cat-5 Cables (plenum rated)	
10', CAT5	CAT5 10FT J1
15', CAT5	CAT5 15FT J1

gotham

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STEAMBOAT BASE AREA

GONDOLA SQUARE INTERIORS (A/C/F) & KVC

14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655

www.me-engineers.com

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L5B

Manufacturer: PRUDENTIAL Specified Catalog #: BPRO4-LIN-FLSH-LED35-MO-8-TMW-SAL-NU-SC-UNV-*-

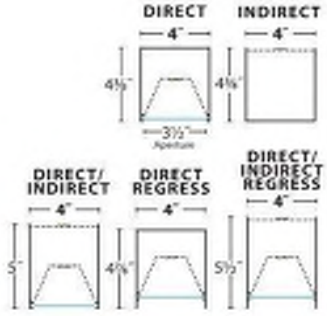
BionicPro4 | Linear

PRUDENTIAL LTG.

PRULITE.COM 213.746.0360

Technical Questions

CLICK HERE



What distinguishes BionicPro?

2" • 3" • 4" • 5" luminaires with a seamless lens for clean lines of light and no light leaks, anywhere. Fantastic optical performance via our TruBeam™ technology delivering the industry's best batwing with remarkably soft, even illumination and low glare (UGR <19), a vastly improved Ceiling Wash, two wall washes to fit your design intent, our Perimeter Fill to wash corridors with light from one side, all with just a lens change.

5 Made in the USA

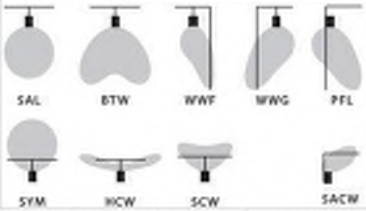
Lumen output may vary +/- 5%
Light Loss Factor (LLF) for CCTs other than 3500K:
4000K +2%, 3000K -5%, 2700K -20%
90 CRI -15% (3K, 3500K, 4K & 5K
ADC -2% LLF
See LED Details PDF for more info

UPTO 127 LM/W

DIRECT:		LO	MO	SO	HO
BTW	Lm/Ft	470	685	950	1200
SAL	Lm/Ft	435	640	885	1100
WWF	Lm/Ft	500	750	1025	1325
WWG / PFL	Lm/Ft	500	750	1000	1275
	W/Ft	4	6	8	10.5
INDIRECT:		LO	MO	SO	HO
SYM	Lm/Ft	625	850	1125	1400
HCW	Lm/Ft	315	475	660	825
SCW	Lm/Ft	575	875	1170	1450
SACW	Lm/Ft	500	750	1000	1200
	W/Ft	4	6	8	10.5
DIRECT / INDIRECT:					
	W/Ft	8	12	16	21

LUMEN CHART AT 3500K-80 CRI

SERIES	LENS POS.	LED COLOR	OUTPUT	NOM. LENGTH	FINISH COLOR	LOUVER COLOR	DISTRIBUTION	UP OPTIONS	CIRCUITING	VOLTAGE	MOUNTING	CEILING SYSTEMS	DRIVERS	OPTIONS & CONTROL SENSORS
BPro4-Lin			–				–							
Bionic Pivot Linear	FLSH Flush Lens REG.S ½" Re-gress LVR ½" Re-gress with Louver	LED27 2700K (90CRI) LED3 3000K LED35 3500K LED4 4000K LED3-90 3000K (90CRI) LED35-90 3500K (90CRI) LED4-90 4000K (90CRI) LED5-90 5000K (90CRI)	LO Low MO Medium SO Standard HO High PROG Programmable Light Output (Specify desired lm/ft or wiFt) SPECIFY DOWN THEN UP IF DIFFERENT OUTPUT DESIRED	2" 3" 4" 5" 6" 7" 8" R____ (Row Length, 1" increments) SRL Symmetric Row Length (See page 7) NOTE: Individual fixtures are NOT intended for row mounting	TMW Textured Matte White (Standard) TMW Textured Matte White YGW Gloss White Y__ Premium Color CC Custom Color	YBK Black Matte (Standard) TMW Textured Matte White YGW Gloss White Y__ Premium Color CC Custom Color	CHOOSE DOWN –AND– UP DOWN: NW No Downlight, SAL Satin Lens, BTW Batwing, WWF Flat Wall Wash, WWG Focal Glow Wall Wash, PFL Perimeter Fill (wall mounted) UP: NU No Uplight, HCW Hard Ceiling Wash, SYM Symmetric (Tested ADC standard), SCW Soft Ceiling Wash, SACW Soft Asymmetric Ceiling Wash	TG Top Glow ADC Acrylic Dust Cover (Clear) (Standard for SYM) (Frosted) TGADC Top Glow with Acrylic Dust Cover UP OPTIONS AVAILABLE WITH ANY UP DISTRIBUTION	SC Single Circuit (Down & Up will dim together) DC Dual Circuit (Needed if dimming Down separately from Up)	UNV (120-277) 347 (Emergency battery required, please order driver box)	CA48", 96" or 144" Aircraft Cable (Adjustable) SUR Surface Mount (Direct only) WM Direct to Wall WS ½" Wall Spacer WS2 2" Wall Spacer WBx.x Wall Bracket (2"-6" in 5" increments, 3" standard if not specified)	X1 T-Bar X3 Hard Ceiling X6 Slot Grid	ND Non-Dimming DM01 0-10v, 1% Dimming (Standard) LDES S-Series EcoSystem LED LDE1 Hi-lume 1% EcoSystem LED (Soft fade on, fade-to-black dimming) ECO 1% 0-10v, EldoLED (Logarithmic dimming std) ECDA 1% DALI, EldoLED (Logarithmic dimming std) SOLO 0.1% 0-10v, EldoLED (Dim-to-dark, Logarithmic dimming std) SODA 0.1% DALI, EldoLED (Dim-to-dark, Logarithmic dimming std) STEP Signify Advance Step Dimming	EMHE CA T20 Emergency Battery (1250 Delivered Lumens, CA Title 20 compliant) ETS-DR Iota ETS-DR Emergency Transfer Switch EMC Emergency Circuiting EBCP1G /2G Single / Dual Gang (Electrical Box Cover Plate/Mud Ring) PIF Pre-installed Individual Fixture (Saves time on individual fixture installs, see page 6) SENSORS: 20S WattStopper PIR Occupancy 20S ON/OFF 20S-STEP: Dim to 50% 20S-DM: Dim to 1% ENL Enlighted SU-SE-IOT LUX Phillips DL LVOC Lutron Vive (Occ & IR) LVRF Lutron Vive IR Only) NXSMP Hubbell (Occ) NLT Acuity N-Light CORNERS: C2-60 Lit 60° C2-90 Lit 90° C2-120 Lit 120° C2-135 Lit 135° C3T Lit 90° 3-Way: T C3Y Lit 120° 3-Way: Y C4T Lit 90° 4-Way: + C4X Lit 45°-135° 4-Way: X C8I Lit Inside 2-Plane C8O Lit Outside 2-Plane LRT Linear to Recessed Transition (Straight runs only)



03-25-2021

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Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

Type: L6

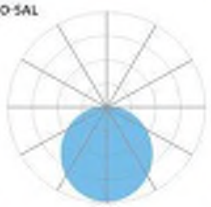
BionicPro4 | Linear

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

DISTRIBUTIONS:

SATIN LENS — DISTRIBUTION

Medium Output:
BPRO4-LIN-FLSH-LED35-MO-SAL
2740 Delivered Lumens
23 Watts
120 lm/w
3500 CCT
1.22 Spacing Criteria
Test
#104013131LAX-003F

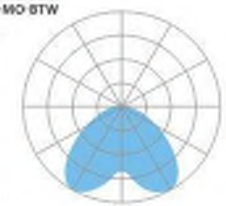


Zonal Lumen Summary:
0-90 = 100%

Vertical Angle	0°	25°	45°	65°	90°
0°	986	986	986	986	986
5°	980	980	977	982	982
15°	934	935	934	942	943
25°	852	852	854	865	869
35°	742	742	746	760	463
45°	613	612	617	630	639
55°	472	471	477	488	497
65°	323	323	329	339	348
75°	175	175	181	190	198
85°	37	37	42	49	56
90°	0	0	0	0	0

BATWING — DISTRIBUTION

Medium Output:
BPRO4-LIN-FLSH-LED35-MO-BTW
2886 Delivered Lumens
23 Watts
127 lm/w
3500 CCT
1.90 Spacing Criteria
Test
#104013131LAX-003B

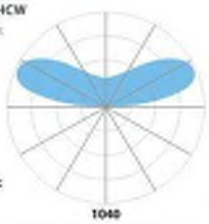


Zonal Lumen Summary:
0-90 = 100%

Vertical Angle	0°	25°	45°	65°	90°
0°	721	721	721	721	721
5°	773	765	742	724	714
15°	996	961	854	724	655
25°	1110	1074	933	698	561
35°	1084	1057	925	634	463
45°	906	907	824	533	378
55°	612	640	635	411	306
65°	360	381	402	287	235
75°	183	192	204	170	154
85°	48	49	55	55	55
90°	0	0	0	0	0

HARD CEILING WASH

Standard Output:
BPRO4-LED35-SO-NW-HCW
2653 Delivered Lumens
33 Watts
80 lm/w
3500 CCT
Test
#104491851LAX-002

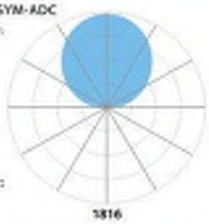


Zonal Lumen Summary:
90-180 = 100%

Vertical Angle	0°	22.5°	45°	67.5°	90°
90°	0	0	0	0	0
95°	74	125	163	129	25
105°	859	777	525	255	96
115°	1040	913	598	301	169
125°	932	815	556	322	229
135°	716	636	474	330	272
145°	530	489	406	331	299
155°	417	399	363	330	315
165°	356	351	339	329	324
175°	330	330	328	328	329
180°	327	327	327	327	327

SYMMETRIC

Standard Output:
BPRO4-LED35-SO-NW-SYM-ADC
4570 Delivered Lumens
33 Watts
139 lm/w
3500 CCT
Test
#L104503052LAX-003



Zonal Lumen Summary:
90-180 = 100%

Vertical Angle	0°	22.5°	45°	67.5°	90°
90°	0	0	0	0	0
95°	73	73	72	71	73
105°	261	263	262	261	266
115°	505	503	499	500	508
125°	764	765	769	774	786
135°	1050	1052	1054	1063	1075
145°	1325	1327	1326	1338	1350
155°	1554	1555	1552	1564	1578
165°	1711	1712	1708	1720	1735
175°	1791	1792	1786	1799	1816
180°	1805	1805	1805	1805	1805

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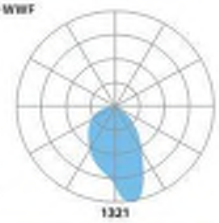
DISTRIBUTIONS:

FLAT WALL WASH — DISTRIBUTION

Standard Output:
BPRO4-FLSH-LED35-LO-4-WWF
2056 Delivered Lumens
15.37 Watts
134 lm/w
3500 CCT
Test
10436102LAX-0048

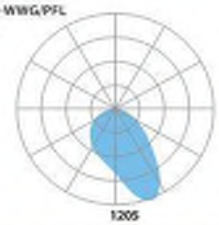


Zonal Lumen Summary:
0-90 = 100%

	Vertical Angle	0°	25°	45°	65°	90°
WALL SIDE	90°	0	0	0	0	0
	85°	22	23	25	27	28
	75°	75	82	91	96	93
	65°	135	159	181	201	185
	55°	224	274	316	393	346
	45°	372	457	526	668	533
	35°	625	736	821	944	670
	25°	967	1070	1140	1095	763
	15°	1321	1297	1257	1058	828
	5°	1065	1027	992	930	862
	0°	863	863	863	863	863
ROOM SIDE	5°	740	757	766	804	862
	15°	646	655	661	704	828
	25°	567	583	591	622	763
	35°	456	482	497	533	670
	45°	344	369	384	419	533
	55°	496	506	531	570	690
	65°	173	167	165	164	185
	75°	109	96	89	85	93
	85°	33	30	27	26	28
	90°	0	0	0	0	0
	Vertical Angle	180°	202.5°	225°	247.5°	270°

FOCAL GLOW WALL WASH / PERIMETER FILL

Low Output:
BPRO4-FLSH-LED35-LO-4-WWG/PFL
1989 Delivered Lumens
15 Watts
132 lm/w
3500 CCT
Test
10666471LAX-015



Zonal Lumen Summary:
0-90 = 100%

	Vertical Angle	0°	25°	45°	65°	90°
WALL SIDE	90°	0	0	0	0	0
	85°	23	24	28	30	30
	75°	77	81	103	108	96
	65°	153	165	225	224	166
	55°	278	309	437	416	256
	45°	513	574	756	629	370
	35°	946	998	1014	746	487
	25°	1205	1165	1006	794	600
	15°	1022	997	910	810	693
	5°	844	836	810	779	739
	0°	747	747	747	747	747
ROOM SIDE	5°	644	658	810	779	739
	15°	518	525	543	595	693
	25°	458	461	468	497	600
	35°	408	409	411	417	475
	45°	403	403	405	416	487
	55°	291	284	262	244	256
	65°	222	210	183	160	166
	75°	137	130	104	92	96
	85°	42	42	33	29	30
	90°	0	0	0	0	0
	Vertical Angle	180°	202.5°	225°	247.5°	270°

LUMEN MAINTENANCE

L70 — 200,000+ Hours
L90 — 100,000+ Hours (LO, MO & SO)
L90 — 60,000+ Hours (HO)

LED SYSTEM LED modules and drivers are field replaceable.

PROG Programmable light output. Specify desired lumens or watts per linear foot.

BINNING Standard binning (all Prudential LED boards) includes testing at the chip level and board integration to provide consistent color temperature within a 3-step MacAdams ellipse, with +/- 5% lumen output range and +/- .004 Duv.

LABELS CSA and ETL damp labeled and L.B.E.W. manufactured.

ELECTRICAL Must specify LED dimming controls. LED fixtures have constant current driver(s) with less than 20% THD when loaded to a minimum of 60%. Drivers sink a maximum of 6mA per driver. DM01 LED drivers are 0-10V dimmable and are compatible with most 0-10V wall slide dimmers and direct 0-10V analog signal dimmers. Max driver size 1.65" w x 1.25" h.

CONSTRUCTION

Housing Extruded aluminum housing and side wall
>25% PC recycled, 100% recyclable.

Lens Polymer, 100% recyclable.

Weight 3.25 lbs/ft

MOUNTING Surface mounted to walls or ceilings, wall spacer, wall bracket to wall, suspended by cable.

WARRANTY Single-source, 5 year limited warranty covers standard components and construction.

BionicPro4 | Linear

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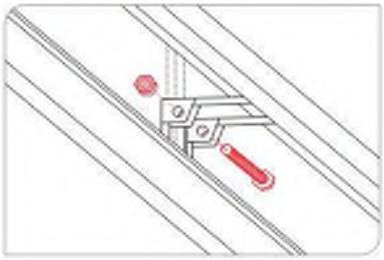
PRULITE.COM 213.746.0360

Choose from one of our Premium Colors with no set-up fee.

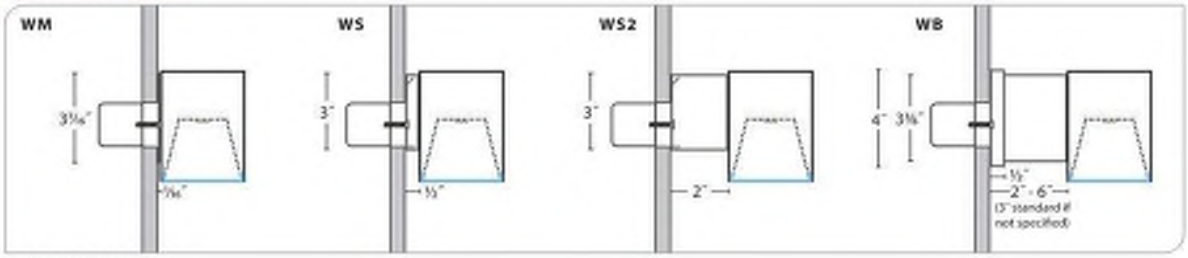
For paint chip samples, please email: info@prulite.com

CAST ALUMINUM END CAPS

ADJOINING DETAILS



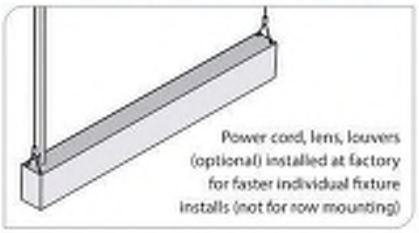
WALL CROSS SECTIONS



FIXTURE SIZE VARIES

SENSOR PLATE

PIF — PRE-INSTALLED INDIVIDUAL FIXTURE



EBCP — ELECTRICAL BOX COVER PLATE

BionicPro4 | Linear

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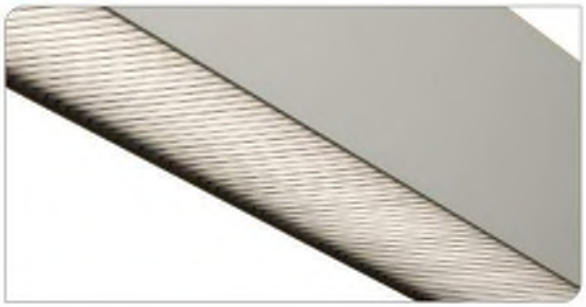
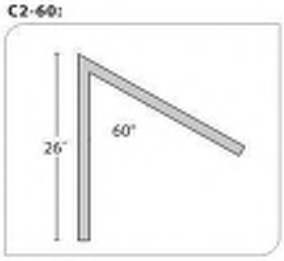
LOUVER DETAIL

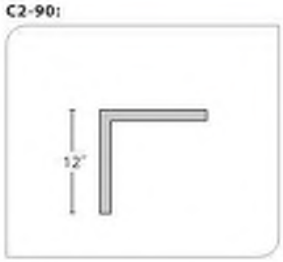


CORNERS

C2-60:



C2-90:



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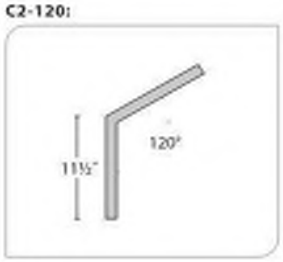
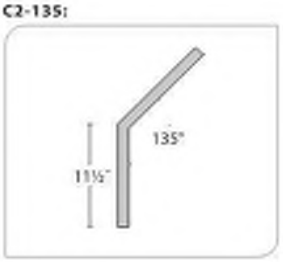
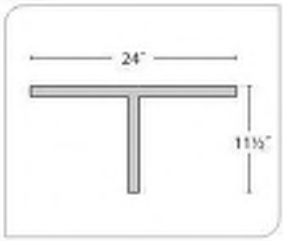


C2-135:



C3T:



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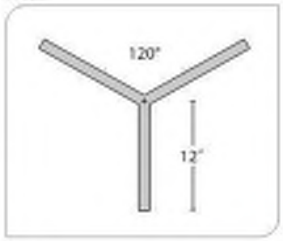
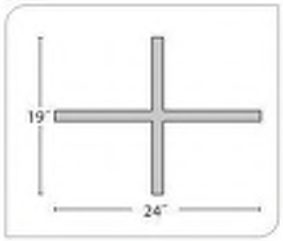
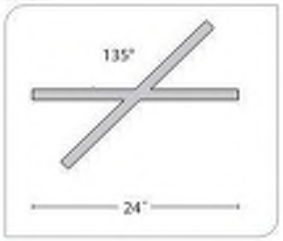


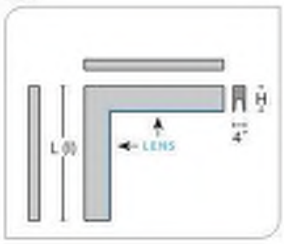
C4T:



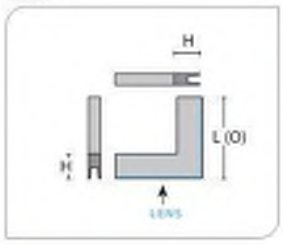
C4X:



C8I:



C8O:



BODY TYPE	DIM "H"	DIM "L" (I)	DIM "L" (O)
Direct Flush	4 ⅜"	16 ⅜"	12"
Direct Regress	4 ⅜"	16 ⅜"	12 ½"
Direct/Indirect Flush	5"	17"	12"
Direct/Indirect Regress	5 ½"	17"	12 ½"

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STEAMBOAT BASE AREA

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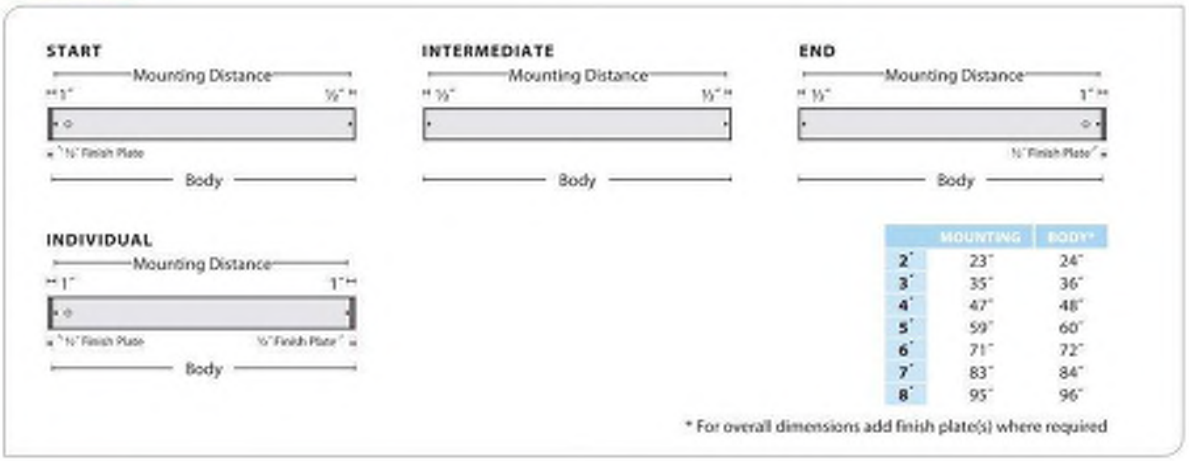
PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

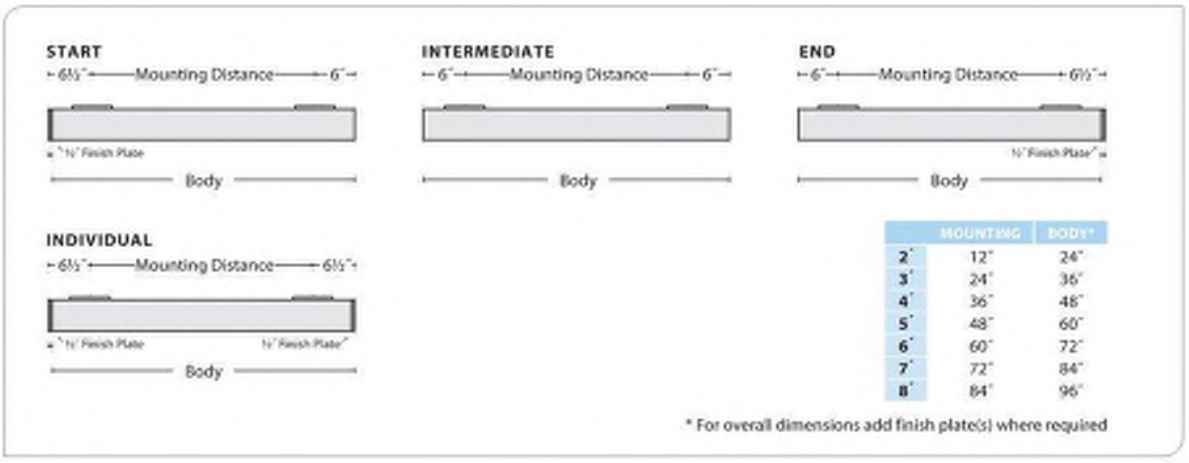
SURFACE MOUNT



	MOUNTING	BODY*
2'	23"	24"
3'	35"	36"
4'	47"	48"
5'	59"	60"
6'	71"	72"
7'	83"	84"
8'	95"	96"

* For overall dimensions add finish plate(s) where required

WALL MOUNT



	MOUNTING	BODY*
2'	12"	24"
3'	24"	36"
4'	36"	48"
5'	48"	60"
6'	60"	72"
7'	72"	84"
8'	84"	96"

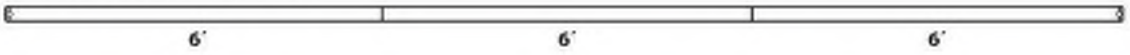
* For overall dimensions add finish plate(s) where required

BionicPro4 | Linear

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

18˝ STANDARD ROW LENGTH:

18˝ SYMMETRIC ROW LENGTH (SRL):



ROW LENGTH	STANDARD ROW LENGTH	SYMMETRIC ROW LENGTH (SRL)
9˝	5+4	3+3+3
10˝	6+4	5+5
11˝	7+4	4+3+4
12˝	8+4	6+6
13˝	8+5	4+5+4
14˝	8+6	7+7
15˝	8+7	5+5+5
16˝	8+8	8+8
17˝	8+5+4	6+5+6
18˝	8+6+4	6+6+6
19˝	8+7+4	6+7+6
20˝	8+8+4	8+4+8
21˝	8+8+5	8+5+8
22˝	8+8+6	8+6+8
23˝	8+8+7	8+7+8
24˝	8+8+8	8+8+8
25˝	8+8+5+4	6+4+5+4+6
26˝	8+8+6+4	8+5+5+8
27˝	8+8+7+4	6+5+5+5+6
28˝	8+8+8+4	8+6+6+8
29˝	8+8+8+5	8+4+5+4+8

ROW LENGTH	STANDARD ROW LENGTH	SYMMETRIC ROW LENGTH (SRL)
30˝	8+8+8+6	8+7+7+8
31˝	8+8+8+7	8+5+5+5+8
32˝	8+8+8+8	8+8+8
33˝	8+8+8+5+4	8+6+5+6+8
34˝	8+8+8+6+4	8+6+6+6+8
35˝	8+8+8+7+4	8+6+7+6+8
36˝	8+8+8+8+4	8+8+4+8+8
37˝	8+8+8+8+5	8+8+5+8+8
38˝	8+8+8+8+6	8+8+6+8+8
39˝	8+8+8+8+7	8+8+7+8+8
40˝	8+8+8+8+8	8+8+8+8+8
41˝	8+8+8+8+5+4	8+6+4+5+4+6+8
42˝	8+8+8+8+6+4	8+8+5+5+8+8
43˝	8+8+8+8+7+4	8+6+5+5+5+6+8
44˝	8+8+8+8+8+4	8+8+6+6+8+8
45˝	8+8+8+8+8+5	8+8+4+5+4+8+8
46˝	8+8+8+8+8+6	8+8+7+7+8+8
47˝	8+8+8+8+8+7	8+8+5+5+5+8+8
48	8+8+8+8+8+8	8+8+8+8+8+8
49˝	8+8+8+8+8+5+4	8+8+6+5+6+8+8
50˝	8+8+8+8+8+6+4	8+8+6+6+6+8+8

NOTE: SRL will effect pricing – please consult factory.

BionicPro4 | Linear

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

BionicPro4 Batwing Vs. Top 4" Competitor (Satin Lens)

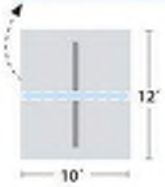
SINGLE OFFICE

BionicPro4

28 32 35 34 30 30 33 34 32 28

Top Competitor

22 28 36 44 52 52 44 36 28 22



	BionicPro4	Competitor
LPW	127	113
SPACING CRITERIA	**1.9**	**1.2**
MAX/MIN	1.6	2.6
W/SQ. FT.	.38	.4
FC AVERAGE	27	29

9' ceiling .85 lf BionicPro4— 5.7w/ft Competitor—6w/ft Footcandles at 30" working plane

OPEN OFFICE

BionicPro4

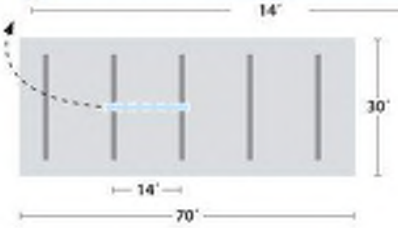
41 45 48 48 46 42 39 38 39 42 45 48 48 44 41

14'

Top Competitor

75 67 58 48 39 33 29 28 29 33 39 48 58 67 75

14'



	BionicPro4	Competitor
LPW	127	117
SPACING CRITERIA	**1.9**	**1.2**
MAX/MIN	2.0	4.5
MAX/MIN BETWEEN ROWS	1.2	2.7
W/SQ. FT.	.36	.38
FC AVERAGE	36	37

9' ceiling .85 lf BionicPro4— 5.7w/ft Competitor—6w/ft Footcandles at 30" working plane

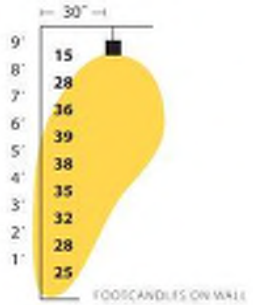
BionicPro4 | Linear

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

Smooth, flat wall washing (WWF)

Our patent-pending TruBeam™ optics redirect light in an ideal flat wall wash for smooth, even illumination.

	Watts/Ft.	Ceiling Height	Average Illuminance	Max/Min	Max/Min Ratio
Medium Output | 750 lumens/ft	6	9'	31 fc	39/15	2.6



Focal glow wall washing (WWG)

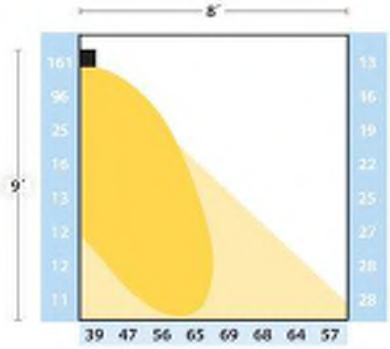
Pique interest by giving works of art 'pop' — more light at eye level

	Watts/Ft.	Ceiling Height	Average Illuminance	Max/Min	Max/Min Ratio
Medium Output | 750 lumens/ft	6	9'	36 fc	50/15	3.3

Perimeter Fill (PFL)

Wash a corridor in light from one side of the perimeter. Our Perimeter Fill is ideal for hospital corridors where a 50 fc average is needed.

	Watts/Ft.	Ceiling Height	Average Illuminance	Max/Min	Max/Min Ratio
High Output | 1275 lumens/ft	1	10'	64 fc	70/57	1.2

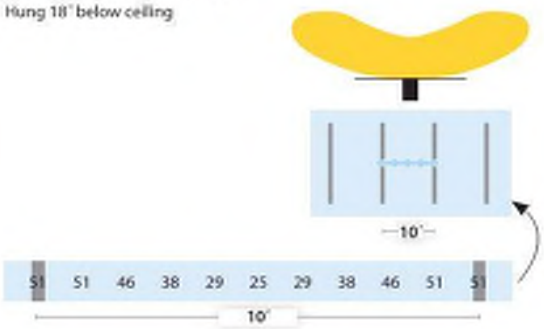


BionicPro4 | Linear

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

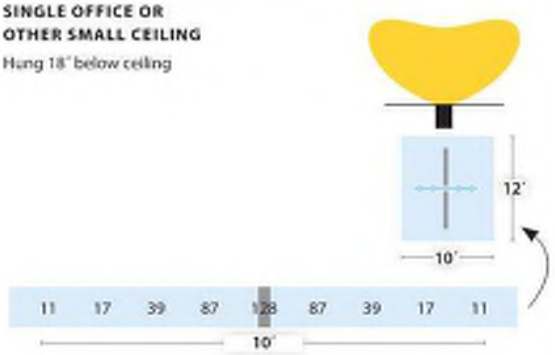
Hard ceiling wash (HCW)

OPEN OFFICE/CLASSROOM
Hung 18" below ceiling



Soft ceiling wash (SCW)

SINGLE OFFICE OR OTHER SMALL CEILING
Hung 18" below ceiling



BionicPro to Bionic/P23-43 Optics Crossing Matrix

DOWNLIGHT:

	Satin	Batwing	Flat Wall Wash	Focal Glow Wall Wash	Perimeter Fill
BionicPro	SAL	BTW	WWF	WWG	PFL
Bio2 / P23 = BionicPro3	SAL	MBW	MWW/D1W	—	MWW/D1R
Bionic4 / P43 = BionicPro4	SAL	ABW/D1X	—	AWL/D1W	AWL/D1R

UPLIGHT:

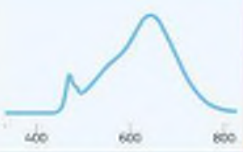
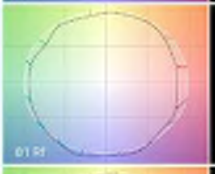
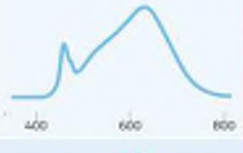
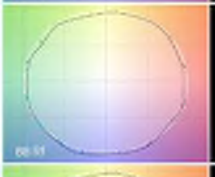
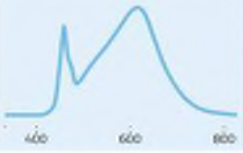
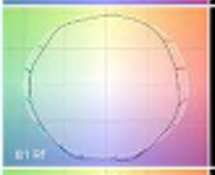
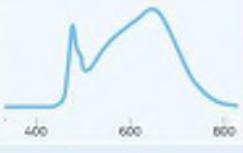
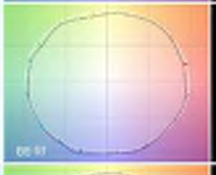
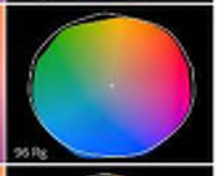
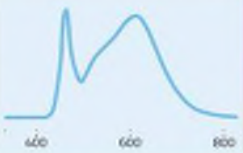
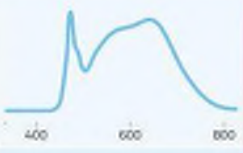
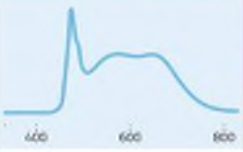
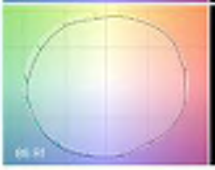
WWG = PFL
Lens aimed away from wall

	Symmetric	Ceiling Wash	Soft Ceiling Wash	Asymmetric Ceiling Wash
BionicPro	SYM	HCW NA BionicPro2	SCW	SACW
Bio2 / P23 = BionicPro3	SYM	CW	—	ACW
Bionic4 / P43 = BionicPro4	SYM	CW	—	—

BionicPro4 | Linear

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

LM79 & TM30 DATA:

	MEASURED CCT	MEASURED LUMENS	CRI	R9	DuV	SPD	TM30 — COLOR VECTOR	TM30 — COLOR DISTORTION
LED27	2680	80%	93	58	0.001			
LED3	3042	95%	82	6	0.001			
LED3-90	3016	85%	93	61	0.000			
LED35	3482	100%	82	3	0.002			
LED35-90	3417	85%	93	67	0.000			
LED4	3952	102%	82	4	0.003			
LED4-90	3882	85%	92	67	0.003			
LED5-90	4889	85%	94	84	0.002			

BRETT 502

LINEAR EASY-SPEC™

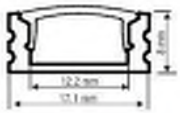
Fixture Type: _____

Project: _____

Location: _____

FEATURES

- 100 to 1000 Lumens per Foot
- Field Replaceable Light Source
- 50,000 Hour Lamp Life
- Dimmable to 1%
- Anodized Finish
- Adjustable-Length Power Feed Included



KELVIN COLOR TEMPERATURE SCALE

SPECIFICATIONS

Input Voltage	24V DC / Constant Voltage
CRI	90+
Diode	Epistar
Dimming Options	PWM, Triac, 0-10V
Temp Range	-40°F to 149°F
Channel Height	8mm (5/16")
Channel Width	17.1mm (11/16")

PART NUMBER BUILDER

Example:
502-I-60-DV-35K-WH-CP-SV-ULV

Model	Setting	Length (Unlimited)[1]	Output	CCT	Lens	Mounting Method	Finish	Power Supply
502	I						SV	ULV
502	I - Indoor	Inches	DL - 200+ lm/ft DK - 400+ lm/ft DV - 700+ lm/ft VT - 1000+ lm/ft RGBW-2 RGBW-3	24K - 2400 Kelvin 27K - 2700 Kelvin 30K - 3000 Kelvin 35K - 3500 Kelvin 40K - 4000 Kelvin 50K - 5000 Kelvin	NA - None WH - White	CP - Mounting Clips PV - Pivot Clips	SV - Silver (Custom Finishes Available)	ULV - Universal Power Supply[2]

[1] Light Source is installed in field allowing for unlimited run lengths
[2] 120V = Forward Phase Dimming | 120/277 = 0-10V Dimming

For use with cULus Light Source

Certified to CAN/CSA Standard C22.2 No. 250.0

RoHS COMPLIANT | 24V DC | DRY LOCATION RATED

Questions/Support | 800-789-3810 | quotes@kelvix.com

072020DM

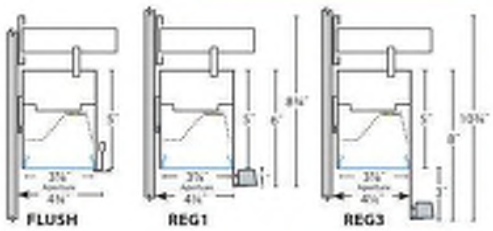
Manufacturer: PRUDENTIAL Specified Catalog #: P43-REG1-LED35-MO-(PER PLAN)-TMW-AWL-D1R-WT

P43 | Cove & Perimeter
4" Perimeter

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

Type:

Job:



High performance wall grazer.

Optics: Glow, Wall Graze or wash a corridor in light (D1R).
Series: P43 recessed linear and Wall Wash for visual continuity.

Bionic Perimeter System contains same great optics with extruded aluminum housing to accommodate more ceiling systems.

LOW OUTPUT:
P43-PSTD-FLSH-LED4-LO-AWW-D1G
1620 Delivered Lumens
16 Watts
101 Lm/W
4000 CCT

UP TO 101 LM/W

FLUSH:		LO	MO	SO	HO
SAL-D1	Lm/Ft	400	600	800	900
AWW-D1G	Lm/Ft	400	600	800	900
AWL-D1R	Lm/Ft	400	600	800	900
REGRESS 3:					
REG3-SAL	Lm/Ft	350	500	700	800
REG3-D1G	Lm/Ft	350	500	700	800
	W/Ft	4	6	8.3	10

CLICK HERE

Made in the USA

Lumen output may vary +/- 5%
4000K used for lm/ft estimates above
3500K +2% lll, 3000K +4%, 2700K +6%
-10% LLF for 90 CRI (4K, 3500K and 3K)

See LED Details PDF for more info

SERIES	LENS POSITION	LED COLOR	OUTPUT	NOMINAL LENGTH	TRIM COLOR	SHIELDING	DISTRIBUTION	MOUNTING	CIRCUITING	CEILING SYSTEMS	VOLTAGE	DRIVERS	OPTIONS, SENSORS & CORNERS
P43-PSTD									SC				
Perimeter Standard	FLSH Flush Lens REG1 1" Regress Lens REG3 3" Regress Lens	LED27 2700K (90CRI) LED3 3000K LED35 3500K LED4 4000K LED3-90 90CRI LED35-90 90CRI LED4-90 90CRI	LO Low MO Medium SO Standard HO High PROG Programmable Light Output (Specify desired lm/ft or w/ft)	2' 3' 4' 6' 7' 8' R___ (Row length) Any row length is achievable with field trimable filler kit. NOTE: Individual not intended for cov mounting	TMW Textured Matte White (Standard) YGW Gloss White Y___ Premium Color CC Custom Color	SAL Satin Acrylic Lens (D1 only) AWW Acrylic Wall Grazer Lens (D1G only) AWL Perimeter Fill Lens (D1R only) SAL-D1 AWW-D1G AWL-D1R	D1 Direct (SAL only) D1G Wall Grazer (AWW only) D1R Perimeter Fill (AWL only, NA - REG3)	WTW Wall to Wall (Very rare length) LP Light Pocket (Typically 1" increments, fixture stops before wall)	SC Single Circuit	X1 T-Bar 9/16" Exposed X1M T-Bar 9/16" Exposed X2 Interlude T-Bar X6 Slot Grid X3B Hard Ceiling (Overlapping Flange) X7 Hard Ceiling (Trimless mud-over concealed flange)	UNV (120-277) 347 (Emergency battery requires a Step Down transformer)	ND Non-Dimming DM01 0-10v, 1% Dimming (Standard) LDES* Lutron S Series EcoSystem LED LDE1* Lutron Hi-lume 1% EcoSystem LED (Soft-on, fade-to-black dimming) * Lutron NA with HO ECO 1% 0-10v, EldoLED (Logarithmic dimming std) ECDA 1% DALI, EldoLED (Logarithmic dimming std) SOLO 0.1% 0-10v, EldoLED (Dim-to-dark, Logarithmic dimming std) SODA 0.1% DALI, EldoLED (Dim-to-dark, Logarithmic dimming std)	EMHE CA T20 Emergency Battery (D1, D1R <3000, D1G <750 delivered lumens, CA Title 20 compliant, 4' or longer (remote for <4')) PRUBIN Meticulous Binning and Labeling every LED Board within a 2-Step MacAdams Ellipse SENSORS: 20S-ON/OFF WattStopper PIR Occupancy 20S-STEP: Dim to 50% 20S-DIM: Dim to 1% LUX Philips DLH ENL Enlighted 2-Wire DLH & Environmental CORNERS: C2I Lit 90° 2-Way Inside C2O Lit 90° 2-Way Outside C2X Special Angled Connector (Consult factory)

me engineers
14143 Denver West Pkwy, Suite 300 Golden, CO 80401 PH:(303)421.6655
www.me-engineers.com

STEAMBOAT BASE AREA
GONDOLA SQUARE INTERIORS (A/C/F) & KVC

Issue: **BP4D - GONDOLA SQUAR**
Date: **21-May-21**
Project #: DV20131

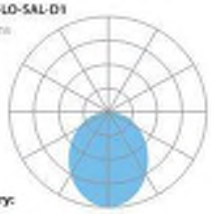
Type: L10

P43 | Cove & Perimeter
4" Perimeter

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

DIRECT

LOW OUTPUT:
P43-PSTD-FLSH-LED4-LO-SAL-D1
1934 Delivered Lumens
19 Watts
101 Lm/W
4000 CCT



Zonal Lumen Summary:
0-90 = 100%

878

Vertical Angle	0°	25°	45°	65°	90°
0°	885	885	885	885	885
5°	876	878	878	885	884
15°	828	825	815	803	797
25°	739	727	704	681	670
35°	619	601	569	540	525
45°	421	403	373	349	337
55°	484	463	429	402	388
65°	229	216	196	181	174
75°	115	107	97	90	86
85°	28	26	24	23	23
90°	0	0	0	0	0

Luminance Chart:

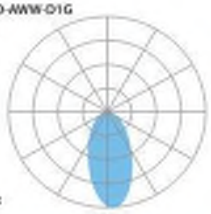
Angle	0°	45°	90°
45°	5823	5168	4058
55°	5173	4484	3997
65°	4618	3950	3500
75°	3768	3189	2841
85°	2711	2362	2243

UPTO 101 LM/W

FLUSH:	LO	MO	SO	HO
Lm/Ft	400	600	800	900
W/Ft	4	6	8.3	10

WALL GRAZER

LOW OUTPUT:
P43-PSTD-FLSH-LED4-LO-AWW-D1G
1620 Delivered Lumens
16 Watts
101 Lm/W
4000 CCT



Zonal Lumen Summary:
0-90 = 100%

1327

Vertical Angle	0°	25°	45°	65°	90°
0°	1317	1317	1317	1317	1317
5°	1271	1285	1311	1327	1296
15°	814	861	981	1159	1258
25°	521	549	638	861	1042
35°	386	393	429	580	828
45°	290	297	309	384	578
55°	205	208	217	253	346
65°	141	145	147	160	187
75°	48	77	84	81	79
85°	24	24	24	23	17
90°	0	0	0	0	0

Luminance Chart:

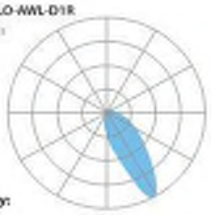
Angle	0°	45°	90°
45°	3390	3618	6847
55°	2952	3134	4958
65°	2768	2881	3646
75°	1543	2683	2572
85°	2292	2292	1746

UPTO 101 LM/W

FLUSH:	LO	MO	SO	HO
Lm/ft	400	600	800	900
W/Ft	4	6	8.3	10

PERIMETER FILL

LOW OUTPUT:
P43-PSTD-FLSH-LED3-LO-AWL-D1R
1594 Delivered Lumens
16 Watts
100 Lm/W
3000 CCT



Zonal Lumen Summary:
0-90 = 100%

1217

Vertical Angle	0°	22.5°	45°	67.5°	90°
0°	461	461	461	461	461
5°	552	545	525	494	460
15°	903	842	698	558	448
25°	1217	1212	1006	634	422
35°	899	944	1064	700	382
45°	614	635	730	705	325
55°	392	402	442	538	250
65°	225	230	244	301	159
75°	98	101	106	123	73
85°	15	16	17	29	12
90°	0	0	0	0	0

Luminance Chart:

Angle	0°	45°	90°
45°	7071	8411	3744
55°	5568	6274	3547
65°	4536	4704	3056
75°	3074	3344	2287
85°	1355	1598	1150

UPTO 100 LM/W

FLUSH:	LO	MO	SO	HO
Lm/Ft	400	600	800	900
W/Ft	4	6	8.3	10

P43 | Cove & Perimeter
4" Perimeter

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

LUMEN MAINTENANCE
Designed to last with cool running mid-power LEDs projected to maintain 90% (L90) of their initial output for 100,000 hours (at HOL and L70 exceeding 150,000 hours.

LED SYSTEM LED modules and drivers are field replaceable.

PROG Programmable light output. Specify desired lumens or watts per linear foot. Min: 2½ w/ft, consult factory for requests above 12 w/ft.

BINNING Standard binning (all Prudential LED boards) includes testing at the chip level and board integration to provide consistent color temperature within a 3-step MacAdams ellipse, with +/- 5% lumen output range and +/- .004 Duv.

PRUBIN™ Prudential Ltg's exclusive 'job binning' method that ensures color temperature consistency across all luminaires on a project. Meticulously testing and labeling **EVERY LED BOARD** to +/- 25 lumens, +/- 50k CCT and +/- .004 Duv — while also separating positive from negative — allows us to match color, hue and intensity throughout a project and provides a consistent color temperature within a 2-step MacAdams ellipse.

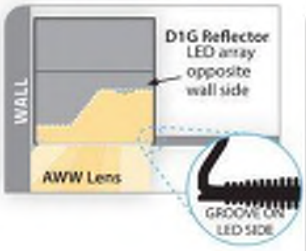
LABELS CSA and ETL damp labeled and L.B.E.W. manufactured.

ELECTRICAL Must specify LED dimming controls. LED fixtures have constant current driver(s) with less than 20% THD when loaded to a minimum of 60%. Drivers sink a maximum of 6mA per driver. DM01 LED drivers are 0-10V dimmable and are compatible with most 0-10V wall slide dimmers and direct 0-10V analog signal dimmers. Max driver size 1¼" w x 1" h.

CONSTRUCTION

Housing	20-gauge steel, >20% PC recycled, 100% recyclable.
Lens	Acrylic, 100% recyclable.
X1, X2, X6 Trim	Steel.
X3, X7 Trim	Extruded aluminum.
Weight	**FLUSH** 4 lbs / ft.
	3" REGRESS 5 lbs / ft.
MOUNTING	Recessed into drywall or T-bar ceilings.
WARRANTY	Single-source, 5 year limited warranty covers standard components and construction.

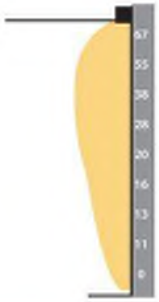
WALL GRAZER ORIENTATION



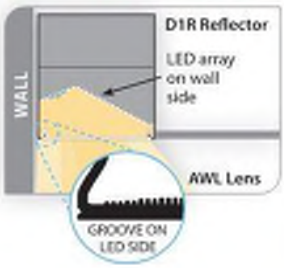
Smooth Wall Grazing.

A tight, focused beam grazes wall textures evenly, accenting and highlighting details to elevate the visual drama.

	Watts/Ft.	Ceiling Height	Average Illuminance	Max	Min	Max/Min Ratio
Standard Output - 750 lm/ft	10	9'	40fc	76fc	16fc	4.75



PERIMETER FILL ORIENTATION



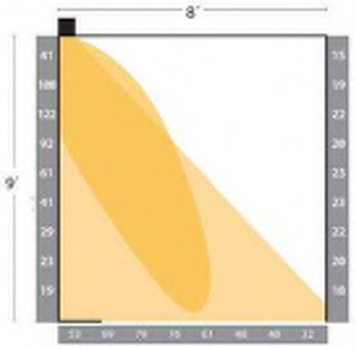
Perimeter Fill.

Fill a Corridor with Light — from the Perimeter.

It's a perimeter optic that washes corridors in light, offering outstanding light distribution, far more energy efficient than typical soft glow solutions and significantly reduces installation cost. Ideal for corridors where budget and energy efficiency conflict with strict IES requirements for high footcandles.

Suspended, surface mounted or recessed, perimeter lighting system.

	Watts/Sq. Ft.	Ceiling Height	Average Illuminance	Max/Min	Max/Min Ratio
Standard Output - 875 lm/ft	1.25	9'	57fc	79/32	2.5:1



Footcandles along the floor Reflectances 80: 50: 20

Manufacturer: PRUDENTIAL Specified Catalog #: P43-REG1-LED35-MO-(PER PLAN)-TMW-AWL-D1R-WT

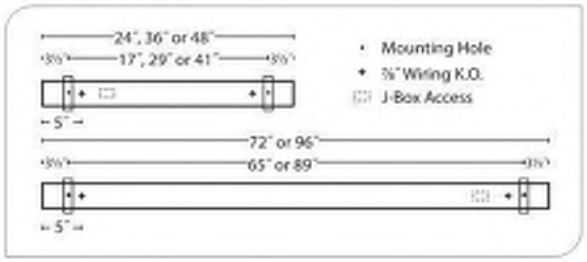
P43 | Cove & Perimeter
4" Perimeter

PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

Choose from one of our Premium Colors with no set-up fee.

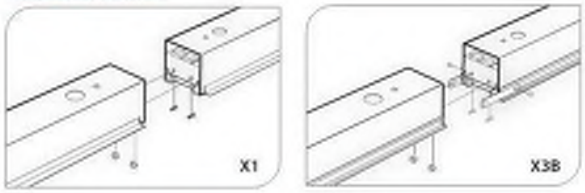
For paint chip samples, please email: info@prulite.com

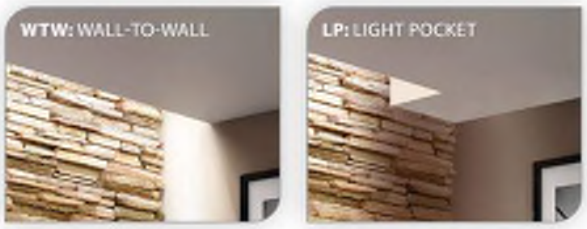
MOUNTING LOCATIONS



CEILING SYSTEMS

ADJOINING DETAILS





P43 | Cove & Perimeter
4" Perimeter

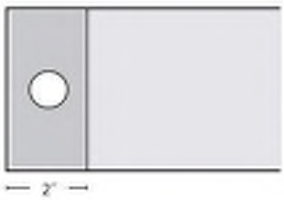
PRUDENTIAL LTG.
PRULITE.COM 213.746.0360

CONTROL SENSORS

20S WattStopper PIR Occupancy

LUX Philips LuxSense Daylight Harvesting, used with Philips HFR Driver

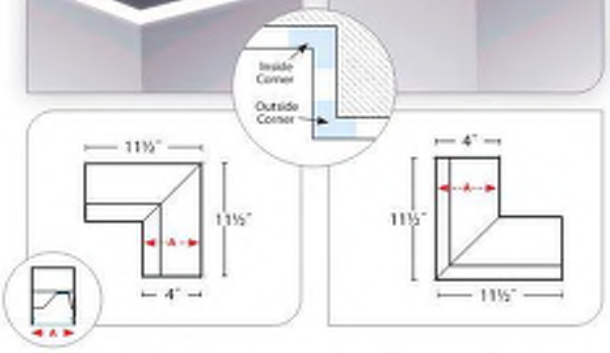
ENL Enlighted 2-Wire PIR Daylight, Motion & Environmental Sensor



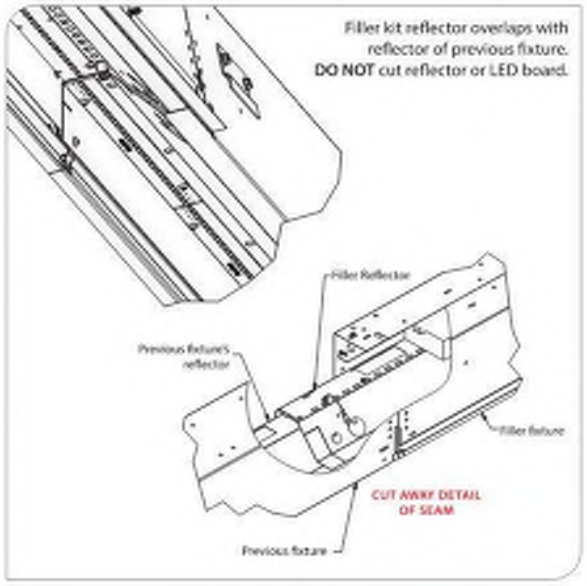
NOTE: Sensor plate will match fixture color finish

Consult factory for other sensors, please email: **info@prulite.com**

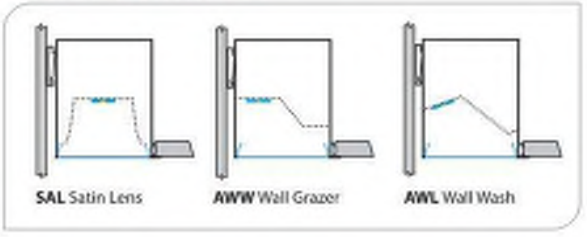
CORNERS



FIELD TRIMMABLE FILLER KIT



DISTRIBUTION CROSS SECTIONS



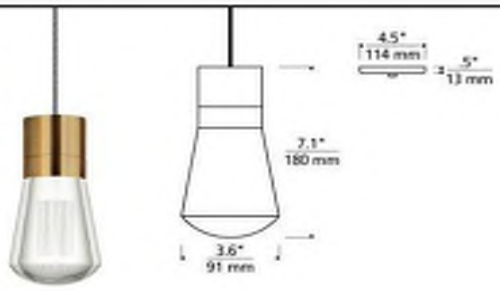
LINE-VOLTAGE PENDANTS/SUSPENSION

Alva Pendant LED

DESCRIPTION
The classic Edison-style squirrel cage lamp is reincarnated here as a modern socket and cord-style LED pendant light. The Alva pendant light from Tech Lighting features a powerful downward-firing LED that is smartly hidden within the "socket" then combined with a solid "bulb" of pure optic crystal. Intricately detailed "filaments" are laser-etched into the crystal for a visually intriguing light fixture. Includes 9 watt, 135 delivered lumen, 3000K, 2200K or Warm Color Dimming 3000K-2200K LED module. Dimmable with low-voltage electronic dimmer. Fixture provided with 12 feet of field-cuttable cloth cord.

INSTALLATION
This product can mount to either a 4" square electrical box with round plaster ring or an octagon electrical box.

WEIGHT
3.66lb / 1.66kg ±



clear crystal

aged brass black & white cord | black finish black & white cord | satin nickel finish black & white cord | aged brass black cord | black finish black cord | satin nickel finish black cord | aged brass blue cord | black finish blue cord | satin nickel finish blue cord

ORDERING INFORMATION

700 SYSTEM	ALVPMC	SHAPE OR SIZE	COLOR	FINISH	LAMP
T0	LINE-VOLTAGE PENDANTS/SUSPENSION	11 11-LITE CHANDELIER 1 1-LITE 3 3-LITE CHANDELIER 7 7-LITE CHANDELIER	B BLACK I BLACK/WHITE U BLUE P COPPER Y GRAY O ORANGE R RED W WHITE	R AGED BRASS B BLACK S SATIN NICKEL	- LED 90 CRI 2200K 120V (T24) LED922 - LED 90 CRI 3000K 120V (T24) LED930 - LED 90 CRI WARM COLOR DIMMING 3000-2200K 120V LEDWD (T24)

TECH LIGHTING®
7400 Linder Avenue
Skokie, Illinois 60077
T 847.410.4400
F 847.410.4500

Tech Lighting, L.L.C.

700 ____ ALVPMC ____ ____ ____ ____

FIXTURE TYPE: _____
JOB NAME: _____
NOTES: _____

Manufacturer: BASELITE Specified Catalog #: D514

PENDANTS

D514/41.5-80U/FWSTC/PR3/150INC

MODEL: D514

PREPARED BY: _____

TYPE: _____

JOB NAME: _____

DATE: _____

CERTIFICATION: UL LISTED

FINISH – Five stage pretreatment process, coated with a lead free TGI C polyester powder coat finish. White is standard inside reflectors, *some finish options excluded. See color chart below for color options (unless specified). Some finish options are not available for certain fixtures. Custom colors and Marine options are available upon request.

LAMP HOLDERS – Accommodates **Incandescent** – medium base porcelain socket, copper shell with nickel plate, rated 250v, 660W.

MOUNTING – Available with stem mounting, fixture is prewired with 48" or 96" leads.

REFLECTOR – Spun from heavy gauge 1100-0 aluminum, ranging in thickness from .050 to .125. Galvanized is from 20 gauge sheets.

MODEL #	FINISH	LIGHT SOURCE				MOUNTING OPTIONS	ACCESSORIES
		INC	CF*	MH*	LED		
D514	18, 19*, 19P, 21P*, 22P*, 23P*, 40*, 41, 42, 43, 44, 45, 46, 48*, 49*, 50, 51, 52, 53, 54*, 55, 57*, 58*, 59, 60, 61*, 62*, 63*, 70*, 71*, 72*, 73*, 74, 75, 76, 77, 78*, 79, 80, 81, 82, 83,* 84*, 85, 86, 87, 88*, 89, 90, 91, 92*, 93*, 94*, 95, 96, 97, 98*, 99, PN	150W	N/A	N/A	N/A	STEM	N/A

* same finish color inside and out.
* remote ballast / driver.

.SUBJECT TO MODIFICATION WITHOUT NOTICE.

BASELITE CORPORATION
12260 EAST END AVE.
CHINO, CA 91710

PH: 877-999-1990
WEB: WWW.BASELITE.COM
EMAIL: SALES@BASELITE.COM

C UL LISTED

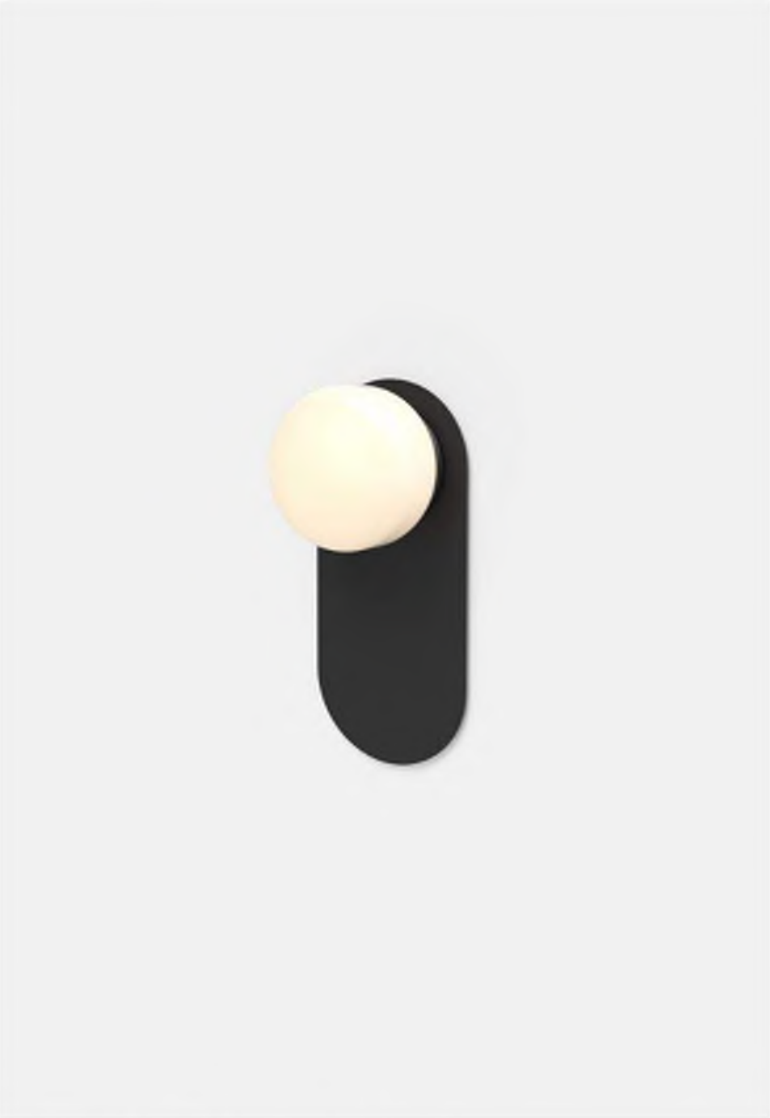
MADE IN U.S.A.

Pastille 1 Wayfind

Sconces

Rich Brilliant Willing

50 Greene St
New York NY 10013
T +1 212 388 1621
sales@rbw.com



For 2D & 3D drawings of all products, including CAD, Revit and IES files, please visit rbw.com

DESCRIPTION

Pastille's design echoes the Art Deco sensibilities of Old Hollywood. The collection offers mix-and-match options for custom installation, including either a droplet profile or faceted pattern for the glass globe, with various finishes for an accent ring or backplate.

MATERIALS

Opal glass, aluminum or steel

COLLECTION NOTES

Custom hand painting and braille solutions are available for the Pastille collection. Inquire with sales@rbw.com.

PERFORMANCE

430 lm
Power Consumption 7.5W
Luminaire Watts 7.5W
57.5 lm/W
90 CRI

LED LIFESPAN

50k hours

PATENT FILE NUMBER

Patent Number 006433652-0001

CERTIFICATION

ADA Compliant
UL Listed
Suitable for Damp Locations
IP20
IP65

PRODUCT DIMENSIONS

12.5L x 5.5W x 3.8 in D

PRODUCT WEIGHT

1 lbs / 0.5 kg

DIMENSIONAL WEIGHT

7 lbs

YOUR PRODUCT CODE

PAS-1W-D-PC30-30-277_10_DEX-IP20

Specification Logic

DIFFUSER STYLE (GLOBE)

Droplet	D
Faceted	F
Ribbed	R

PRIMARY FINISH

Matte White Fine Texture	PC20
Silk Grey	PC25
Matte Black	PC30
Breccia	PC31
Vermillion	PC42
Custom Powder Coat	PCXX
Polished Chrome	PF13
Satin Brass	PF17
Custom Plated Finish	PFXX

CCT

2200K (Candle Light)	22
2700K (warm white)	27
3000K (soft white)	30
3500K (neutral white)	35

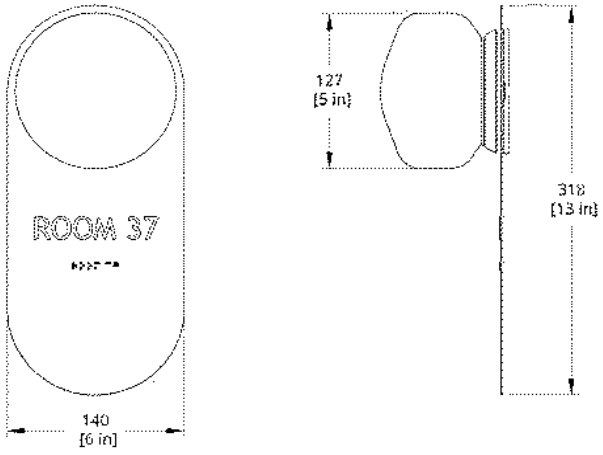
INPUT / CONTROL / POWER

110-120V Input Triac Control 10% dimming	120_TR_LINE
110-120V Input Triac / ELV / 0-10, 1% dimming	120_TM_DEX
220-240V Input 0-10V, 1% dimming	220_10_DEX
220-240V Input ELV Reverse Phase, 1% dimming	220_ELV_DEX
220-240V Input Triac / Forward Phase, 1% dimming	220_TR_DEX
110-277V Input 0-10V, 0.1% dimming	277_10_DEX
110-277V Input Dali, 0.1% dimming	277_DL_DEX

IP RATING

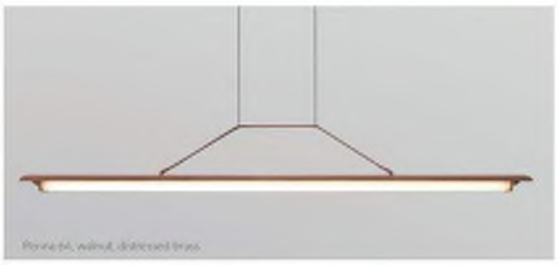
IP20 Rated	IP20
IP65 Rated	IP65

Drawings



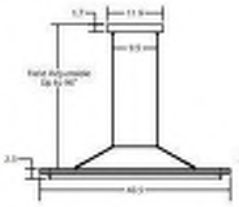
PAS-1W Pastille Wayfind Sconce Dimension

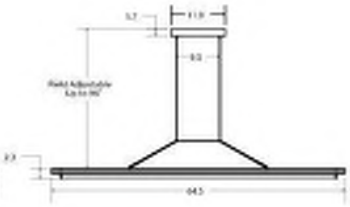
cerno



Penna 40 / Penna 64

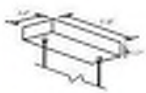
linear pendant





Penna 40 dimensions: 40.5" x 7.7", 2.3"
Penna 64 dimensions: 64.5" x 7.7", 2.3"
Penna 40 weight: 7 lb
Penna 64 weight: 10 lb
Light source: integrated LED
Penna 40 light output: 1550 Lumens (source)
Penna 64 light output: 2350 Lumens (source)
Light color*: 2700 K or 3500 K
Color accuracy: 90+ CRI
Penna 40 power usage: 25 W
Penna 64 power usage: 35 W
Dimmable (see driver below)
Linear canopy included
Canopy dimensions: 11.9" x 4.4", 1.7"
Canopy finish: matte black (CM-085)
See website for more canopy information
8'-0" drop length, field adjustable
Suitable for a sloped ceiling
Wood grain will vary
Specifications subject to change

linear canopy,
matte black finish



brushed brass
(CM-008)

walnut
(CM-001)

distressed brass
(CM-009)

dark stained walnut
(CM-002)

brown leather
(CM-098)

MATERIAL & FINISH OPTIONS

Penna pendant part # 07-150- __ B __ -

Penna 40	40
Penna 64	64
Metal Finish	
brushed brass (CM-008)	B
distressed brass (CM-009)	D
Wood Body	
walnut (CM-001)	W
dark stained walnut (CM-002)	D
*Lamping**	
2700 K LED	27
3500 K LED	35
Driver	
120 V AC input voltage TRIAC, ELV & 0-10 V dimming	P1
277 V AC input voltage TRIAC, ELV & 0-10 V dimming	P2

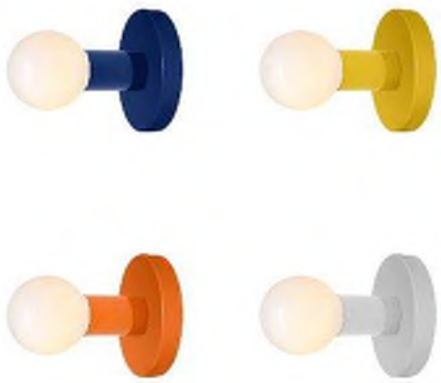
Includes
brown leather (CM-098)
frosted polymer (CM-057)

*Available in 3000K, 4000K and other color temperatures upon request

On our Cerno journey, we continue to evolve as designers and craftsmen. The Penna is a celebration of us, drawing and reflecting on our last ten years. This design is an embodiment of all the lessons that we have learned from designing and building thousands of lights. This fixture balances utility and sophisticated beauty well. The walnut, brass, and leather work in concert to compose a modern form with materials that have been used for thousands of years.

Nick Sheridan
Designer

Color Twink Sconce
60125



Measurements:

Backplate	5"
Depth	3.5"
Weight	1 lb

Available Finishes:

Available in multiple colors. Custom colors also available.

Material:

Steel

Wiring:

Configured to be hard-wired only; can be installed on ceiling.

Lampholder:

One medium base (E26) socket

Rating:

120V 60Hz, MAX 60W, Type A bulb (not included); fixture is dimmable. Fixture may be labeled for lower maximum wattage to meet energy efficiency requirements by request. UL Listed for dry locations. Damp locations available by request.

Dutton Brown Design LLC
1-612-789-0530
support@duttonbrown.com
www.duttonbrown.com

instagram.com/duttonbrown
facebook.com/duttonbrowndesign
pinterest.com/duttonbrown

EMERGENCY
Fixtures

LITHONIA LIGHTING

Catalog Number	
Notes	
Type	

FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for applications requiring attractive edge-lit exit signage, universal installation and low energy consumption.

CONSTRUCTION — Extruded brushed aluminum finish.

Clear acrylic panels- letters measure 6" high with 3/4" stroke, with 100 ft viewing distance rating, based upon UL 924 standard.

For single-face clear panels, EXIT is seen as a reversed image from the back.

OPTICS — LEDs mounted on printed circuit board. The typical life of the exit LED lamp is 10 years.

The LED operating frequency is 120Hz.

ELECTRICAL — Dual voltage input capacity (120/277V).

Battery: (EL Option) – Sealed, maintenance free nickel-cadmium battery delivers 90 minutes capacity to emergency lamps. Test switch provides manual activation of 30-second diagnostic testing for on-demand visual inspection.

Self- diagnostic testing (EL Option Only) for 30 seconds every 30 days and 90 minutes annually. Diagnostic evaluation of LED light source, AC to DC transfer, charging and battery condition.

INSTALLATION — EDG – Universal mounting canopy for top or end mount. Back mount standard for single face only. Canopy provided.

EDGR – Recessed mounting. Bar hanger and brackets provided for both new or restricted ceiling access installation applications. Back wall mount (WM) option.

Universal directional indicators. Field selected and attached.

LISTINGS — UL damp location listed 32°-122°F (0°-50°C) standard. Meets UL924, NFPA 101 (current Life Safety Code), NEC and OSHA illumination standards. Meets all applicable FCC Title 47, Part 15, Subpart B requirements.

WARRANTY — 5-year limited warranty. Complete warranty terms located at: www.acuitybrands.com/support/customer-support/terms-and-conditions

NOTE: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25°C.

Specifications subject to change without notice.

† Exit Signs Certified in the CA Title 20 Appliance Efficiency Database.

EDG (surface mount)

EDGR (recessed mount)

LED Edge-Lit Exits

EDG
EDGR

LED Lamps

Specifications

EDG (End Mount)	EDG (Top Mount)
Length: 13-5/8 (34.6)	Length: 13 (33.0)
Depth: 5-1/2(14.0)	Depth: 4-5/16 (11.0)
Height: 11-1/8 (28.3)	Height: 11-3/4 (29.8)
Shipping Weight : 4 lbs (1.8 kgs)	Shipping Weight : 4 lbs (1.8 kgs)
EDG (Back Mount)	**EDGR**
Length: 13 (33.0)	Length: 13 (33.0)
Depth: 3 (7.6)	Depth: 1-3/4 (4.4)
Height: 11-1/8 (28.3)	Height: 8 (20.3)
Shipping Weight : 4 lbs (1.8 kgs)	Shipping Weight : 6.8 lbs (3.1 kgs)
	Shipping Weight (WM option) : 8.1 lbs (3.7 kgs)

All dimensions are inches (centimeters) unless otherwise noted.

ORDERING INFORMATION For shortest lead times, configure products using **bolded options.** **Example:** EDG 1 R EL

Family	Housing color	Number of faces	Letter color	Operations	Options
EDG Surface mount LED edge-lit exit	**(blank)** Brushed aluminum	**1** Single face	**R** Red on clear (single face only)[2]	**(blank)** AC only	**(blank)** None
EDGR Recessed LED edge-lit exit	W White	**2** Double face	**G** Green on clear (single face only)[2]	**EL** Nickel-cadmium battery	WM Recessed wall mount[8]
			RMR Red on mirror[2]	X2 Lamp wired on two separate AC circuits (specify 120V or 277V)[4]	
			GMR Green on mirror[2]	SD Self diagnostics[5]	
			RW Red on white[2]		
			GW Green on white[2]		

Accessories: Order as separate item.	
ELA U512	12" stem kit with brushed aluminum canopy[7]
ELA W U512	12" stem kit with white canopy[7]
ELA WG1	Wireguard[3]

Notes

1. For single-face clear panels, EXIT is seen as a reversed image from the back.
2. Available with single and double face.
3. White panel standard for double and single face.
4. Not available with EL and SD options. Both circuits can be energized at the same time.
5. Available with EL option only.
6. Available on EDGR single face only.
7. See spec sheet ELA Standards. Only available for EDG.
8. Back mount only.

EDG-EDGR LED, Surface and Recessed Mount Edge-Lit Exits

SPECIFICATIONS

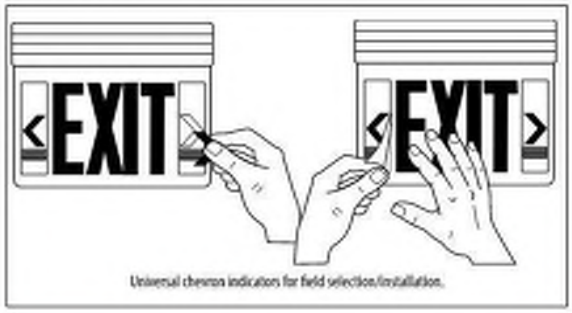
ELECTRICAL						
Primary Circuit						
Type	Typical LED life[1]	Supply voltage	EDG		EDGR	
			Input Watts	Max amps.	Input Watts	Max amps.
Red LED AC only	10 years	120	2.5	0.020	3.8	0.030
		277	2.8	0.010	4.5	0.014
Green LED AC only	10 years	120	2.2	0.020	3.8	0.030
		277	2.2	0.010	4.5	0.020
Red LED emergency	10 years	120	3.0	0.030	3.8	0.031
		277	3.1	0.010	4.5	0.015
Green LED emergency	10 years	120	2.6	0.020	3.8	0.031
		277	2.8	0.010	4.5	0.020

BATTERY (EL option)			
Sealed Nickel-Cadmium			
Shelf life[2]	Typical life[2]	Maintenance[3]	Temperature range[4]
3 years	7-9 years	none	32-122°F (0-50°C)

Notes:

1. Based on continuous operation. The typical life of the exit LED lamp is 10 years.
2. At 77°F (25°C).
3. All life safety equipment, including emergency lighting for path of egress must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.
4. Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

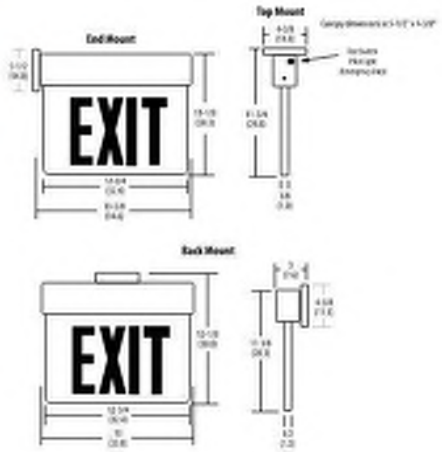
KEY FEATURES



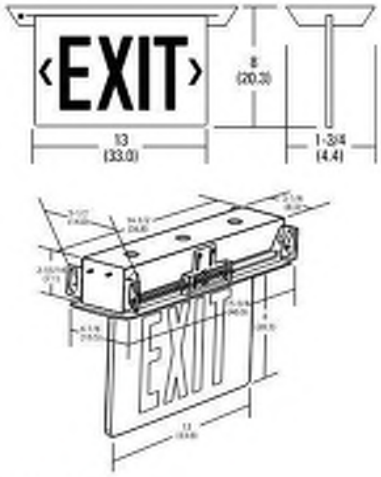
Universal chevron indicators for field selection/installation.

MOUNTING

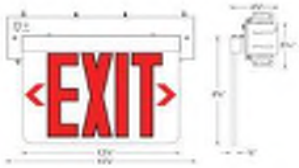
EDG



EDGR



EDGR WM option



LITHONIA LIGHTING EDG-EDGR