GENERAL CONDITIONS SECTION 1 DEFINITIONS

1.0 **DEFINITIONS**

Whenever in any of the Contract Documents the following terms are used, the intent and meaning shall be defined as follows:

1.1 CONTRACT

The agreement executed by the Owner and the Contractor, of which these General Conditions form a part.

1.2 <u>OWNER</u>

The City of Pensacola, the party of the first part of the Contract.

1.3 CONTRACTOR

A person, firm or corporation with whom a Contract has been made directly or through accredited representatives that may have entered into a Contract with the City of Pensacola, and who is liable for the acceptable performance of all legal debts pertaining to the work, the party of the second part of the Contract.

1.4 ENGINEER

The authorized representative of the Owner employed to provide engineering supervision, and/or inspection of the work performed by the Contractor and where the term "Owner" is used in connection with the interpretation of the drawings and specifications, or in connection with the enforcement of the provisions of same, the Engineer, as the Owner's representative, shall have authority to act.

1.5 SUBCONTRACTOR

A person, firm, or corporation to whom the Contractor sublets any part of the Contract.

1.6 INSPECTOR

The authorized representative of the Engineer, assigned to make all necessary inspections of the materials furnished for the work and of the work performed by the Contractor.

1.7 CONTRACT DOCUMENTS

The Contract Documents are composed of the Invitation to Quote, Instruction to Quoters, Form of Proposal, Form of Contract, General Conditions, Project Specifications, and Drawing(s) if applicable.

GENERAL CONDITIONS SECTION 2 EXECUTION OF CONTRACT

2.0 ASSIGNMENT

The contractor shall not assign the whole or any part of this contract or any monies due or to become due hereunder without written consent of the City of Pensacola. In case the Contractor assigns all or any part of any monies due or to become due under this contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to the Contractor shall be subject to prior liens of all persons, firms and corporations for services rendered or materials supplied for the performance of the work called for in this contract.

2.1 PRECONSTRUCTION CONFERENCE

Within ten (10) days after execution of the Agreement, the Contractor will submit to the City Engineer for approval an estimated progress schedule indicating the starting and completion dates of the various stages of the work and a schedule of shop drawing submissions.

Before starting the work, a conference will be held to review the above schedules, to establish procedures for handling shop drawings and other submissions and for processing applications for payment, and to establish a working understanding between the parties as to the project. Present at the conference will be the Engineer of Record and/or his representatives, and the Contractor and/or his representatives and any others deemed necessary by the City of Pensacola.

2.2 TERMINATION OF CONVENIENCE

A contract may be terminated in whole or in part by the City of Pensacola at any time and for any reason in accordance with this clause whenever the City of Pensacola shall determine that such termination is in the best interest of the City of Pensacola. Any such termination shall be effected by the delivery to the contractor at least five (5) working days before the effective date of a Notice of Termination specifying the extent to which performance shall be terminated and the date upon which termination becomes effective. An equitable adjustment in the contract price shall be made for the completed service, but no amount shall be allowed for anticipated profit on unperformed services.

GENERAL CONDITIONS SECTION 3 CONTRACTOR

3.0 LICENSES, PERMITS, CONSTRUCTION, AND EMPLOYMENT PRACTICES

All contractors shall secure all licenses and permits and comply with all laws, regulations and building and construction codes as required by the State, City and County in which the project is to be constructed, also with all regulations for the protection of workers and in respect to wages and hours which may be promulgated by the State and Federal Government.

3.1 QUALIFICATIONS FOR EMPLOYMENT

Preference shall be given to qualified local residents in the employment of laborers and mechanics for work on the project under this contract. No person shall be employed in violation of the State or the National labor laws. No person under the age of sixteen (16) years shall be employed on the project under the contract. No person whose age or physical condition is such as to make his employment dangerous to his health or safety or to the health or safety of others shall be employed on the project under this contract; provided, that this shall not operate against the employment of physically handicapped persons, otherwise employable, where such persons may be safely assigned to work which they can ably perform. Contractor agrees that it will not discriminate on the basis of race, creed, color, national origin, sex, age, or disability. No person currently serving sentence in a penal or correctional institution and no inmate of an institution for mental defectives shall be employed on the project under this contract.

3.2 CHARACTER OF WORKMEN AND EQUIPMENT

The Contractor shall employ such superintendents, foremen and workmen as are careful and competent. Whenever the Engineer shall determine that any person employed by the Contractor is, in his opinion, incompetent, unfaithful, disorderly or insubordinate, such person shall, upon notice, be discharged from the work and shall not again be employed on it except with the written consent of the Engineer.

Should the Contractor fail to remove such person or persons or fail to furnish suitable or sufficient machinery, equipment or force for the proper prosecution of the work, the Engineer may withhold all estimates which are, or may become due, or may suspend the work until such orders are complied with.

The equipment used on any portion of the work shall be such that no injury to adjacent property, or to streets or highways, will result from its use; equipment shall be modern, in good condition and adequate in size to perform the work in satisfactory time intervals.

3.3 USE OF PREMISES

The Contractor shall confine his apparatus, storage of materials, and construction operations to such limits as may be directed by the Owner and shall not unreasonably encumber the premises with his materials.

The Contractor shall not load or permit any part of any structure to be loaded to such an extent as to endanger its safety.

The Contractor shall enforce any instructions of the Owner regarding signs, advertising, fires, danger signals, barricades, and smoking and shall require all persons employed on the work to comply with all building, post or institutional regulations while on the premises.

3.4 MATERIALS, SERVICES, AND FACILITIES

It is understood that, except as otherwise specifically stated in the Contract Documents, the Contractor shall provide and pay for all materials, labor, tools, equipment, water, light, power, transportation, superintendence and temporary construction of every nature whatsoever necessary to execute, complete, and deliver the work within the specified time.

Any work necessary to be performed after regular working hours, on Sundays or legal holidays, shall be performed without additional expense to the Owner.

3.5 WARRANTY OF TITLE

No material, supplies, or equipment for the work shall be purchased subject to any chattel mortgage or under a conditional sale or other agreement by which an interest therein or in any part thereof is retained by the seller or supplier. The Contractor warrants good title to all material, supplies, and equipment installed or incorporated in the work and agrees upon completion of all work to deliver the premises, together with all improvements and appurtenances constructed or placed thereon by him, to the Owner free from any claims, liens, or charges, and further agrees that neither he nor any person, firm or corporation furnishing any materials or labor for any work covered by this contract shall have any right to a lien upon the premises or any improvements or appurtenances thereon, provided that this shall not preclude any contractor from installing metering devices and other equipment of utility companies or of municipalities, the title to which is commonly retained by the utility company or the City. In the event of the installation of such metering device or equipment, the Contractor shall advise the Owner as to the owner thereof. Nothing contained in this section, however, shall defeat or impair the right of such persons furnishing materials or labor under any bond given by the Contractor for their protection or any rights under any law permitting such persons to look to funds due to the Contractor in the hands of the Owner. The provisions of this section shall be inserted in all subcontracts and material contracts and notice of its provisions shall be given to all persons furnishing materials for the work when no formal contract is entered into for such materials.

3.6 PAYMENTS BY CONTRACTOR

The Contractor shall pay:

- 1. For all transportation and utility services not later than the 20th day of the calendar month following that in which such services are rendered.
- 2. For all materials, tools, and other expendable equipment to the extent of ninety (90) percent of the cost thereof, not later than the 20th day of the calendar month following that in which such materials, tools, and equipment are delivered at the site of the project, and the balance of the cost thereof not later than the 30th day following the completion of that part of the work in or on which such materials, tools and equipment are incorporated or used.
- 3. To each of his subcontractors, not later than the 5th day following each payment to the Contractor, the respective amount allowed the Contractor on account of the work performed by his subcontractors, to the extent of each subcontractor's interest therein.

3.7 SUBCONTRACTING

The Contractor shall not award any work to any subcontractor without prior written approval of the Owner, which approval will not be given until the Contractor submits to the Owner a written statement concerning the proposed award to the subcontractors, which statement shall contain such information as the Owner may require.

3.8 REMOVAL AND DISPOSAL OF OBSTRUCTIONS

- 1. All fences, buildings, or other obstructions upon or within the limits of the work area, shall be removed by the Contractor and carefully placed on the abutting property or otherwise disposed of, if and as required. The cost of removing any existing structure shall be included in the price bid for the construction of new structures.
- 2. Any artifacts or items of historical value that are discovered in the work area are the property of the City of Pensacola and shall be removed as directed by the Engineer. The Contractor shall take care not to damage said items if at all possible.

3.9 INVESTIGATION, UTILITIES, AND DIFFERING SITE CONDITIONS

1. Contractor shall have the sole responsibility of satisfying itself concerning the nature and location of the Work taking into specific account the Project site and the general and local conditions related thereto, and particularly, but without limitation, with respect to the following: those affecting transportation, access, disposal, handling and storage of materials; availability and quality of labor; water and electric power; availability and condition of roads; work area; living facilities; climatic conditions and seasons; physical conditions at the work-site and the Project area as a whole, topography and ground surface conditions; nature and quality of the surface materials to be encountered; subsurface conditions, equipment and facilities needed preliminary to and during performance of the Work, and all other costs associated with such performance. The failure of Contractor to acquaint itself with any applicable conditions shall not relieve Contractor from any of its responsibilities to perform under the Contract Documents, nor shall it be considered the basis for any claim for additional time or compensation.

- 2. Contractor shall locate all existing roadways, railways, drainage facilities and utility services above, upon, or under the Project site, said roadways, railways, drainage facilities and utilities being referred to in this Section 4 as the "Utilities". Contractor shall contact the owners of all Utilities to determine the necessity for relocating or temporarily interrupting any Utilities during the construction of the Project Contractor shall schedule and coordinate its Work around any such relocation or temporary service interruption. Contractor shall be responsible for properly shoring, supporting and protecting all Utilities at all times during the course of the Work.
- 3. During the Work, the Contractor shall immediately upon the discovery of, and, before such conditions are disturbed, notify the City in writing of: (a) subsurface or latent physical conditions at the site differing materially from those indicated in the Plans and Specifications or other City-furnished information, or (b) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in this Agreement If, however, a differing or unknown site condition requires immediate action by the Contractor to protect Work in progress from significant damage or to protect the health or safety of persons, the Contractor shall as soon as possible under the circumstances, and before such conditions are disturbed, if reasonably possible, provide the written notice specified herein. The City will promptly investigate the conditions, and if such conditions materially differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performance of any part of the Work, whether or not changed as a result of such conditions, the construction completion dates shall be equitably adjusted by Change Order upon timely and proper request for Change Order in accordance with Section 5.
- 4. No claim by the Contractor under this Section will be allowed unless the Contractor has given the notices required in Section 5. If the City is not given written notice before the conditions are disturbed, or in accordance with the Section 5 for later notice in the case of a condition requiring immediate emergency action to protect the Work in progress or the health or safety of persons, the Contractor will be deemed to have waived its right to assert a claim for additional compensation and time arising out of such conditions.

GENERAL CONDITIONS SECTION 4 CONTROL OF WORK

4.1 ENGINEER AS REFEREE

It is agreed by the parties hereto that the Engineer of Record shall decide all questions which may arise relative to the interpretation of the plans, specifications, and other contract documents pertaining to the character, quality, amount and value of any work done, and the materials furnished under or by reason of this Contract. His estimates and decisions upon all such claims and questions shall be final and conclusive upon the parties thereto.

4.2 DRAWINGS

1. The general character and scope of the work are illustrated by the drawings accompanying the Contract Documents. Where necessary, the approved plans will be supplemented by the Engineer with such full scale details, sketches, etc., as are necessary to adequately control the work. It is mutually agreed that all authorized alterations affecting the requirements and information given on the approved plans shall be in writing.

The Contractor shall furnish such detailed plans as may be required for the prosecution of the work and are not included in the plans furnished by the Consultant They shall include shop details, erection plans, masonry layout diagrams and bending diagrams for reinforcing steel, approval of which by the Engineer must be obtained before any work involving these plans shall be performed. Plans for cribs, cofferdams, false work, centering and form work may also be required and such cases shall be likewise subject to approval unless approval is waived by the Engineer.

It is expressly understood, however, that approval by the Consultant of the Contractor's working drawings does not relieve the Contractor of any responsibility for accuracy of dimensions and details or of mutual agreement of dimensions and details. It is mutually agreed that the Contractor shall be responsible for agreement and conformity of his working drawings with the approved plans and specifications. The Contractor shall not attempt to construct the parts of the work for which such detail drawings are required until he has received them.

The contract price shall include the cost of furnishing all working drawings and the Contractor will be allowed no extra compensation for such drawings.

2. Where the word "similar" occurs on the drawings, it shall be interpreted in its general sense and not as meaning identical and all details shall be worked out in relation to their location and their connection to other parts of the work.

3. Where on any of the drawings a portion of the work is drawn out and the remainder is indicated in outline, the parts drawn out shall apply also to all other like portions of the work. Where ornament or other detail is indicated by starting only, such detail shall be continued throughout the courses or parts in which it occurs and shall also apply to all other similar parts in the work, unless otherwise indicated.

4.3 SHOP DRAWINGS

- 1. The Contractor shall submit for approval of the Engineer of Record, copies of all shop and setting drawings and schedules required for the work and no work shall be fabricated by the Contractor, save at his own risk, until such approval has been given. Copies of these drawings and schedules shall be furnished in such number as the Engineer may direct.
- 2. The Contractor shall submit all drawings and schedules sufficiently in advance of construction requirements to allow ample time for checking, correcting, resubmitting and rechecking; and no claim by the Contractor for delays, arising from his failure in this respect, shall be allowed.
- 3. All shop drawings submitted must bear the stamp of approval of the Contractor as evidence that the drawings have been checked by the Contractor. Any drawings submitted without this stamp of approval shall not be considered and will be returned to the Contractor for resubmission. If the shop drawings show variations from the requirements of the Contract documents because of standard shop practice or other reason, the Contractor shall make specific mention of such variation in his letter of transmittal in order that, if acceptable, suitable action may be taken for proper adjustment; otherwise, the Contractor shall not be relieved of the responsibility for executing the work in accordance with the Contract Documents even though such shop drawings have been approved.
- 4. Where a shop drawing as submitted by the Contractor indicates a departure from the contract which the Consultant deems to be a minor adjustment in the interest of the City and which does not involve a change in the Contract price or extension of time, the Engineer of Record will approve the drawing.
- 5. The approval by the Engineer of Record of shop drawings will be general and shall not relieve the Contractor from the responsibility for adherence to the Contract, nor shall it relieve him of the responsibility for any error that may exist.

4.4 INTENT OF CONTRACT DOCUMENTS

1. It is the intent of the Contract Documents to describe a functionally complete Project (or portion thereof) to be constructed in accordance with the Contract Documents. Any work, materials or equipment that may reasonably be inferred from the Contract Documents as being required to produce the intended result shall be supplied by the Contractor whether or not specifically called for. When words which have a well-known technical or trade meaning are used to describe work, materials or equipment, such words shall be interpreted in accordance with that meaning. Reference to standard specifications, manuals or codes of any technical society, organization or association or to the laws or regulations of any governmental authority having jurisdiction over the Project, whether such reference be specific or by implication, shall mean the latest standard specification, manual, code, law or regulation in affect at the time the Work is performed, except as may be otherwise specifically stated herein.

- 2. If during the performance of the Work Contractor discovers a conflict, error or discrepancy in the Contract Documents, Contractor immediately shall report same to the City in writing and before proceeding with the Work affected thereby and shall obtain a written interpretation or clarification from the City. Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to Contractor with the Contract Documents before commencing any portion of the Work.
- 3. Drawings are intended to show general arrangements, design, and extent of Work and are not intended to serve as shop drawings. Specifications are separated into divisions for convenience of reference only and shall not be interpreted as establishing divisions for the Work, trades, subcontracts, or extent of any part of the Work. In the event of a discrepancy between or among the drawings, specifications, or of other Contract Document provisions, Contractor shall be required to comply with the provision which is the more restrictive or stringent requirement upon the Contractor, as determined by the City.

4.5 COORDINATION OF PLANS AND SPECIFICATIONS

The specifications, plans, and all supplementary documents are essential parts of the contract. Any requirement occurring in one is as binding as though occurring in all. Items shown on the plans and not shown on the specifications and items noted in the specifications but not shown on the plans are to be considered as shown on the plans and noted in the specifications. Any errors or omissions as to standards of work in the specifications or on the plans shall not relieve the Contractor of the obligation to furnish a strictly first-class job in strict accord with best practice to be found in structures or work of a similar nature.

4.6 FITTING AND COORDINATION OF THE WORK

The Contractor shall be responsible for the proper fitting of all work for and the coordination of the operation of all trades, subcontractors, or suppliers engaged in the work. He shall be prepared to guarantee to each of his subcontractors the dimensions which they may require for the fitting of their work to all surrounding work and shall do, or cause his agents to do, all cutting, fitting, adjusting, and patching necessary to make the several parts of the work come together properly and to fit the work to receive or be received by that of other contractors.

4.7 OTHER WORK

- 1. City may perform other work related to the Project at the site by the City's own forces, have other work performed by utility owners or let other direct contracts to other contractors. If the fact that such other work is to be performed is not noted in the Contract Documents, notice thereof will be given to Contractor. If Contractor believes that such performance will involve additional expense to Contractor or require additional time, Contractor shall send written notice of that fact to the City and Architect/Engineer within forty-eight (48) hours of being notified of the other work If the Contractor will be deemed to have waived any rights it otherwise may have had to seek an extension to the Contract Time or adjustment to the Contract Amount
- 2. Contractor shall afford each utility owner and other contractor (or City, if City is performing the additional work with City's employees) proper and safe access to the site and a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such work and shall properly connect and coordinate its Work with theirs. Contractor shall do all cutting, fitting and patching of the Work that may be required to make its several parts come together properly and integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering their work and will only cut or alter their work with the written consent of the City and the others whose work will be affected.
- 3. If any part of Contractor's Work depends for proper execution or results upon the work of any other contractor or utility owner (or City), Contractor shall inspect and promptly report to the City in writing any delays, defects or deficiencies in such work that render it unavailable or unsuitable for such proper execution and results. Contractor's failure to report will constitute an acceptance of the other work as fit and proper for integration with Contractor's Work.

4.8 CONSTRUCTION STAKING AND PROJECT LAYOUT

1. City shall provide initial vertical and horizontal (h/v) control information for the project, in the form of surveyed benchmarks, at designated coordinate locations as specifically indicated on the plans. The Contractor shall be responsible for the protection and preservation of all benchmarks throughout the duration of the project. The Contractor shall be responsible for all initial, intermediate, and finish h/v layout and staking necessary for the completion of construction. This shall include, but not be limited to, the establishment of finished layout and/or grade points/elevations of intersections, curb islands and drainage structures, etc., based upon the initial h/v control information provided by the City. Replacement of damaged/removed benchmarks by the City shall be handled by the Contractor and done at the Contractor's expense.

2. Should the Contractor, in the course of work, find that the points, grades, and dimensions which are shown upon the plans are not conformable to the physical conditions of the locality at the proposed project site, he shall immediately inform the City of the discrepancy between the actual physical conditions of the locality of the proposed work, and the points, grades and dimensions which are shown on the plans. Should the Contractor, in the course of work, discover/determine that any surveyed benchmark information provided by the City (or other entity) is inconsistent with the plans or has been incorrectly established, he shall notify the City immediately. No claim shall be made by the Contractor against the City for compensation or damages by reasons for failure of the City to represent upon said plans, points, grades and dimensions conformable to the actual physical conditions of the locality of the proposed work.

4.9 INSPECTION

The City and its authorized representatives and agents shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records.

4.10 **INSPECTION FACILITIES**

The Contractor shall provide and shall maintain, unless otherwise specified, suitable, and adequate facilities at the site of the project for the use of those representatives or agents of the City assigned to the project until the completion of this Contract.

4.11 INSPECTION AND TESTING OF MATERIALS

Unless otherwise specifically provided for in the specifications, the inspection and testing of materials and finished articles to be incorporated in the work at the site shall be made by bureaus, laboratories or agencies approved by the City. The Contractor shall furnish evidence satisfactory to the City that the materials and finished articles have passed the required tests prior to the incorporation of such materials and finished articles in the work. Testing of all materials shall be paid for by the City. Retesting required because of failure to comply with the specifications shall be paid for by the Contractor.

4.12 <u>"OR EQUAL" CLAUSE</u>

Specified reference in the specifications to any article, device, product, material, fixtures, form, or type of construction, etc., by name, make, or catalogue number, with or without the words "or equal", shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The Contractor, in such cases, may at his option use any article, device, product, material, fixture, form, or type of construction which, in the judgment of the City, expressed in writing, is equal to that named.

4.13 TEMPORARY SUSPENSION OF WORK

The Engineer/City shall have the authority to suspend the work wholly or in part for such period or periods as may be deemed necessary, due to unsuitable weather, or such other conditions as considered unfavorable for the suitable prosecution of the work, or for such time as is necessary due to the failure on the part of the Contractor to carry out orders given or to perform any or all provisions of the Contract.

4.14 SUSPENSION OF WORK

If the Contractor should be adjudged bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed for the Contractor, or any of his property, or if he should persistently or repeatedly refuse or fail to supply enough properly skilled workmen or proper materials, or if he should refuse or fail to make prompt payment to persons supplying labor or materials for the work under the contract, or persistently disregard instructions of the Consultant or fail to observe or perform any provisions of the contract documents, or otherwise be guilty of a substantial violation of any provisions of the contract documents, then the City may, by at least five (5) days prior written notice to the Contractor, without prejudice to any other rights or remedies of the City in the premises, terminate the Contractor's right to proceed with the work. In such event, the City may take over the work and prosecute the same to completion, by contract or otherwise, and the Contractor and his sureties shall be liable to the City for any excess cost occasioned to the City thereby; and, in such case, the City may take possession of and utilize in completing the work such materials, appliances, and plants as may be on the site of the work and necessary therefore. The foregoing provisions are in addition to, and not in limitation of, the rights of the City under any other provisions of the contract documents.

4.15 DELAYS – DAMAGES

1. If the Contractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as will insure its completion within the time specified in the Form of Proposal, or any extension thereof, or fails to complete said work within such time, the City may, by written notice to the Contractor, terminate his right to proceed with the work or such part of the work as to which there has been delay. In such event, the City may take over the work and prosecute the same to completion by contract or otherwise, and the Contractor and his sureties shall be liable to the City for any excess cost occasioned the City thereby. If the Contractor's right to proceed is so terminated, the City may take possession of and utilize in completing the work such materials, appliances, and plants as may be on the site of the work and necessary therefore. If the City does not terminate the right of the Contractor to proceed, the Contractor shall continue the work, in which event the actual damage for the delay will be impossible to determine and, in lieu thereof, the Contractor shall pay to the City as fixed, agreed, delay penalties for each calendar day of delay until the work is completed or accepted, the amount as set forth in the Form of Proposal,

and the Contractor and sureties shall be liable for the amount thereof. Provided, that the right of the Contractor to proceed shall not be terminated nor the Contractor charged with delay penalties because of any delays in the completion of the work due to unforeseeable causes beyond the Contractor's control and without the fault or negligence of the Contractor, including, but not restricted to, acts of God or of the public enemy, acts of the Government, fires, floods, epidemics, guarantine restrictions, strikes, freight embargoes, and unusually severe weather or delays of subcontractors due to such causes, if the Contractor shall within ten (10) days from the beginning of any such delay (unless the City shall grant a further period of time prior to the date of final settlement of the contract) notify the City in writing of the causes of delay, who shall ascertain the facts and the extent of the delay and extend the time for completing the work when in his judgment the findings of fact justify such an extension, and his findings of fact thereon shall be final and conclusive on the parties hereto, subject only to appeal, within thirty (30) days, by the Contractor to the City, whose decision on such appeal as to the facts of the delay and the extension of time for completing the work shall be final and conclusive on the parties hereto.

- 2. No interruption, interference, inefficiency, suspension, or delay in the commencement or progress of the Work from any cause whatever, including those for which the City may be responsible, in whole or in part, shall relieve Contractor of its duty to perform or give rise to any right to damages or additional compensation from City. Contractor expressly acknowledges and agrees that it shall receive no damages for delay. Contractor's sole remedy, if any, against the City will be the right to seek an extension to the Contract Time; provided, however, the granting of any such time extension shall not be a condition precedent to the aforementioned "No Damages For Delay" provision. This paragraph shall expressly apply to claims for early completion, as well as to claims based on late completion.
- 3. Where actual damages for any delay in completion contemplated by this section are impossible to determine by reason of the City's election under said sections not to terminate the right of the Contractor to proceed, the Contractor and his sureties shall be liable for and shall pay to the City, as set forth in the form of Proposal, agreed and delay penalties for each calendar day of such delay until the work is completed or accepted. <u>Provided</u>, that the City may accept the work if there has been such a degree of completion as will, in its opinion, make the project reasonably safe, fit, and convenient for the use and accommodation for which it was intended. In such case, the Contractor shall not be charged with delay penalties, but the City may assess damages caused by such delay.

4.16 TIME FOR COMPLETION

The work shall be commenced at the time stated in the notice to the Contractor to proceed and shall be completed in the number of consecutive calendar days stated in the Form of Proposal.

GENERAL CONDITIONS SECTION 5 PROTECTION OF PERSONS AND PROPERTY

5.0 <u>LAWS</u>

The Contractor shall comply with all federal, state, county, and city laws, ordinances, or regulations controlling the action or operation of those engaged upon the work, or affecting material used, and govern himself in accordance with them. He shall indemnify and save harmless the Owner and all of its officers, agents, and servants against any claim or liability arising from or based on the violation of any such laws, by-laws, ordinances, regulations, orders, or decrees, whether by himself or his employees.

5.1 FURNISHING RIGHT OF WAY

All necessary right of way for the proper completion of the work will be secured by the Owner without cost to the Contractor.

5.2 SANITARY PROVISIONS

The Contractor shall provide and maintain at his own expense, in a sanitary condition, such accommodations for the use of his employees as is necessary to comply with the requirements and regulations of the State or Local Board of Health. He shall commit no public nuisance.

5.3 PUBLIC CONVENIENCE AND SAFETY

No street or roadway shall be closed, except when and where directed by the City Engineer, and whenever the street or roadway is not closed, the work must be so conducted that there shall at all times be a safe passageway for traffic. Whenever it is necessary to divert traffic from any part of the street or roadway actually under construction, the Contractor shall provide and maintain a passable driveway as directed by the Engineer.

The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient red lights, danger signals and signs, provide a sufficient number of watchmen, and take all necessary precautions for the protection of the work and safety of the public. Streets or highways closed to traffic shall be protected by effective barricades on which acceptable warning signs shall be placed. The Contractor shall provide and maintain acceptable warning and detour signs at all closures, intersections and along the detour routes, directing the traffic around the closed portion or portions of the work so that the acceptable warning and detour signs at all closures, intersections and along the detour routes, directing the traffic around the closed portion or portions of the work so that the temporary detour route or routes shall be indicated clearly throughout its entire length. All barricades and obstructions shall be illuminated at night and all lights shall be kept burning from sunset until sunrise. Barricades shall be well built and so designed so as not to be blown over by the wind. Fire hydrants on or adjacent to the premises on streets where construction is in progress shall be kept accessible to the fire apparatus at all times and no material or obstruction shall be placed within ten (10) feet of any such hydrant. Adjacent premises must be given access as far as practicable and obstruction of gutters and ditches will not be permitted. Material stored along the street or roadway must be placed so as to cause as little obstruction to the public as possible.

5.4 PRESERVATION OF PROPERTY

The Contractor shall preserve from damage all property along the line of the work, the removal or destruction of which is not called for by the plans. This applies to public utilities, trees, monuments, fences, pipe, and underground structures, etc., and whenever such property is damaged due to the activities of the Contractors, it shall be immediately restored to its original condition by the Contractor at his own expense.

In case of failure on the part of the Contractor to restore such property or make good such damage or injury, the Owner may, upon forty-eight (48) hours' notice, proceed to repair, rebuild, or otherwise restore such property as may be deemed necessary, and the cost thereof will be deducted from any monies due or which may become due the Contractor from receiving property compensation for the removal, damage, or replacement of any public or private property, not shown on the plans, when same is made necessary by alteration of grade or alignment, and such work is authorized by the Owner, provided that such property has not been damaged through fault of the Contractor, his employees, or agents.

GENERAL CONDITIONS SECTION 6 PAYMENT

6.0 SCOPE OF PAYMENTS

It is understood and agreed that the Contractor shall receive and accept the prices and rates, as herein specified, in full payment for furnishing all materials, labor, equipment and tools, and for performing all the work contemplated and embraced in the attached specifications and proposal; and also, for all loss or damage arising out of the nature of the work aforesaid, or from action of the elements or from any foreseen difficulties or obstructions which may arise or be encountered in the prosecution of the work until its final acceptance, as hereinafter provided for; and also, for all risks of every description and all expenses incurred by or in consequence of the suspension or discontinuance of the work as herein provided for, or for any infringement of patent, trademark, or copyright, and for the completion of the work in accordance with the plans specifications and contract.

6.1 CONTRACTOR'S RESPONSIBILITY FOR WORK

Until acceptance of the work by the City, it shall be under the charge and care of the Contractor and he shall take every necessary precaution against injury or damage to the work by the action of the elements or from any other cause whatsoever, whether arising from the execution or from the non-execution of the work. The Contractor shall rebuild, repair, restore, and make good, at his own expense, all injuries or damages to any portion of the work occasioned by any of the above causes before its completion and acceptance.

6.2 PAYMENT AND COMPENSATION FOR ALTERED QUANTITIES

When alterations in plans or quantities of work as herein provided for are ordered and performed, the Contractor shall accept payment in full at the contract unit price for the actual quantities or work done.

Except as otherwise herein provided, no charge for any extra work or material will be allowed unless the same has been ordered in writing by the City and the price stated in such work order.

6.3 CHANGES IN WORK

- A. The City may at any time, by written order and without notice to the sureties, make changes in the drawings and specifications of this contract and within the general scope thereof. In making any change the charge or credit for the change shall be approximately determined by the City in one of the following methods prior to the issuance of the order for the changed work:
 - 1. The order shall fix the total lump sum value of the change in the work of the Contractor, and shall set out the price which shall be added to or deducted from the contract price (which price shall include the Contractor's overhead and profit.) On any change which involves a net credit to the City, no allowance for overhead and profit shall be figured.

- 2. By estimating the number of unit quantities of each part of the work which is changed and then multiplying the estimated number of such unit quantities by the price (which price shall include the Contractor's overhead and profit) for a unit quantity thereof.
- 3. By ordering the Contractor to proceed with the work and to keep and present, in such form as the City may direct, a correct account of the cost of the change together with all vouchers therefor.

(Cost applicable to 1, 2, and 3 above may include an allowance for overhead and profit not to exceed 15% of the net cost. The cost may also include all items of labor or materials, the use of power tools and equipment actually used, power and all items of cost such as public liability and workmen's compensation insurance, pro rate charges for foremen, also social security, old age and unemployment insurance; however, no percentage for overhead and profit shall be allowed on items of social security, old age and unemployment insurance. If deductions are ordered, the credits shall be the net cost. Among the items considered as overhead are included insurance other than mentioned above, bond, or bonds, superintendent, timekeeper, clerks, watchmen, use of small tools, incidental job burdens and general office expense.)

- B. The Contractor shall, when required by the City, furnish to the City an itemized breakdown of the quantities and prices used for computing the value of any change that might be ordered.
- C. In figuring changes, instructions for measurement of quantities set forth in the specifications shall be followed.
- D. Should the Contractor encounter, or the City discover, during the progress of the work, sub-surface or latent conditions at the site materially differing from those shown on the drawings or indicated in the specifications, or unknown conditions of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in work of character provided for in the drawings and specifications, the attention of the City shall be called immediately to such conditions before they are disturbed. The City shall thereupon promptly investigate the conditions, and if he finds that they do so materially differ, the Contract shall, with the written approval of the City, be modified to provide for any increase or decrease of cost or difference in time resulting from such conditions.

6.4 CLAIMS AND DISPUTES

A Claim is a demand or assertion by one of the parties seeking an adjustment or interpretation of the terms of the Contract Documents, payment of money, extension of time or other relief with respect to the terms of the Contract Documents. The term "Claim" also includes other disputes and matters in question between City and Contractor arising out of or relating to the Contract Documents. The responsibility to substantiate a Claim shall rest with the party making the Claim.

Claims by the Contractor shall be made in writing to the City within forty-eight (48) hours after the first day of the event giving rise to such Claim or else the Contractor shall be deemed to have waived the Claim Written supporting data shall be submitted to the City within fifteen (15) calendar days after the occurrence of the event, unless the City grants additional time in writing, or else the Contractor shall be deemed to have waived the Claim All claims shall be priced in accordance with the provisions of Subsection 6.3.

The Contractor shall proceed diligently with its performance as directed by the City, regardless of any pending Claim, action, suit, or administrative proceeding, unless otherwise agreed to by the City in writing. The City shall continue to make payments in accordance with the Contract Documents during the pendency of any Claim.

6.5 <u>OMITTED ITEMS</u>

The City shall have the right to cancel the portions of the Contract relating to the construction of any time therein by the payment to the Contractor of a fair and equitable amount covering all items of cost incurred prior to the date of cancellation or suspension of work by order of the City.

6.6 DEDUCTIONS FOR UNCORRECTED WORK

If the City deems it inexpedient to require the Contractor to correct the work injured or not performed in accordance with the Contract documents, an equitable deduction from the contract price shall be made by agreement between the City and Contractor.

6.7 CONTRACT TIME AND DELAY PENALTIES

Time is of the essence in the performance of the Work under this Agreement. Contractor shall commence the Work within ten (10) calendar days from the Commencement Date, established in the Notice to Proceed from the City. No Work shall be performed at the Project site prior to the Commencement Date. Contractor shall provide forty-eight (48) hours' notice prior to beginning the Work.

The Work shall be fully/finally completed and deemed ready by the City for final completion within the allotted calendar days from the Commencement Date. The Contract Time shall be the time period from the Commencement Date to the date of Final Completion ("Contract Time")

As the project approaches final completion, the City shall compile a "punch list" of any remaining exceptions to final/full completion of the project. The Project shall be deemed to be fully/finally completed by the City on the date that the City certifies in writing that the construction of it, or specified part thereof, is completed in accordance with the Contract Documents, so that the Project or specified part can be utilized for the purposes for which it is intended, and all punch list items have been completed to the satisfaction of the City.

6.8 ACCEPTANCE AND FINAL PAYMENT

Whenever the improvement provided for under this Contract shall have been completely performed on the part of the Contractor, and all parts of the work have been approved by the City, according to the Contract, the City shall within ten (10) days unless otherwise provided, make the final inspection and a final estimate showing the value of the work as soon as the necessary measurements and computations can be made. All prior certificates or estimates upon which payments have been made are approximate only, subject to correction in the final payment. The amount of this estimate, less any sums that may have been deducted or retained upon the provision of this contract, will be paid to the Contractor within thirty (30) days after the final estimate has been approved by the City, provided that the Contractor has properly maintained the project as hereinafter specified, and provided he has furnished to the party of the first part a sworn affidavit to the effect that all bills are paid and no suits are pending in connection with the work done under this contract.

The Contractor agrees that the payment of all just claims for materials, against him, or any subcontractor in connection with this contract, and his bond will not be released by final acceptance and payment by the City unless all such claims are paid or released.

6.9 GENERAL GUARANTEE

Neither the final certificate of payment nor any provision in the contract documents nor partial or entire use or occupancy of the premises by the City shall constitute an acceptance of work not done in accordance with the contract documents or relieve the Contractor of liability in respect to any express warranties or responsibility for faulty materials or workmanship. The Contractor shall remedy any defects in the work and pay for any damage to other work resulting therefrom which shall appear within a period of one year from the date of final acceptance of the work unless a longer period is specified. The City will give notice of observed defects with reasonable promptness.

6.10 TERMINATION OF CONTRACTOR'S RESPONSIBILITY

This Contract will be considered complete when all work has been completed and the final inspection made, the work accepted by the City and the final estimate paid. The Contractor will then be released from further obligation except as set forth in Section 6.7 of these General Conditions and the requirement to maintain products and completed operations coverage as contained herein.

6.11 INVOICE SUBMITTAL

The City of Pensacola will accept only one request for partial payment per month. Applications for partial payments must reference subject project, note the City's purchase order number, coincide with the City's percentage of work completed, and be certified by the City Engineer's office before the partial request for payment will be processed. Unless otherwise modified in the contract documents, retainage shall be ten (10) percent until final payment. The City of Pensacola normally issues checks for payment of invoices on the 10th of each month. The signed and correct Pay Request must have been received by the Engineering Division by the 25th of the prior month or as otherwise requested. Pay requests received after the 25th will be processed by the 10th of the subsequent following month. Each Pay Request shall be accompanied by a (1) Lien Release and Affidavit from each subcontractor and each supplier showing that all materials, labor, equipment and other bills associated with that portion of the work payment is being requested on have been paid in full, and (2) an updated construction project schedule. The City shall not be required to make payment until and unless these documents are furnished by the contractor. All invoices are payable by the City under the terms of Florida Prompt Payment Act, Florida Statue § 218.70. All purchases subject to availability of funds in the City's budget.

6.12 PAYMENTS WITHHELD

The City may decline to approve any Application for Payment, or portions thereof, because of subsequently discovered evidence, subsequent inspections of the Work, or failure of the Contractor to submit pay request as described in Section 6.9 above.

The City may nullify the whole or any part of any approval for payment previously issued and the City may withhold any payments otherwise due Contractor under this Agreement or any other agreement between the City and Contractor, to such extent as may be necessary in the City's opinion to protect it from loss because of: (a) defective Work not remedied; (b) third party claims filed or reasonable evidence indicating probable filing of such claims; (c) failure of Contractor to make payment properly to subcontractors or for labor, materials or equipment; (d) reasonable doubt that the Work can be completed for the unpaid balance of the Contract Amount; (e) reasonable indication that the Work will not be completed within the Contract Time; (f) unsatisfactory prosecution of the Work by the Contractor; or (g) any other material breach of the Contract Documents.

If these conditions are not remedied or removed, City may, after three (3) days written notice, rectify the same at Contractor's expense.

The City also may offset against any sums due Contractor the amount of any delay penalty obligations of Contractor to City, whether relating to or arising out of this Agreement or any other agreement between Contractor and the City.

APPLICATION AND CERTIFICATION FOR PAYMENT

APPLICATION AND	CERTIFICA	TION FOR PAYMENT	Page 1 of 1				
To Owner:		Project Manager:	Application #:				
City of Pensacola		· -	Period:				
Engineering and Construction Services							
P. O. Box 12910							
Pensacola, FL 32521							
From Constructory							
From Contractor:		Date Submitted:					
Project Name:							
		Purchase Order #:					
CUNTRACTORS APPLICATION FOR PATIMENT			The undersigned Contractor certifies that to the best of the	he Contractor's knowledge, information			
Application is made for payment, as s	hown below, in conne	ection with the Contract.	and belief the Work covered by this Application for Paym	nent has been completed in			
			accordance with the Contract Documents, that all amou	ints have been paid by the			
			Contractor for Work for which previous Certificates for Payment were issued and payments				
1. ORIGINAL CONTRACT SUM		\$	received from the Owner, and that current payment shown herein is now due.				
2. Net change by Change Orders		\$	CONTRACTOR:				
3. CONTRACT SUM TO DATE (Line 1+2)		\$		-			
4. TOTAL COMPLETED & STORED TO DA	TE	\$	By:	Date:			
			State or:				
5. RETAINAGE:			County of:				
a <u> 5 </u> % of Complet	ed Work	\$	Subscribed and sworn to before me by	who is			
			personally known to me/whose identity i proved on the basis				
b% of Stored Material		\$	this day of				
			My Commission expires:				
Total Retainage (Line 5a+5b)		\$	ENGINEER'S CERTIFICATE FOR PAY	MFNT			
6. TOTAL EARNED LESS RETAINAGE		\$	In accordance with the Contract Documents, based on on-site observations and the data				
(Line 4 less Line 5 Total)		•	comprising this application, the Engineer certifies to the Owner that to the best of the				
7. LESS PREVIOUS PAYMENTS		\$	Engineer's knowledge, information and belief the Work has p	rogressed as indicated, the			
			quality of the Work is in accordance with the Contract Docum	nents, and the Contractor			
			is entitled to payment of the AMOUNT CERTIFIED.				
			AMOUNT CERTIFIED	\$			
8. CURRENT PAYMENT DUE		\$	(Attach explanation if amount certified differs from the amound	nt applied for. Initial			
(Line 6 less Line 7 Total)			all figures on this Application and on the Continuation Sheet t	hat are changed to			
			conform to the amount certified.)				
			ENGINEER:				
CHANGE ORDER SUMMARY	ADDITIONS	DEDUCTIONS	Ву:	Date:			
Total changes approved in			This Certificate is not negotiable . The AMOUNT CERTIFIED is	payable only to the Con-			
previous months by Owner			tractor named herein. Issuance, payment and acceptance of p	payment are without			
Total approved this Month			prejudice to any rights of the Owner or Contractor under this	Contract.			
TOTALS							
NET CHANGES by Change order							

PAY REQUEST-SCHEDULE OF VALUES

Project Name: ROGER SCOTT POOL FACILITIES Date Received:

City of Pensacola Engineering and Construction Services

Inspector:
Contract Duration:
Start Date:
Date of Completion:

Application #: Period:				Contract Amount		Work Completed To Date		% Completed To Date
Item #	Brief Description	Qty	Units	Unit Price	Amount	Quantity	Amount	%
1	Concrete Foundations							
2	Masonry Walls							
3	Roofing System							
4	EIFS System							
5	Interior Finishes							
6	Plumbing Fixtures							
7	HVAC System							
8	Electrical System							
9	Site Preparation							
10	Demolition							
11	Site Utilities							
12	Exterior Improvements							
TOTAL BASE BID								

Fax:

Note:

1. Bid shall include all associated earthwork and necessary back-sloping as determined by the City of Pensacola

2. This bid proposal contains line items which may not be called out on the plans. Such items have been included to address potential unforeseen conditions.

Phone:

Contractor:

GENERAL CONDITIONS SECTION 7 PREVENTION, CONTROL, AND ABATEMENT OF EROSION AND WATER POLLUTION

7.1 Description.

Provide erosion control measures on the project and in areas outside the right-ofway where work is accomplished in conjunction with the project, so as to prevent pollution of water, detrimental effects to public or private property adjacent to the project right-of-way and damage to work on the project. Construct and maintain temporary erosion control features or, where practical, construct and maintain permanent erosion control features as shown in the plans or as may be directed by the Engineer.

7.2 General.

Coordinate the installation of temporary erosion control features with the construction of the permanent erosion control features to the extent necessary to ensure economical, effective, and continuous control of erosion and water pollution throughout the life of the Contract.

7.3 Control of Contractor's Operations Which May Result in Water Pollution.

Prevent pollution of streams, canals, lakes, reservoirs, and other water impoundments with fuels, oils, bitumens, calcium chloride, or other harmful materials. Also, conduct and schedule operations to avoid or otherwise minimize pollution or siltation of such water impoundments, and to avoid interference with movement of migratory fish. Do not dump any residue from dust collectors or washers into any live stream.

Restrict construction operations in rivers, streams, lakes, tidal waters, reservoirs, canals, and other water impoundments to those areas where it is necessary to perform filling or excavation to accomplish the work shown in the plans and to those areas which must be entered to construct temporary or permanent structures. As soon as conditions permit, promptly clear rivers, streams, and impoundments of all obstructions placed therein or caused by construction operations.

Do not frequently ford live streams with construction equipment. Wherever an appreciable number of stream crossings are necessary at any one location, use a temporary bridge or other structure.

Except as necessary for construction, do not deposit excavated material in rivers, streams, canals, or impoundments, or in a position close enough thereto, to be washed away by high water or runoff.

Where pumps are used to remove highly turbid waters from enclosed construction areas such as cofferdams or forms, treat the water by one or more of the following methods prior to discharge into State waters: pumping into grassed swales or appropriate vegetated areas or sediment basins, or confined by an appropriate enclosure such as turbidity barriers when other methods are not considered appropriate. Do not disturb lands or waters outside the limits of construction as staked, except as authorized by the Engineer.

Obtain the Engineer's approval for the location of, and method of operation in, borrow pits, material pits, and disposal areas furnished for waste material from the project (other than commercially operated sources) such that erosion during and after completion of the work will not result in probability of detrimental siltation or water pollution.

7.4 Materials for Temporary Erosion Control.

The Engineer will not require testing of materials used in construction of temporary erosion control features other than as provided for geotextile fabric unless such material is to be incorporated into the completed project. When no testing is required, the Engineer will base acceptance on visual inspection.

The Contractor may use new or used materials for the construction of temporary silt fence, staked turbidity barriers, and floating turbidity barrier not to be incorporated into the completed project, subject to the approval of the Engineer.

7.5 Preconstruction Conference.

At the Preconstruction Conference, provide to the City a special plan to prevent, control, and reduce erosion and water pollution, meeting the requirements or special conditions of all permits authorizing project construction. If no permits are required or the approved permits do not contain special conditions or specifically address erosion and water pollution, the project erosion control plan will be governed by federal, state, and local regulations.

7.6 Construction Requirements.

- **7.6.1** Limitation of Exposure of Erodible Earth: The Engineer may limit the surface areas of unprotected erodible earth exposed by the construction operation and may direct the Contractor to provide erosion or pollution control measures to prevent contamination of any river, stream, lake, tidal waters, reservoir, canal, or other water impoundments or to prevent detrimental effects on property outside the project right-of-way or damage to the project. Limit the area in which excavation and filling operations are being performed so that it does not exceed the capacity to keep the finish grading, grassing, sodding, and other such permanent erosion control measures functional.
- **7.6.2** Incorporation of Erosion Control Features: Incorporate permanent erosion control features into the project at the earliest practical time. Use approved temporary erosion control features to correct conditions that develop during construction which were not foreseen at the time of design, to control erosion prior to the time it is practical to construct permanent control features, or to provide immediate temporary control of erosion that

develops during normal construction operations, which are not associated with permanent erosion control features on the project.

The Engineer may authorize temporary erosion control features when Topsoil is specified in the Contract and the limited availability of that material from the grading operations will prevent scheduled progress of the work or damage the permanent erosion control features.

7.6.3 Scheduling of Successive Operations: Schedule operations such that the area of unprotected erodible earth exposed at any one time is not larger than the minimum area necessary for efficient construction operations, and the duration of exposure of uncompleted construction to the elements is as short as practicable.

Schedule and perform clearing and grubbing so that grading operations can follow immediately thereafter. Schedule and perform grading operations so that permanent erosion control features can follow immediately thereafter if conditions on the project permit.

7.6.4 Details for Temporary Erosion Control Features:

7-6.4.1 General: Use temporary erosion and water pollution control features that consist of, but are not limited to, temporary grassing, temporary sodding, temporary mulching, sandbagging, slope drains, sediment basins, sediment checks, berms, baled hay or straw, floating turbidity barrier, staked turbidity barrier and silt fence. For design details for some of these items, refer to the Water Quality Section of the Roadway and Traffic Design Standards, latest edition of FDOT specifications.

- **7.6.4.2 Temporary Grassing**: The Engineer may designate certain areas of grassing constructed as temporary erosion control features. The Engineer may direct the Contractor to omit permanent type grass seed from grassing and the reduce the specified rate of spread for fertilizer used in conjunction with grassing operations when such work is designated as a temporary erosion control feature.
- **7.6.4.3 Temporary Sod**: Furnish and place sod within areas designated by the Engineer to temporarily control erosion. If the Engineer determines that the sod will be of a temporary nature, he may not require fertilizer and lime. Keep the sod in a moist condition in order to ensure growth. The Contractor will pay for all required watering under erosion control.

- **7.6.4.4 Temporary Mulching**: Furnish and apply a 2 to 4 inch [50 to 100 mm] thick blanket of straw or hay mulch to designated areas, then mix or force the mulch into the top 2 inches [50 mm] of the soil in order to temporarily control erosion. Use only undecayed straw or hay which can readily be cut into the soil. The Contractor may substitute other measures for temporary erosion control, such as hydromulching, chemical adhesive soil stabilizers, etc., for mulching with straw or hay, if approved by the Engineer. When beginning permanent grassing operations, plow under temporary mulch materials in conjunction with preparation of the ground.
- **7.6.4.5 Sandbagging**: Furnish and place sandbags in configurations to control erosion and siltation.
- **7.6.4.6 Slope Drains**: Construct slope drains in accordance with the details shown in the plans, the Roadway and Traffic Design Standards, or as may be approved as suitable to adequately perform the intended function.
- **7.6.4.7 Sediment Basins**: Construct sediment basins in accordance with the details shown in the plans, the Roadway and Traffic Design Standards, or as may be approved as suitable to adequately perform the intended function. Clean out sediment basins as necessary in accordance with the plans or as directed.
- **7.6.4.8 Berms**: Construct temporary earth berms to divert the flow of water from an erodible surface.
- **7.6.4.9 Baled Hay or Straw**: Provide bales having minimum dimensions of 14 by 18 by 36 inches [350 by 450 by 900 mm], at the time of placement. Construct baled hay or straw dams to protect against downstream accumulations of silt. Construct the baled hay or straw dams in accordance with the details shown in the plans or the Roadway and Traffic Design Standards.

Place the dam to effectively control silt dispersion under conditions present on this project. The Contractor may use alternate solutions and usage of materials if approved.

7.6.4.10 Temporary Silt Fences:

7.6.4.10.1 General: Furnish, install, maintain, and remove temporary silt fences, in accordance with the manufacturer's directions, these Specifications, the details as shown on the plans, and the Roadway and Traffic Design Standards.

7.6.4.10.2 Materials and Installation: Use a geotextile fabric made from woven or nonwoven fabric, meeting the physical requirements necessary to accommodate those applications for erosion control.

Choose the type and size of posts, wire mesh reinforcement (if required), and method of installation. Do not use products which have a separate layer of plastic mesh or netting. Provide a durable and effective temporary silt fence that controls sediment comparable to the Roadway and Traffic Design Standards, Index No. 102.

Install all sediment control devices in a timely manner to ensure the control of sediment and the protection of lakes, streams, gulf or ocean waters, or any wetlands associated therewith and to any adjacent property outside the right-of-way as required.

At sites where exposure to such sensitive areas is prevalent, complete the installation of any sediment control device prior to the commencement of any earthwork.

After installation of sediment control devices, repair portions of any devices damaged at no expense to the City.

Erect temporary silt fence at upland locations across ditchlines and at temporary locations shown on the plans or approved by the Engineer where continuous construction activities change the natural contour and drainage runoff. Do not attach temporary silt fence to existing trees unless approved by the Engineer.

7.6.4.10.3 Inspection and Maintenance: Inspect all temporary silt fences immediately after each rainfall and at least daily during prolonged rainfall. Immediately correct any deficiencies. In addition, make a daily review of the location of silt fences in areas where construction activities have changed the natural contour and drainage runoff to ensure that the silt fences are properly located for effectiveness. Where deficiencies exist, install additional silt fences as directed by the Engineer.

Remove sediment deposits when the deposit reaches approximately ½ of the volume capacity of the temporary silt fence or as directed by the Engineer. Dress any sediment deposits remaining in place after the temporary silt fence is no longer required to conform to the finished grade, and prepare and seed them.

- 7.6.4.11 Floating Turbidity Barriers and Staked Turbidity Barriers: Install, maintain, and remove turbidity barriers to contain turbidity that may occur as the result of dredging, filling, or other construction activities which may cause turbidity to occur in the waters of the State. The Contractor may need to deploy turbidity barriers around isolated areas of concern such as seagrass beds, coral communities, etc. both within as well as outside the right-ofway limits. The Engineer will identify such areas. Place the barriers prior to the commencement of any work that could impact the area of concern. Install the barriers in accordance with the details shown in the plans or as approved by the Engineer. Ensure that the type barrier used and the deployment and maintenance of the barrier will minimize dispersion of turbid waters from the construction site. The Engineer may approve alternate methods or materials. Operate turbidity barriers in such a manner to avoid or minimize the degradation of the water quality of the surrounding waters.
- **7.6.4.12 Rock Bags**: Furnish and place rock bags to control erosion and siltation. Place the bags as shown in the plans, the Roadway and Traffic Design Standards or as directed by the Engineer. Use a fabric material with openings that are clearly visible to minimize clogging yet small enough to prevent rock loss. Use material of sufficient strength to allow removing and relocating bags without breakage. The bag size when filled with rocks shall be approximately 12 by 12 by 4 inch [300 by 300 by 100 mm]. Use No. 4 or No. 5 coarse aggregate rock.
- **7.6.5** Removal of Temporary Erosion Control Features: In general, remove or incorporate into the soil any temporary erosion control features existing at the time of construction of the permanent erosion control features in an area of the project in such a manner that no detrimental effect will result. The Engineer may direct that temporary features be left in place.

7.7 Maintenance of Erosion Control Features.

- **7.7.1 General**: Provide routine maintenance of permanent and temporary erosion control features, at no expense to the City, until the project is complete and accepted. If reconstruction of such erosion control features is necessary due to the Contractor's negligence or carelessness or, in the case of temporary erosion control features, failure by the Contractor to install permanent erosion control features as scheduled, the Contractor shall replace such erosion control features at no expense to the City. If reconstruction of permanent or temporary erosion control features is necessary due to factors beyond the control of the Contractor, the City will pay for replacement under the appropriate Contract pay item or items.
- **7.7.2 Mowing**: The Engineer may direct mowing of areas within the limits of the project. Mow these designated areas within seven days of receiving such order. Do not mow slopes that are steeper than three horizontal to one vertical.

7.8 **Protection During Suspension of Contract Time.**

If it is necessary to suspend the construction operations for any appreciable length of time, shape the top of the earthwork in such a manner to permit runoff of rainwater, and construct earth berms along the top edges of embankments to intercept runoff water. Provide temporary slope drains to carry runoff from cuts and embankments that are in the vicinity of rivers, streams, canals, lakes, and impoundments. Locate slope drains at intervals of approximately 500 feet [150 m], and stabilize them by paving or by covering with waterproof materials. Should such preventive measures fail, immediately take such other action as necessary to effectively prevent erosion and siltation. The Engineer may direct the Contractor to perform, during such suspensions of operations, any other erosion control work deemed necessary.

7.9 Compliance with NPDES requirements

Contractor shall be solely responsible for ensuring all dirt/sediment/turbid water remains on this jobsite and overall NPDES compliance. Any failure to comply will result in a \$500 penalty per daily occurrence. Contractor will be provided with written notice of failure and funds will be deducted from final payment for contract retainage.

7.10 Basis of Payment.

The lump sum amount listed under erosion control on the proposal shall be the only compensation allowed the contractor. The items covered under this item includes construction and routine maintenance of temporary erosion control features and for moving. Separate payment will not be made for the cost of constructing temporary earth berms along the edges of the roadways to prevent erosion during grading and subsequent operations. The Contractor shall include these costs in the Contract prices for grading items. Additional temporary erosion control features constructed as directed by the Engineer will be paid for as unforeseeable work.

In case of failure on the part of the Contractor to control erosion, pollution, or siltation, the Engineer reserves the right to employ outside assistance or to use the City's forces to provide the necessary corrective measures. Any such costs incurred, including engineering costs, will be charged to the Contractor and appropriate deductions made from the monthly progress payment.

PROJECT SPECIFICATIONS

ROGER SCOTT POOL FACILITIES

PENSACOLA, FLORIDA

BIDDING REQUIREMENTS AND CONTRACT DOCUMENTS

for the construction of the

NEW RESTROOM AND TICKETING BUILDINGS

Jacobs

Pensacola, FL

June

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Project No. D3754400

ROGER SCOTT POOL FACILITIES

PENSACOLA, FLORIDA

BIDDING REQUIREMENTS AND CONTRACT DOCUMENTS

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ROGER SCOTT POOL FACILITIES PENSACOLA, FLORIDA

NEW RESTROOM AND TICKETING BUILDINGS

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THIS ITEM HAS BEEN DIGITALLY SIGNED AND SEALED BY KENNETH MICHAEL DANE ON THE DATE ADJACENT TO THE SEAL. PRINTED COPIES OF THIS DOCUMENT ARE NOT CONSIDERED SIGNED AND SEALED AND THE SIGNATURE MUST BE VERIFIED ON ANY ELECTRONIC COPIES.


NEW RESTROOM AND TICKETING BUILDINGS

SECTION 00 01 07 SEALS PAGE

TECHNICAL SPECIFICATIONS Adam N. Dolsak, R.A. No. 92469 **DIVISION 04—MASONRY** 04 22 19 DIVISION 06-WOOD, PLASTICS, AND COMPOSITES 06 10 00, 06 40 00 DIVISION 07-THERMAL AND MOISTURE PROTECTION 07 21 01, 07 41 13, 07 62 00, 07 70 01, 07 92 00 **DIVISION 08—OPENINGS** 08 11 16, 08 14 00, 08 41 13, 08 71 00, 08 80 00, 08 90 00 **DIVISION 09—FINISHES** 09 29 00, 09 30 00, 09 51 13, 09 65 01, 09 90 05 **DIVISION 10—SPECIALTIES** 10 14 00, 10 21 00, 10 28 00, 10 44 00 **DIVISION 12—FURNISHINGS** 12 20 00

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NEW RESTROOM AND TICKETING BUILDINGS

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TECHNICAL SPECIFICATIONS DIVISION 22—PLUMBING 22 07 00, 22 10 01, 22 10 01.01, 22 30 00, 22 40 00 Brandon Russakis, P.E. No.91180





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TECHNICAL SPECIFICATIONS DIVISION 23—HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC) 23 05 93, 23 07 00, 23 09 00, 23 09 00.01, 23 09 00.02, 23 09 13, 23 23 00, 23 31 13, 23 34 00, 23 34 05, 23 37 00, 23 77 00, 23 84 00 Abel Valiente, P.E. No.70128

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No. 52786 * No. 52786 * STATE OF SCORIDA

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TECHNICAL SPECIFICATIONS

SECTION 01 11 00 SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The completed Work will provide Owner with two new buildings at the Roger Scott Pool facility and includes:
 - 1. Demolition of the existing ticketing and administration building.
 - a. Existing utilities shall be temporarily supported, re-routed and installed in the new locations according to the Documents.
 - b. Existing pool sump utilities and equipment are to be protected and not damaged.
 - 2. Construction of a new ticketing building with access ramp.
 - 3. Construction of a new restroom building.
- B. The Work shall be completed following Labor Day 2024 and shall be completed prior to Memorial Day 2025.

1.02 WORK BY OTHERS

- A. The City has procured temporary restroom facilities that will be in place for the 2024 swimming season. Prior to start of Construction, the City will remove the temporary restroom facilities.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00 SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

- A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.
- B. Deferred Submittal: Information submitted by Contractor for portions of design that are to be submitted to permitting agency for approval prior to installation of that portion of the Work, along with Engineer's review documentation that submittal has been found to be in general conformance with Project's design.
- C. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 PROCEDURES

- A. Direct submittals to Owner, unless specified otherwise.
- B. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.
 - 1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
 - 2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
 - 3. PDF files shall be set to open "Bookmarks and Page" view.
 - 4. Add general information to each PDF file, including title, subject, author, and keywords.
 - 5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
 - 6. Submit new electronic files for each resubmittal.
 - 7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
 - 8. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.

- 9. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.
- C. Transmittal of Submittal:
 - 1. Contractor shall:
 - a. Review each submittal and check for compliance with Contract Documents.
 - b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
 - Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
 - 2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
 - 2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
 - 3. Identify each submittal with the following:
 - a. Numbering and Tracking System:
 - 1) Sequentially number each submittal.
 - 2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
 - b. Specification section and paragraph to which submittal applies.
 - c. Project title and Engineer's project number.
 - d. Date of transmittal.
 - e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
 - 4. Identify and describe each deviation or variation from Contract Documents.
- D. Format:
 - 1. Do not base Shop Drawings on reproductions of Contract Documents.
 - 2. Package submittal information by individual Specification section. Do not combine different Specification sections together in submittal package, unless otherwise directed in specification.
 - 3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
 - 4. Index with labeled tab dividers in orderly manner.

SUBMITTAL PROCEDURES 01 33 00 - 2

- E. Timeliness: Schedule and submit in accordance Schedule of Submittals and requirements of individual Specification sections.
- F. Processing Time:
 - 1. Time for review shall commence on Engineer's receipt of submittal.
 - 2. Engineer will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
 - 3. Resubmittals will be subject to same review time.
 - 4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.
- G. Resubmittals: Clearly identify each correction or change made.
- H. Incomplete Submittals:
 - 1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
 - 2. When any of the following are missing, submittal will be deemed incomplete:
 - a. Contractor's review stamp; completed and signed.
 - b. Transmittal of Contractor's Submittal; completed and signed.
 - c. Insufficient number of copies.
- I. Submittals not required by Contract Documents:
 - 1. Will not be reviewed and will be returned stamped "Not Subject to Review."
 - 2. Engineer will keep one copy and return submittal to Contractor.

1.03 ACTION SUBMITTALS

- A. Prepare and submit Action Submittals required by individual Specification sections.
- B. Shop Drawings:
 - 1. Identify and Indicate:
 - a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
 - b. Equipment and Component Title: Identical to title shown on the Drawings.

- c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
- d. Project-specific information drawn accurately to scale.
- 2. Manufacturer's standard schematic drawings and diagrams as follows:
 - a. Modify to delete information that is not applicable to the Work.
 - b. Supplement standard information to provide information specifically applicable to the Work.
- 3. Product Data: Provide as specified in individual specifications.
- 4. Deferred Submittal: See the Drawings for list of deferred submittals.
 - a. Contractor-design drawings and product data related to permanent construction.
 - 1) Written and graphic information.
 - 2) Drawings.
 - 3) Cut sheets.
 - 4) Data sheets.
 - 5) Action item submittals requested in individual Specification section.
 - b. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit required supporting data and drawings for review and acceptance by Engineer.
- C. Samples:
 - 1. Preparation: Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
 - a. Manufacturer name.
 - b. Model number.
 - c. Material.
 - d. Sample source.
 - 2. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
 - 3. Full-size Samples:
 - a. Size as indicated in individual Specification section.
 - b. Prepared from same materials to be used for the Work.
 - c. Cured and finished in manner specified.
 - d. Physically identical with product proposed for use.

- D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted:
 - 1. Approved:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal.
 - b. Distribution: Electronic.
 - 2. Approved as Noted:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - b. Distribution: Electronic.
 - 3. Partial Approval, Resubmit as Noted:
 - a. Make corrections or obtain missing portions, and resubmit.
 - b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - c. Distribution: Electronic.
 - 4. Revise and Resubmit:
 - a. Contractor may not incorporate product(s) or implement Work covered by submittal.
 - b. Distribution: Electronic.

1.04 INFORMATIONAL SUBMITTALS

- A. General:
 - 1. Refer to individual Specification sections for specific submittal requirements.
 - 2. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that submittal be corrected and resubmitted.
- B. Certificates:
 - 1. General:
 - a. Provide notarized statement that includes signature of entity responsible for preparing certification.
 - b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
 - 2. Welding: In accordance with individual Specification sections.

- 3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual Specification section.
- 4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- 5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual Specification sections.
- 6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
- C. Contractor-design Data (related to temporary construction):
 - 1. Written and graphic information.
 - 2. List of assumptions.
 - 3. List of performance and design criteria.
 - 4. Summary of loads or load diagram, if applicable.
 - 5. Calculations.
 - 6. List of applicable codes and regulations.
 - 7. Name and version of software.
 - 8. Information requested in individual Specification section.
- D. Deferred Submittals: See the Drawings for list of deferred submittals.
 - 1. Contractor-design data related to permanent construction:
 - a. List of assumptions.
 - b. List of performance and design criteria.
 - c. Summary of loads or load diagram, if applicable.
 - d. Calculations.
 - e. List of applicable codes and regulations.
 - f. Name and version of design software.
 - g. Factory test results.
 - h. Informational submittals requested in individual Specification section.
 - 2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Engineer. Documentation of review and indication of compliance with general design intent and project criteria provided on Engineer's comment form as meets conditions of the Contract, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.

- E. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual Specification section.
- F. Payment: Application for Payment: In accordance with Owner's Payment Procedures.
- G. Quality Control Documentation: As required in Section 01 45 16.13, Contractor Quality Control.
- H. Schedules:
 - 1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule.
 - a. Show for each, at a minimum, the following:
 - 1) Specification section number.
 - 2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
 - 3) Estimated date of submission to Engineer, including reviewing and processing time.
 - b. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.
 - 2. Progress Schedules: As requested by the Owner or Engineer.
- I. Special Guarantee: Supplier's written guarantee as required in individual Specification sections.
- J. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.
- K. Submittals Required by Laws, Regulations, and Governing Agencies:
 - 1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
 - 2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.
- L. Test, Evaluation, and Inspection Reports:
 - 1. General: Shall contain signature of person responsible for test or report.

- 2. Factory:
 - a. Identification of product and Specification section, type of inspection or test with referenced standard or code.
 - b. Date of test, Project title and number, and name and signature of authorized person.
 - c. Test results.
 - d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - e. Provide interpretation of test results, when requested by Engineer.
 - f. Other items as identified in individual Specification sections.
- 3. Field:
 - a. As a minimum, include the following:
 - 1) Project title and number.
 - 2) Date and time.
 - 3) Record of temperature and weather conditions.
 - 4) Identification of product and Specification section.
 - 5) Type and location of test, Sample, or inspection, including referenced standard or code.
 - 6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
 - 7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - 8) Provide interpretation of test results, when requested by Engineer.
 - 9) Other items as identified in individual Specification sections.
- M. Testing and Startup Data.

1.05 SUPPLEMENTS

- A. The supplements listed below, following "End of Section", are part of this specification.
 - 1. Forms: Transmittal of Contractor's Submittal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SUBMITTAL PROCEDURES 01 33 00 - 8

Jacobs TRANSMITTAL OF (ATTACH TO EACH SUBMITTA	CONTRACTOR'S SUBMITTAL
TO:	Submittal No.: New Submittal Project: Project No.: Specification Section No.: (Cover only one section with each transmittal) Schedule Date of Submittal:
SUBMITTAL TYPE: Shop Drawing	Sample Informational

The following items are hereby submitted:

Number of	Description of Item Submitted	Spec. and	Drawing or	Contains Variation to Contract	
Copies	(Type, Size, Model Number, Etc.)	Para. No.	Brochure Number	No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By:_____

Contractor (Authorized Signature)

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SECTION 01 45 16.13 CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 - b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.03 SUBMITTALS

- A. Informational Submittals:
 - 1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
 - 2. CQC Report: Submit, weekly, an original and one copy in report form.

1.04 OWNER'S QUALITY ASSURANCE

- A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.
- B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:
 - 1. Relieve Contractor of responsibility for providing adequate quality control measures;
 - 2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance;
 - 3. Constitute or imply acceptance; or
 - 4. Affect the continuing rights of Owner after acceptance of the completed Work.

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- C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.
- D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.
- E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.
 - B. Maintain complete inspection records and make them available at all times to Owner and Engineer.
 - C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

- A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.
- B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor's management and control with the Owner's Quality Assurance.
- C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

CONTRACTOR QUALITY CONTROL 01 45 16.13 - 2

3.03 QUALITY CONTROL ORGANIZATION

- A. CQC System Manager:
 - 1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
 - 2. CQC System Manager may perform other duties on the Project.
 - 3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years construction experience on similar type Work.
 - 4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
 - 5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
 - 6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.
- B. CQC Staff:
 - 1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Engineer.
 - 2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
 - 3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
 - 4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.
- C. Organizational Changes: Obtain Engineer's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

3.04 QUALITY CONTROL PHASING

- A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:
 - 1. Preparatory Phase:
 - a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
 - b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
 - c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.
 - d. Perform prior to beginning Work on each definable feature of Work:
 - 1) Review applicable Contract Specifications.
 - 2) Review applicable Contract Drawings.
 - 3) Verify that all materials and/or equipment have been tested, submitted, and approved.
 - 4) Verify that provisions have been made to provide required control inspection and testing.
 - 5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
 - 6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
 - 7) Review the appropriate activity hazard analysis to verify safety requirements are met.
 - 8) Review procedures for constructing the Work, including repetitive deficiencies.
 - 9) Document construction tolerances and workmanship standards for that phase of the Work.
 - 10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.
 - 2. Initial Phase:
 - a. Accomplish at the beginning of a definable feature of Work:
 - 1) Notify Owner at least 48 hours in advance of beginning the initial phase.

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- 2) Perform prior to beginning Work on each definable feature of Work:
 - a) Review minutes of the preparatory meeting.
 - b) Check preliminary Work to verify compliance with Contract requirements.
 - c) Verify required control inspection and testing.
 - d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
 - e) Resolve all differences.
 - f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
- Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
- 4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
- 3. Follow-up Phase:
 - a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
 - b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
 - c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
- 4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.05 CONTRACTOR QUALITY CONTROL PLAN

A. General:

- 1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
- 2. An interim plan for the first 30 days of operation will be considered.
- 3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
- 4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.
- B. Content:
 - 1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
 - a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Paragraph QC Phasing) for all aspects of the Work specified.
 - b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
 - c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
 - d. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
 - e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.

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- f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
- g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
- h. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.
- C. Acceptance of Plans: Acceptance of the Contractor's basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.
- D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Engineer, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Engineer.

3.06 CONTRACTOR QUALITY CONTROL REPORT

- A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.
- B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.
- C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:
 - 1. Contractor/subcontractor and their areas of responsibility.
 - 2. Operating plant/equipment with hours worked, idle, or down for repair.
 - 3. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
 - 4. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
 - 5. Material received with statement as to its acceptability and storage.
 - 6. Identify submittals reviewed, with Contract reference, by whom, and action taken.

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- 7. Offsite surveillance activities, including actions taken.
- 8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- 9. List instructions given/received and conflicts in the Drawings and/or Specifications.
- 10. Contractor's verification statement.
- 11. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
- 12. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

3.07 SUBMITTAL QUALITY CONTROL

A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.08 TESTING QUALITY CONTROL

- A. Testing Procedure:
 - 1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Procure services of a licensed testing laboratory. Perform the following activities and record the following data:
 - a. Verify testing procedures comply with contract requirements.
 - b. Verify facilities and testing equipment are available and comply with testing standards.
 - c. Check test instrument calibration data against certified standards.
 - d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
 - e. Documentation:
 - 1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
 - 2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
 - 3) Actual test reports may be submitted later, if approved by Engineer, with a reference to the test number and date taken.

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- 4) Provide directly to Engineer an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
- 5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.
- B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.09 COMPLETION INSPECTION

- A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.
- B. Punchlist:
 - 1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
 - 2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
 - 3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
 - 4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION
SECTION 01 50 00 TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Association of Nurserymen (AAN): American Standards for Nursery Stock.
 - 2. Federal Emergency Management Agency (FEMA).
 - 3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
 - 4. Telecommunications Industry Association (TIA); Electronic Industries Alliance (EIA): 568B, Commercial Building Telecommunications Cabling Standard.
 - 5. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
 - 6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

A. Informational Submittals: Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.

1.03 MOBILIZATION

- A. Mobilization includes, but is not limited to, these principal items:
 - 1. Obtaining required permits.
 - 2. Moving Contractor's field office and equipment required for first month operations onto Site.
 - 3. Installing temporary construction power, wiring, and lighting facilities.
 - 4. Providing onsite Internet service.
 - 5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
 - 6. Arranging for and erection of Contractor's work and storage yard.
 - 7. Posting OSHA required notices and establishing safety programs and procedures.
 - 8. Having Contractor's superintendent at Site full time.

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1.04 PROTECTION OF WORK AND PROPERTY

- A. Comply with Owner's safety rules while on Owner's property.
- B. Keep Owner informed of serious onsite accidents and related claims.
- 1.05 VEHICULAR TRAFFIC
 - A. Traffic Control and Routing: Contractor shall coordinate with City for all activities that are anticipated to interfere with public traffic or public parking at the Site.

PART 2 PRODUCTS

2.01 PROJECT SIGN

A. Provide and maintain one, 8-foot-wide by 4-foot-high sign constructed of 3/4-inch exterior high density overlaid plywood. Sign shall bear name of Project, Owner, Contractor, Engineer, and other participating agencies.

PART 3 EXECUTION

3.01 TEMPORARY UTILITIES

- A. Power: Coordinate with Owner for temporary electric power.
- B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.
- C. Heating, Cooling, and Ventilating:
 - 1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage because of temperature or humidity. Costs for temporary heat shall be borne by Contractor.
 - 2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.

- 3. Pay costs of installation, maintenance, operation, removal, and fuel consumed.
- 4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
- 5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.
- D. Water: Coordinate with Owner for temporary construction and drinking water at Site.
- E. Sanitary and Personnel Facilities: Provide and maintain facilities for Contractor's employees, Subcontractors, and other onsite employers' employees. Service, clean, and maintain facilities and enclosures.
- F. Telephone Service: Contractor: As required by Contractor, arrange and provide onsite telephone service for use during construction. Pay costs of installation and monthly bills.
- G. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.02 PROTECTION OF WORK AND PROPERTY

- A. General:
 - 1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
 - 2. No residence or business shall be cut off from vehicular traffic for a period exceeding 4 hours, unless special arrangements have been made.
 - 3. Maintain in continuous service existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
 - 4. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate activities with owner of said utility and perform work to their satisfaction.
 - 5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.

- 6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
- 7. In areas where Contractor's operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by Contractor.
- 8. Notify property owners and utility offices that may be affected by construction operation at least 2 days in advance: Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.
- 9. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.
- 10. Maintain original Site drainage wherever possible.
- B. Site Security:
 - 1. Erect a temporary security fence. Maintain fence throughout construction period. Obtain Engineer's written permission before removal of temporary security fencing.
 - 2. Provide and maintain additional temporary security fences as necessary to protect the Work and Contractor-furnished products not yet installed.
- C. Trees and Plantings:
 - 1. Protect from damage and preserve trees, shrubs, and other plants outside limits of the Work and within limits of the Work, which are designated on the Drawings to remain undisturbed.
 - a. Where practical, tunnel beneath trees when on or near line of trench.
 - b. Employ hand excavation as necessary to prevent tree injury.
 - c. Do not stockpile materials or permit traffic within drip lines of trees.
 - d. Provide and maintain temporary barricades around trees.
 - e. Water vegetation as necessary to maintain health.
 - f. Cover temporarily exposed roots with wet burlap, and keep burlap moist until soil is replaced around roots.
 - g. No trees, except those specifically shown on the Drawings to be removed, shall be removed without written approval of Engineer.
 - h. Dispose of removed trees in a legal manner off the Site.

TEMPORARY FACILITIES AND CONTROLS 01 50 00 - 4

- Balling and burlapping of trees indicated for replacement shall conform to recommended specifications set forth in the American Standards for Nursery Stock, published by American Association of Nurserymen. Balls shall be firm and intact and made-balls will not be accepted. Handle ball and burlap trees by ball and not by top.
- 3. In event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
- 4. Replace each plant that dies as a result of construction activities.
- D. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.
- E. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.
- F. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

3.03 TEMPORARY CONTROLS

- A. Air Pollution Control:
 - 1. Minimize air pollution from construction operations.
 - 2. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.
 - 3. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

- B. Noise Control:
 - 1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
 - 2. Noise Control Plan: Propose plan to mitigate construction noise and to comply with noise control ordinances, including method of construction, equipment to be used, and acoustical treatments.
- C. Water Pollution Control:
 - 1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.
 - 2. Prior to commencing excavation and construction, obtain Owner's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and dewatering pump discharges.
 - 3. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.
- D. Erosion, Sediment, and Flood Control: Provide, maintain, and operate temporary facilities to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

3.04 STORAGE YARDS AND BUILDINGS

- A. Coordinate requirements with Section 01 61 00, Common Product Requirements.
- B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.
- C. Temporary Storage Buildings:
 - 1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
 - 2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
 - 3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

3.05 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

3.06 VEHICULAR TRAFFIC

- A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Ensure the least possible obstruction to traffic and normal commercial pursuits.
- B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.
- C. Whenever it is necessary to cross, close, or obstruct roads, driveways, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.
- D. Road Closures: Maintain satisfactory means of exit for persons residing or having occasion to transact business along route of the Work. If it is necessary to close off roadway or alley providing sole vehicular access to property for periods greater than 2 hours, provide written notice to each owner so affected 3 days prior to such closure. In such cases, closings of up to 4 hours may be allowed. Closures of up to 10 hours may be allowed if a week's written notice is given and undue hardship does not result.
- E. Maintenance of traffic is not required if Contractor obtains written permission from Owner and tenant of private property, or from authority having jurisdiction over public property involved, to obstruct traffic at designated point.
- F. In making street crossings, do not block more than one-half the street at a time. Whenever possible, widen shoulder on opposite side to facilitate traffic flow. Provide temporary surfacing on shoulders as necessary.
- G. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.
- H. When flaggers and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange wearing apparel and other regulation traffic control devices.

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- I. Notify fire department and police department before closing street or portion thereof. Notify said departments when streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets, in excess of 300 linear feet, without written permission from fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish Contractor's night emergency telephone numbers to police department.
- J. Coordinate traffic routing with that of others working in same or adjacent areas.

3.07 CLEANING DURING CONSTRUCTION

- A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.
- B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up and dispose of debris.
- C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least weekly, dispose of such waste materials, debris, and rubbish offsite.
- D. At least weekly, brush sweep entry drive, roadways, and other streets and walkways affected by the Work and where adjacent to the Work.

END OF SECTION

SECTION 01 61 00 COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

- A. Products:
 - 1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
 - 2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
 - 3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

- A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of latest edition of the Florida Building Code.
 - 1. Refer to the Drawings for all loading requirements.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at the Project Site.
- B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation.

1.04 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

- B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.
- C. Extra Materials, Special Tools, Test Equipment, and Expendables:
 - 1. Furnish as required by individual Specifications.
 - 2. Schedule:
 - a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
 - b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
 - 3. Packaging and Shipment:
 - a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
 - b. Prominently displayed on each package, the following:
 - 1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
 - 2) Applicable equipment description.
 - 3) Quantity of parts in package.
 - 4) Equipment manufacturer.
- D. Deliver materials to Site. Request a minimum 7-day advance notice of shipment from manufacturer.
- E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.05 DELIVERY AND INSPECTION

- A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.
- B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

- C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.
- D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.06 HANDLING, STORAGE, AND PROTECTION

- A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.
- B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.
- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.
- D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.
- E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.
- G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.
- B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.
- C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.
- D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
- F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.
- G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.
- H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

- I. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.
- J. Equipment Finish: Provide manufacturer's standard finish and color, except where specific color is indicated.
- K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.
- L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.
- M. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 FABRICATION AND MANUFACTURE

- A. General:
 - 1. Manufacture parts to U.S.A. standard sizes and gauges.
 - 2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
 - 3. Design structural members for anticipated shock and vibratory loads.
 - 4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.

COMMON PRODUCT REQUIREMENTS 01 61 00 - 5

- 5. Modify standard products as necessary to meet performance Specifications.
- B. Lubrication System:
 - 1. Require no more than weekly attention during continuous operation.
 - 2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
 - 3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
 - 4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

- A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.
- B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
- C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.

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- B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

- A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. No shimming between machined surfaces is allowed.
- C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Repaint painted surfaces that are damaged prior to equipment acceptance.
- E. Do not cut or notch any structural member or building surface without specific approval of Engineer.
- F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.
- G. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.04 FIELD FINISHING

A. In accordance with individual Specification sections.

3.05 ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

3.06 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.07 SUPPLEMENTS

- A. The supplement listed below, following "End of Section", is part of this Specification.
 - 1. Form: Manufacturer's Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER:	PRODUCT, MATERIAL, OR SERVICE SUBMITTED:
PROJECT NAME: PROJECT NO:	
I haraby cartify that the above referenced t	product material or service called for by the
Contract for the named Project will be furn requirements. I further certify that the prod specified and conform in all respects with t quantity shown.	nished in accordance with all applicable luct, material, or service are of the quality the Contract requirements, and are in the
Date of Execution:	, 20
Manufacturer:	
Manufacturer's Authorized Representative	e (print):
(Authori	ized Signature)

(Authorized Signature)

SECTION 03 30 10 STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 GENERAL

A. Work shall conform to requirements of ACI 301, Specifications for Structural Concrete, unless otherwise specified.

1.02 REFERENCES

- A. In accordance with ACI 301 and the following:
 - 1. American Concrete Institute (ACI):
 - a. 301, Specifications for Structural Concrete.
 - b. 305.1, Specification for Hot Weather Concreting.
 - c. 306.1, Specification for Cold Weather Concreting.
 - d. 308.1, Specification for Curing Concrete.
 - e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary.
 - f. SP-66, Detailing Manual.
 - 2. ASTM International (ASTM):
 - a. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
 - b. D1056, Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
 - 3. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.
 - b. Placing Reinforcing Bars.
 - c. ANSI/CRSI RB 4.1, CRSI Standard for Supports for Reinforcement Used in Concrete.
 - 4. Corps of Engineers (COE): CRD-C-572, Corps of Engineers Specifications for Polyvinylchloride Waterstop.
 - 5. National Ready Mixed Concrete Association (NRMCA).

1.03 DEFINITIONS

A. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.

ROGER SCOTT POOL FACILITIES

- B. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4-inch in diameter, cold joints, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.
- C. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.
- D. Hot Weather: As defined in ACI 305.1.
- E. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Formwork and Formwork Accessories: Unless otherwise specified, conform to requirements of ACI 301.
 - b. Reinforcing steel prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66 Detailing Manual:
 - 1) Bending lists.
 - 2) Placing drawings.
 - c. Construction Joints, Expansion Joints, and Control Joints: Layout and location for each type.
 - 2. Mix Design:
 - a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
 - b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
 - c. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common product Requirements, for the following:
 - 1) Portland cement.
 - 2) Fly ash.
 - 3) Slag cement.

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- 4) Aggregates, including specified class designation for coarse aggregate.
- 5) Admixtures.
- 6) Concrete producer has verified compatibility of constituent materials in design mix.
- d. Test Reports:
 - 1) Cement: Chemical analysis report.
 - 2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
 - 3) Aggregates:
 - a) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
 - b) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
 - 4) Water-Soluble Chloride-Ion Content in Hardened Concrete: One of the following:
 - a) Test report in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
 - b) Calculation of water-soluble chloride content based on certified chloride content of each constituent material and proportion of constituent material in concrete mixture.
 - 5) Alkali Aggregate Reactivity: Where required, in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.
- e. Product Data:
 - 1) Admixtures: Manufacturer's product data sheets for each admixture used in proposed mix designs.
- 3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
 - a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
 - b. Documentation of embeds that must be at a temperature above freezing prior to placement of concrete.
 - c. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
 - d. Methods for temperature protection during placement.
 - e. Types of covering, insulation, housing, or heating to be provided.
 - f. Curing methods to be used during and following protection period.
 - g. Use of strength accelerating admixtures.
 - h. Methods for verification of in-place strength.

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ROGER SCOTT POOL FACILITIES

- i. Procedures for measuring and recording concrete temperatures.
- j. Procedures for preventing drying during dry, windy conditions.
- 4. Detailed plan for hot-weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
 - a. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
 - b. Use of retarding admixture.
 - c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
 - d. Types of shading and wind protection to be provided.
 - e. Curing methods, including use of evaporation retardant.
 - f. Procedures for measuring and recording concrete temperatures.
 - g. Procedures for preventing drying during dry, windy conditions.
- 5. Concrete repair techniques.
- B. Informational Submittals:
 - 1. Preinstallation Conference minutes.
 - 2. Manufacturer's application instructions for bonding agent and bond breaker.
 - 3. Manufacturer's Certificate of Compliance to specified standards:
 - a. Bonding agent.
 - b. Bond breaker.
 - c. Repair materials.
 - 4. Statement of Qualification:
 - a. Batch Plant: Certification as specified herein.
 - b. Mix designer.
 - c. Installer.
 - d. Testing agency.
 - 5. Manufacturer's written instructions for product shipment, storage, handling, installation/application, and repair for:
 - a. Joint filler and primer.
 - b. Preformed control joint.
 - 6. Concrete Delivery Tickets:
 - a. For each batch of concrete before unloading at Site.
 - b. In accordance with ASTM C94/C94M, including Requirement 14.2.1. through Requirement 14.2.10.
 - c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.05 QUALITY ASSURANCE

A. Qualifications:

- 1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
- 2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
- 3. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
- 4. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 - a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician–Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician–Grade II.
- B. Preinstallation Conference:
 - 1. Required Meeting Attendees:
 - a. Contractor, including pumping, placing and finishing, and curing subcontractors.
 - b. Ready-mix producer.
 - c. Admixture representative.
 - d. Testing and sampling personnel.
 - e. Steel Reinforcement Installer
 - f. Owner and/or Owner's designee.
 - 2. Schedule and conduct prior to incorporation of respective products into Project. Notify Owner of location and time.
 - 3. Agenda shall include:
 - a. Admixture types, dosage, performance, and redosing at Site.
 - b. Mix designs, test of mixes, and Submittals.
 - c. Placement methods, techniques, equipment, consolidation, and form pressures.
 - d. Slump or slump flow and placement time to maintain slump and slump flow.

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- e. Finish, curing, and water retention.
- f. Steel reinforcement details.
- g. Protection procedures for weather conditions.
- h. Other specified requirements requiring coordination.
- 4. Conference minutes.

PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise specified, Work must be in accordance with ACI 301.

2.02 FORMWORK

- A. Form Materials:
 - 1. For exposed areas, use hard plastic finished plywood, overlaid waterproof particle board, or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.
 - 2. For unexposed areas, use new shiplap or plywood.
 - 3. Earth cuts may be used for forming footings.
- B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.
- C. Form Ties:
 - 1. Material: Steel.
 - 2. Spreader Inserts:
 - a. Conical or spherical type.
 - b. Design to maintain positive contact with forming material.
 - c. Furnish units that will leave no metal closer than 1-1/2 inches to concrete surface when forms, inserts, and tie ends are removed.
 - 3. Wire ties not permitted.

2.03 CONCRETE

- A. Materials:
 - 1. Cementitious Materials:
 - a. Cement:
 - 1) Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.

- 2) Blended Hydraulic Cement:
 - a) Unless otherwise specified, excluding Type IS (greater than 70), conforming to ASTM C595/C595M.
 - b) Portland cement used in blended hydraulic cement; conform to requirements of ASTM C150/C150M.
- 3) Furnish from one source.
- b. Supplementary Cementitious Materials (SCM):
 - 1) Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:
 - a) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
 - 2) Slag Cement: In accordance with ASTM C989/C989M, Grade 100 or Grade 120.
 - 3) Silica Fume: In accordance with ASTM C1240.
- 2. Aggregates: Unless otherwise permitted, furnish from one source for each aggregate type used in a mix design.
 - a. Aggregates:
 - 1) In accordance with ASTM C33/C33M, except as modified herein.
 - a) In accordance with ACI 301, except as modified herein.
 - b) Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
 - c) Aggregates that are susceptible to alkali-carbonate reactions shall not be used.
 - d) Alkali Silica Reactivity: See Article Concrete Mix Design.
 - 2) Fine Aggregates:
 - a) In accordance with ASTM C33/C33M, except as modified herein.
 - b) In the event manufactured sand is included in the mix design, the material shall be from the same source as the coarse aggregate.
 - c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
 - Limit material finer than 75-μm (No. 200) sieve to 3 percent mass of total sample.
 - (2) Limit coal and lignite to 0.5 percent.
 - 3) Coarse Aggregate:
 - a) Crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles as determined by ASTM D4791.

- b) Class designation in accordance with ASTM C33/C33M, Table 3: 4S unless otherwise specified.
- c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.
- 3. Admixtures:
 - a. Characteristics:
 - 1) Compatible with other constituents in mix.
 - 2) Contain at most, only trace amount chlorides in solution.
 - 3) Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
 - b. Air-Entraining Admixture: ASTM C260/C260M.
 - c. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
 - d. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - e. Accelerating Admixture: ASTM C 494/C 494M, Type C.
 - f. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
- 4. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.
 - a. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
 - 1) Chloride Content: 1,000 ppm.
 - 2) Sulfate Content as SO₄: 3,000 ppm.
 - 3) Alkalis as $(Na_2O + 0.658 K_2O)$: 600 ppm.
 - 4) Total Solids by Mass: Less than 50,000 ppm.
- B. Concrete Mix Design:
 - 1. General:
 - a. Unless otherwise specified, refer to Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
 - b. Unless otherwise specified, prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301.
 - c. Unless otherwise specified, selection of constituent materials and products in mix design are optional.
 - d. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, or water-reducing admixture for the following:
 - 1) Pumped concrete.

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- 2) Concrete with a water-cementitious materials ratio below 0.50.
- 3) Concrete mixtures used in walls.
- 4) When needed to achieve fresh properties that facilitate handling, placing, and consolidating of concrete mixtures, and to achieve specified hardened properties.
- 5) When anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
- e. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.
- f. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies such as use of supplementary cementitious materials and aggregate packing, and self-consolidating concrete.
- 2. Proportions:
 - a. Design mix to meet aesthetic, durability, and strength requirements.
 - b. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent of weight of total cementitious materials.
 - c. Where silica fume is included in mix, minimum silica fume content shall be 5 percent of weight of total cementitious materials.
- 3. Slump:
 - Unless otherwise specified, and prior to submitting mix design, select a target slump at the point of delivery for concrete mixtures used for Work. Selected target slump shall not exceed 9 in. Concrete shall not show visible signs of segregation. The target slump indicated on the submittal shall be used as the basis for acceptance during the project. Determine the slump by ASTM C143/C143M.
 - b. Slump tolerance shall meet requirements of ACI 117.
- 4. Size of Coarse Aggregate:
 - a. Unless otherwise specified, nominal maximum size of coarse aggregate shall not exceed:
 - 1) Three-fourths of minimum clear spacing between reinforcement.
 - 2) One-fifth of narrowest dimension between sides of forms.
 - 3) One-third of thickness of slabs or toppings.

- 5. Temperature Limits:
 - a. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set, plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
 - b. For mass concrete sections, provide documentation that maximum concrete temperature in structure will not exceed 160 degrees F, and maximum temperature differential between center of section and external surfaces of concrete will not exceed 35 degrees F.
 - c. Accelerating admixture may not be used in mass concrete sections unless the thermal control plan specifically addresses the concrete mixtures with the same accelerating admixture, at a dosage equal to or greater than being proposed for the mass concrete.

2.04 REINFORCING STEEL

- A. Deformed Steel Reinforcing Bars: ASTM A615/A615M, Grade 60. Welding of reinforcing bars is not permitted.
- B. Fabrication: Follow CRSI Manual of Standard Practice.

2.05 ANCILLARY MATERIALS

- A. Bonding Agent:
 - 1. Unless otherwise specified, in accordance with the following:
 - a. ASTM C881/C881M, Type V.
 - b. Two-component, moisture-insensitive, 100 percent solids epoxy.
 - c. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
 - d. Manufacturers and Products:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject 1500.
 - 2) Euclid Chemical Co., Cleveland, OH; Euco # 352 Epoxy System LV.
 - 3) Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
 - 4) Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.
- B. Bond Breaker:
 - 1. Nonstaining type, providing positive bond prevention.

- 2. Manufacturers and Products:
 - a. Dayton Superior Corporation, Miamisburg, OH; Sure Lift J6WB.
 - b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.
- C. Reinforcing Steel Accessories:
 - 1. Plastic Protected Wire Bar Supports: In compliance with ANSI/CRSI RB 4.1 Class 1 Reinforcement Supports.
 - 2. Stainless Steel Protected Wire Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Class 2 Reinforcement Supports, except legs shall be made wholly from stainless steel wire.
 - Precast Concrete Bar Supports: In compliance with ANSI/CRSI RB
 4.1 Cementitious (Precast) Reinforcement Supports.
 - a. Precast concrete bar supports shall have equal or greater strength than the surrounding concrete.
 - b. Precast concrete bar supports shall be four square inches minimum, in plan.
 - c. Precast concrete bar supports shall have tie wires.
- D. Tie Wire:
 - 1. Black, soft-annealed 16-gauge wire.
 - 2. Nylon-coated, epoxy-coated, or plastic-coated wire.
- E. Premolded Joint Filler:
 - 1. Bituminous Type: ASTM D994/D994M or ASTM D1751.
 - 2. Sponge Rubber:
 - a. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum.
 - b. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK515IHD.
- F. Curing Compound:
 - 1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.
 - 2. Manufacturers and Products:
 - a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
 - b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
 - c. Vexcon Chemical, Inc., Philadelphia, PA; Starseal 1315.
 - d. Dayton Superior; Safe Cure and Seal 1315 EF.

- G. Evaporation Retardant:
 - 1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
 - 2. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterKure ER 50.
 - b. Euclid Chemical Co., Cleveland, OH; Eucobar.
- H. Nonshrink Grout:
 - 1. Nonmetallic, nongas-liberating.
 - 2. Prepackaged natural aggregate grout requiring only the addition of water.
 - 3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
 - 4. Test in accordance with ASTM C1107/C1107M:
 - a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
 - b. Temperatures of 40 degrees F, 80 degrees F, and 100 degrees F.
 - 5. Pass fluid grout through flow cone with continuous flow 1 hour after mixing.
 - 6. Minimum Strength of Fluid Grout:
 - a. 3,500 psi at 1 day.
 - b. 4,500 psi at 3 days.
 - c. 7,500 psi at 28 days.
 - 7. Maintain fluid consistency when mixed in 1 yard to 9 yard loads in ready-mix truck.
 - 8. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterFlow 928.
 - b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
 - c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
 - d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
- I. Repair Material:
 - 1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
 - 2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
 - 3. Obtain Manufacturer's Certificate of Compliance that products selected are appropriate for specific applications.
 - 4. Repair mortar shall be Site mixed.

- 5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
- 6. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterEmaco S Series products.
 - b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop Series.
- J. Crack Repair:
 - 1. Obtain Letter of Certification from manufacturer's technical representative, that products selected are appropriate for the specific applications.
 - 2. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
 - 3. Use part epoxy injection resin for structural crack repairs.
 - a. Manufacturers:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject Series.
 - 2) Euclid Chemical Co., Cleveland, OH.; Euco Series (#452).
 - 3) Sika Chemical Corp., Lyndhurst, NJ.; Sikadur Series.
 - 4. Use hydrophilic polyurethane injection resin for non-structural crack repairs.
 - a. Manufacturers:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject 1210 IUG.
 - 2) Euclid Chemical Co., Cleveland, OH.; Dural Aqua-Fil.
 - 3) Sika Chemical Corp., Lyndhurst, NJ.; SikaFix HH Hydrophilic.
 - 4) Prime Resins, Inc., Conyers, GA.; Prime Flex 900 XLV.

2.06 SOURCE QUALITY CONTROL

A. Source Quality Control Inspection: Owner shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and subcontractors, providing products included in this section.

PART 3 EXECUTION

- 3.01 FORMWORK
 - A. Form Construction:
 - 1. Construct forms and provide smooth-form finish.
 - 2. Form 3/4-inch bevels at concrete edges, unless otherwise shown.

- 3. Make joints tight to prevent escape of mortar and to avoid formation of fins.
- 4. Brace as required to prevent distortion during concrete placement.
- 5. On exposed surfaces, locate form ties in uniform pattern or as shown.
- 6. Construct so ties remain embedded in the member with no metal within 1-inch of concrete surface when forms, inserts, and tie ends are removed.
- B. Form Removal:
 - 1. Nonsupporting forms (walls and similar parts of Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
 - a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
 - b. Curing and protection operations are maintained.
 - 2. Remove forms with care to prevent scarring and damaging the surface.
 - 3. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

3.02 PLACING REINFORCING STEEL

- A. Unless otherwise specified, in accordance with ACI 301.
- B. Accessories:
 - 1. Bar Supports in Contact with Ground: Provide precast concrete block supports.
 - a. Do not use brick, broken concrete masonry units, spalls, rocks, construction debris, or similar material for supporting reinforcing steel.
 - 2. Bar Supports in Contact with Forms: Unless otherwise noted, bar supports shall be plastic protected wire bar supports, stainless steel protected wire bar supports, or precast concrete block bar supports.
 - a. Use stainless steel protected wire bar supports or precast concrete block bar supports at formed surfaces that will receive abrasive blasting, hydro-blasting, or grinding.
 - 3. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports, and location of reinforcement remains within tolerance throughout work.

- C. Splices and Laps:
 - 1. Lap Splice Reinforcing: Refer to Structural General Notes on the Drawings for additional information.
 - 2. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 CONCRETE PLACEMENT INTO FORMWORK

- A. Inspection: Notify Owner and Special Inspector at least 1 work day in advance before starting to place concrete.
- B. Placement into Formwork:
 - 1. Reinforcement: Secure in position before placing concrete.
 - 2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs that shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
 - 3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
 - 4. Use means and methods that prevent segregation.
 - 5. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
 - 6. Joints in Footings and Slabs:
 - a. Ensure space beneath plastic waterstop completely fills with concrete.
 - b. During concrete placement, make visual inspection of entire waterstop area.
 - c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.
 - d. Apply procedure to full length of waterstop.
 - 7. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
- C. Conveyor Belts and Chutes:
 - 1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
 - 2. Do not use chutes longer than 50 feet.
 - 3. Wipe clean with device that does not allow mortar to adhere to belt.
 - 4. Cover conveyor belts and chutes.

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- D. Retempering: Not permitted for concrete where cement has partially hydrated.
- E. Pumping of Concrete:
 - 1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
 - 2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
 - 3. Replace pumping equipment and hoses (conduits) that are not functioning properly.
- F. Maximum Size of Concrete Placements:
 - 1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
 - 2. Locate expansion, control, and contraction, joints where shown.
 - 3. Construction Joints:
 - a. Unless otherwise shown or permitted, locate construction joints as follows:
 - 1) Locate construction joints as shown on the Drawings or where approved in the joint location submittal.
 - 2) Locate expansion, control, and contraction joints where shown on the Drawings.
 - 3) Provide vertical construction joints at maximum spacing of 40 feet unless shown or approved otherwise.
 - 4) When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
 - 5) Uniformly space vertical construction joints within straight sections of walls, avoiding penetrations.
 - 4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
- G. Minimum Time between Adjacent Placements:
 - 1. Typical Unless Noted Otherwise: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
 - 2. Expansion or Contraction Joints: 1 day.

3. If continuous placement of beams, girders, or slabs with columns or walls is indicated in Contract Documents, do not place horizontal elements until the underlying concrete is consolidated and bleed water is not on the surface of the supporting member, unless otherwise specified.

3.04 CONSOLIDATION AND VISUAL OBSERVATION

A. Provide at least one standby vibrator in operable condition at placement site prior to placing concrete.

3.05 COLD WEATHER PLACEMENT

- A. Unless otherwise permitted, shall be in accordance with requirements of ACI 301, ACI 306.1, and as follows:
 - 1. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
 - 2. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Owner.
 - 3. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
 - 4. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.
 - 5. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
 - 6. Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.
- B. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout Work to allow monitoring of concrete surface temperatures representative of Work. Unless otherwise permitted, record surface temperature of concrete at least once every 12 hours during specified curing period.
- C. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.
- D. Cure as specified.
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3.06 HOT WEATHER PLACEMENT

- A. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
 - 1. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
 - 2. Internal concrete temperature in structure shall not exceed 160 degrees F, and maximum temperature differential between center of section and external surfaces of concrete shall not exceed 35 degrees F.
 - 3. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
 - 4. Cure as specified.

3.07 CONCRETE BONDING

- A. Construction Joints at Existing Concrete:
 - 1. Thoroughly clean and roughen existing concrete surfaces to roughness profile range between CSP 7 to CSP 9 when verified by comparison to PC1-10.
 - 2. Saturate surface with water for 24 hours prior to placing new concrete.

3.08 PREMOLDED JOINT FILLER INSTALLATION

- A. Sufficient in width to completely fill joint space where shown.
- B. Drive nails approximately 1-foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.
- C. Secure premolded joint filler in forms before concrete is placed.

3.09 FINISHING FORMED SURFACES

A. Provide surface finish 2.0 (SF-2.0) in accordance with ACI 301 and as herein specified.

B. Tie Holes:

- 1. Unless otherwise specified, fill with specified repair material.
 - a. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.
- C. Repair defective areas of concrete.
 - 1. Cut edges perpendicular to surface at least 1/2-inch deep. Do not feather edges. Soak area with water for 24 hours.
 - 2. Patch with specified repair material.
 - 3. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from Owner prior to use.
 - 4. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Owner.
 - 5. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
 - 6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Owner.
- D. Inject cracks that meet the definition of defective area.
 - 1. When crack repair is deemed by Owner as requiring a structural repair, use part epoxy injection resin.
 - 2. When crack repair is deemed by Owner as requiring a nonstructural repair, use hydrophilic polyurethane injection resin.

3.10 FINISHING UNFORMED SURFACES

- A. General:
 - 1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
 - 2. Do not use "jitterbugs" or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
 - 3. Do not dust surfaces with dry materials nor add water to surfaces.
 - 4. Cure concrete as specified.

- B. Slab Tolerances:
 - 1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
 - 2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
 - 3. Steel gauge block 5/16-inch thick.
 - 4. Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
 - 5. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2-inch plus.
- C. Interior Slab Finish: Provide trowel finish unless specified otherwise.
- D. Exterior Slab Finish:
 - 1. Provide broom finish unless specified otherwise.
 - 2. Finish exposed edges with steel edging tool.
 - 3. Mark sidewalks transversely at 5-foot intervals with jointing tool.

3.11 EXPOSED METAL OBJECTS

- A. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1-inch and then cutting or removing metal object.
- B. Repair area of chipped-out concrete as specified for defective areas.

3.12 BLOCKOUTS AT PIPES OR OTHER PENETRATIONS

A. Where shown, install in accordance with requirements of the Drawings.

3.13 PROTECTION AND CURING

- A. Protect and cure concrete in accordance with requirements of ACI 301, ACI 308.1, and as follows:
 - 1. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
 - 2. Continuously wet cure concrete surfaces of hydraulic structures for a 7-day period. Intermittent wetting is not acceptable.
 - 3. Use curing compound only where approved by Owner.

- 4. Cure formed surfaces with curing compound applied in accordance with manufacturer's written instructions as soon as wet curing and finishing are completed.
- 5. Remove and replace concrete damaged by freezing.
- 6. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.14 NONSHRINK GROUT

- A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer's written instructions.
- B. Grouting Machinery Foundations:
 - 1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.
 - 2. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.
 - 3. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.
 - 4. Form with watertight forms at least 2 inches higher than bottom of plate.
 - 5. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's written instructions.

3.15 BACKFILL AGAINST STRUCTURES

- A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.
- B. Refer to General Structural Notes on the Drawings for additional requirements, including elevated slab and diaphragm completion prior to backfill.
- C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.16 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. General:
 - 1. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

- 2. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours and for additional time as may be required before transporting to test lab.
- 3. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
- 4. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
- 5. Evaluation will be in accordance with ACI 301 and Specifications.
- 6. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
- 7. Frequency of testing may be changed at discretion of Owner.
- 8. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M.
- 9. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.
- B. Concrete Strength Test:
 - 1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
 - 2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing by 7 additional days.
 - 3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Owner.
 - 4. Segregation Test Objective: Concrete shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump or slump flow test.
 - a. Test Procedure: Make slump or slump flow test and check for excessive slump or slump flow. Observe to see if mortar or moisture flows from slumped concrete.
 - b. Reject concrete if mortar or moisture separates and flows out of mix.

- C. Cold Weather Placement Tests:
 - 1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
 - a. Six extra test cylinders from last 100 cubic yards of concrete.
 - b. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.
 - 2. These specimens shall be in addition to those cast for lab testing.
 - 3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
 - 4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
 - 5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
 - 6. Use test results to determine specified strength gain prior to falsework removal.
- D. Slab Finish Tolerances and Slope Tolerances:
 - 1. Support 10-foot-long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
 - 2. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

3.17 SUPPLEMENTS

- A. Requirements of concrete mix designs following "End of Section," are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:
 - 1. Concrete Mix Design, Class 5000F3S1P2C2.

END OF SECTION

CONCRETE MIX DESIGN, CLASS 5000F3S1P2C2

- A. Mix Locations: Typical, unless otherwise specified.
- B. Exposure Categories and Classifications: F3S1P2C2.
- C. Mix Properties:
 - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.40.
 - 2. Minimum concrete compressive strength (f'c) shall be 5,000 psi at 28 days.
 - 3. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
 - a. Slabs to receive hard-troweled finish.
 - b. Slabs to receive dry shake floor hardener.
 - c. Slabs to receive topping placed monolithically as two-course floor on top of plastic concrete.
 - 4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in.‡	Air Content (%)*
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2 [§]	5.0
3§	4.5

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Nominal Maximum Aggregate Size	Air Content
in. [‡]	$(\%)^*$

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is $\pm 1-1/2$ percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.

5. Limit supplementary cementitious materials as follows:

Limits on cementitious materials for concrete assigned to Exposure Class F3 [‡] *		
Supplementary cementitious materials	Maximum percent of total cementitious materials by mass	
Fly as or natural pozzolans conforming to ASTM C618	25	
Slag cement conforming to ASTM C989	50	
Silica fume conforming to ASTM C1240	10	
Total of fly ash or natural pozzolans and silica fume	35	
Total of fly ash or natural pozzolans, slag cement, and silica fume	50	
[‡] Supplementary cementitious materials, including fly ash and natural pozzolans, slag cement, and silica fume, used in the manufacture of ASTM C595 and C1157 blended cements shall be included in		

assessing compliance with these limits.

* The individual limits shall apply regardless of the number of cementitious materials in a concrete mixtures.

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- 6. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in mix design, as follows:
 - a. Fly Ash and other Pozzolans: 25 percent.
 - b. Slag Cement: 50 percent.
 - c. Silica Fume: 10 percent.
 - d. Total cementitious materials include ASTM C150/C150M and ASTM C595/C595M cement.
 - 1) Fly ash and other pozzolans in Type IP, blended cement, ASTM C595/C595M.
 - 2) Slag used in the manufacture of an IS blended cement, ASTM C595/C595M.
- 7. Provide cementitious materials in accordance with one of the following:
 - a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
 - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
 - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
 - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
 - c. ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
 - 1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
- 8. Unless otherwise permitted, minimum cementitious materials content in mix design shall be as follows:
 - a. 515 pounds per cubic yard for concrete with 1-1/2-inch nominal maximum size aggregate.
 - b. 535 pounds per cubic yard for 1-inch nominal maximum size aggregate.
 - c. 560 pounds per cubic yard for 3/4-inch nominal maximum size aggregate.
 - d. 580 pounds per cubic yard for 1/2-inch nominal maximum size aggregate.
 - e. 600 pounds per cubic yard for 3/8-inch nominal maximum size aggregate.
 - f. Unless otherwise permitted, limit cementitious materials content to 100 pounds per cubic yard greater than specified minimum cementitious materials content in mix design.

- 9. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
 - a. Limits are stated in terms of chloride ions in percent by weight of cement.
 - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
- D. Refer to PART 1 through PART 3 of this section for additional requirements.

SECTION 04 22 00 CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. C33, Standard Specification for Concrete Aggregates.
 - d. C90, Standard Specification for Loadbearing Concrete Masonry Units.
 - e. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - f. C144, Standard Specification for Aggregate for Masonry Mortar.
 - g. C150, Standard Specification for Portland Cement.
 - h. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - i. C270, Standard Specification for Mortar for Unit Masonry.
 - j. C404, Standard Specification for Aggregates for Masonry Grout.
 - k. C476, Standard Specification for Grout for Masonry.
 - 1. C618 12 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - m. C744, Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
 - n. C979, Pigments for Integrally Colored Concrete.
 - o. C989, Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
 - p. C1314, Standard Test Method for Compressive Strength of Masonry Prisms.
 - q. C1403, Standard Test Method for Rate of Water Absorption of Masonry Mortars.
 - r. E514/E514M, Standard Test Method for Water Penetration and Leakage through Masonry.
 - 2. The Masonry Society (TMS):
 - a. TMS 402/ACI 530/ASCE 5; Building Code Requirements for Masonry Structures and Companion Commentaries. (MSJC Code and Commentary).

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- b. TMS 602/ACI530.1/ASCE6; Specification for Masonry Structures.
- c. 602/American Concrete Institute ACI 530.1/ASCE 6, Specification for Masonry Structures and Companion Commentaries. (Masonry Standards Joint Committee Specifications and Commentary).

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings.
 - 2. Data Sheets:
 - a. Horizontal joint reinforcement.
 - b. Preformed control joint materials.
 - c. Water repellant masonry sealer.
 - d. Grout mix design.
 - e. Mortar mix design.
 - f. Grout sand gradation in accordance with ASTM C404.
- B. Informational Submittals:
 - 1. Method and Location of Placing Grout: High lift or low lift.
 - 2. Mix design test results.
 - 3. Certifications:
 - a. Units comply with ASTM C55 and ASTM C90.
 - b. Grout test results conform to ASTM C1019.
 - c. Grout aggregates conform to requirements of ASTM C33, including nonreactivity.
 - d. Mortar sand conform to requirements of ASTM C144.
 - 4. Test results of Project samples from masonry unit manufacturer stating that units comply with ASTM C90. Documentation of material testing shall be one less than 1 year old.
 - 5. Test results of proposed grout mix deign stating that units comply with ASTM C1019. Documentation of material testing shall be 1 year old or less.
 - 6. Test reports stating aggregates for mortar meet requirements of ASTM C144.
 - 7. Test reports or letter of certification stating aggregates for grout meet requirements of ASTM C404.
 - 8. Letter from water repellent admixture manufacturer verifying masonry unit manufacturer's proper use of product.

- 9. Method and materials for removal of efflorescence.
- 10. Field test results to qualify materials.
 - a. Grout tests in accordance with ASTM C1019.

1.03 QUALITY ASSURANCE

- A. Preinstallation Conference:
 - 1. Required Meeting Attendees:
 - a. Masonry subcontractor, including masonry foreman.
 - b. Ready-mix producer.
 - c. Admixture representative.
 - d. Testing and sampling personnel.
 - e. Design Structural Engineer.
 - f. Project Architect for coating system and appearance.
 - 2. Schedule and conduct prior to start of masonry construction.
 - 3. Notify Engineer of location and time.
 - 4. Agenda shall include:
 - a. High lift and low lift procedures.
 - b. Mortar, grout, unit, and reinforcing submittals.
 - c. Types and locations of rebar splices.
 - d. Joint tooling.
 - e. Admixture types, dosage, performance, and redosing at Site.
 - f. Mix designs and test of mix.
 - g. Placement methods, techniques, equipment, consolidation, and reconsolidation.
 - h. Protection procedures for environmental conditions.
 - i. Other specified requirements requiring coordination.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Keep units and mortar/grout cementitious ingredients, including lime, dry.

PART 2 PRODUCTS

2.01 COMPRESSIVE STRENGTH OF MASONRY ASSEMBLAGE

A. Minimum 28-Day Specified Compressive Strength (f'm) of Masonry: 2,500 psi.

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2.02 CONCRETE MASONRY UNITS (CMU)

- A. ASTM C90: Normal weight.
 - 1. Net Area Compressive Strength: 2,800 psi minimum, in accordance with TMS 602, Table 2.
 - a. Water Repellent Admixture:
 - 1) Structural concrete masonry units in weather exposed exterior wall shall be manufactured with integral liquid polymeric admixture to provide resistance to water penetration.
 - 2) Manufacturers and Products:
 - a) W.R. Grace & Co.; Dry-Block Block Admixture.
 - b) BASF Construction Chemicals; Rheopel Plus.
 - 2. Nominal Size: 16 inches long by 8 inches high by thickness shown on the Drawings.
 - 3. Color of Units: See the Drawings.
 - 4. Surface Texture on Exposed Surfaces: As shown on the Drawings.
 - 5. Surface Texture: Smooth on interior, concealed exterior, and surface 1-foot below finished grade.
- B. General Concrete Masonry Unit (CMU) Requirements:
 - 1. Furnish or cut special shapes for corners, jambs, lintels, and other areas shown or required.
 - 2. Special units shall match color and texture of standard units.
 - 3. Where units are placed so end of unit is exposed, such as at a corner or intersection, exposed end of that block shall have surface to match color and texture of sides of other units.
 - 4. Furnish sound, dry, clean units free of cracks, prior to placing in structure.
 - 5. Vertical Cells to be Grouted: Capable of alignment sufficient to maintain clear, unobstructed continuous vertical cell dimensions in accordance with TMS 602, Table 7.
 - 6. Masonry unit size and shape shall allow for all placement patterns. Use vertical grout dams to prevent materials, such as grout, from escaping from cell being filled to adjacent cells where material is not intended to be placed.
- C. Textured Concrete Masonry Units (TCMU):
 - 1. Same type as structural units.
 - 2. Split Face: Scored.
 - 3. Color of Units: See the Drawings.

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2.03 MORTAR MATERIALS

- A. Portland Cement-Lime Mortar:
 - 1. ASTM C270.
 - 2. Cement: ASTM C150, Type II portland cement.
 - 3. Lime: ASTM C207, Type S hydrated.
 - 4. Aggregates:
 - a. Non-reactive in accordance with ASTM C33, Appendix X1.
 - b. Mortar: ASTM C144, sand.
- B. Water: Fresh, clean, and potable.
- C. Water Repellent Admixture:
 - 1. ASTM C1403.
 - 2. Mortar for structural concrete masonry units in weather exposed exterior walls shall include an integral liquid polymeric admixture to provide resistance to water penetration.
 - 3. Manufacturer and Product: BASF Construction Chemicals; Rheopel Plus Mortar Admixture.
- D. Manufacturers and Products:
 - 1. W.R. Grace; DRY-BLOCK.
 - 2. Harris Specialty Chemicals.
 - 3. Axim Italcementi Group; Intrapel.
 - 4. BASF Chemical Co.; Rheopel Admixture.
- E. Mortar Color Admixture:
 - 1. Meet the requirements of ASTM C979.
 - 2. Manufacturer and Product: Davis Colors, Los Angeles, CA; True Tone Mortar Color.
 - 3. Color shall be as shown on the Drawings.

2.04 GROUT MATERIALS

- A. Cement: ASTM C150, Type II portland cement.
- B. Fly Ash: Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618.
- C. Slag Cement: In accordance with ASTM C989, Grade 100 or Grade 120.
- D. Lime: ASTM C207, Type S hydrated.

- E. Aggregates:
 - 1. ASTM C404, fine and coarse.
 - 2. Non-reactive in accordance with ASTM C33, Appendix X1.
- F. Water: Fresh, clean, and potable.

2.05 REINFORCEMENT

- A. Reinforcement: Clean and free from loose rust, scale, and coatings that reduce bond.
- B. Deformed Bars: As specified in Section 03 30 10, Structural Concrete.
- C. Horizontal Joint Reinforcement:
 - 1. Two parallel, ASTM A82/A82M, No. 9 wires, galvanized in accordance with ASTM A153/A153M, weld connected to No. 9 perpendicular cross wire at 16 inches, maximum, center.
 - 2. Furnish special manufactured corner and wall intersection pieces.
 - 3. Manufacturer: Dayton Superior/Dur-O-Wal, Dayton, OH.

2.06 PREFORMED CONTROL JOINTS

- A. Solid rubber cross-shape extrusions as manufactured by:
 - 1. Dayton Superior/Dur-O-WalDayton, OH; DA 2001 Control Joint Regular Rubber.
 - 2. Hohmann and Barnard, Inc, Hauppauge, NY; #RS-Standard.

2.07 MORTAR MIXES

- A. In accordance with ASTM C270, Type S and MSJC Specifications.
- B. Mix Method:
 - 1. Property Method: Minimum average mortar 28-day compressive strength 1,800 psi.
- C. Mixing: Machine mix in approved mixers in accordance with ASTM C270.
- D. Where colored masonry units are used, color mortar to match. Inert coloring pigments may be added, but shall not exceed 6 percent by weight of cement.

2.08 GROUT MIXES

- A. Compressive Strength Property: Minimum 2,000 psi at 28 days. Grout strength shall not exceed two times the minimum specified strength.
- B. Mix Design:
 - 1. Proportions: Design mix to meet property/strength requirements.
 - 2. Slump: 8-inch minimum, 11-inch maximum.

C. Mixing:

- 1. Do not use water reducers, air entrainment, plasticizing, high-range water reducers, or other non-specified admixtures in grout mixes.
- 2. Transit-Mixed Grout: Meet requirements of ASTM C476.
- 3. For high lift grouting, add approved grout expansion admixture in accordance with manufacturer's recommendations.
- 4. Fluid consistency suitable for placing without segregation with a slump of 8 inches to 11 inches.

2.09 WATER REPELLENT MASONRY SEALER

- A. Characteristics:
 - 1. Water-based blend of silanes and siloxanes.
 - 2. VOC compliant.
- B. Performance Requirements:
 - 1. Water Absorption: 95 percent reduction in weight gain when tested in accordance with ASTM C140.
 - 2. Water Repellency: 99 percent reduction in weight gain when tested in accordance with ASTM E514.
- C. Manufacturers and Products:
 - 1. W. R. Grace & Co.; Infiniseal DB Sealer.
 - 2. BASF Construction Chemicals; Enviroseal PBT.

PART 3 EXECUTION

- 3.01 GENERAL
 - Meet requirements of Florida Building Code, Chapter 21 and The Masonry Society (TMS) 602/American Concrete Institute (ACI)530.1/ASCE 6, Specification for Masonry Structures and Companion Commentaries (MSJC), Part 3, Execution, except as modified in this section.

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- B. Moisture Protection:
 - 1. Keep units dry while stored on Site.
 - 2. Do not wet units prior to laying.
- C. Provide measures to prevent moisture from entering incomplete walls and open cells.
- D. Cold Weather: Meet requirements of MSJC Specification section "Cold Weather Construction".
- E. Hot Weather: Meet requirements of MSJC Specification section "Hot Weather Construction".
- F. After construction during cold weather, maintain newly constructed masonry temperature above 32 degrees F for a minimum of 24 hours using MSJC or other approved cold weather methods.
- G. After construction and during hot weather, fog spray newly constructed masonry in accordance with MSJC hot weather construction requirements.

3.02 PREPARATION

- A. Concrete Foundations: Meet tolerance requirements of ACI 117 prior to starting any masonry work.
- B. Prepare surface contact area of foundation concrete for initial mortar placement by removing laitance, loose aggregate, and other materials, and anything that would prevent mortar from bonding to foundation.
- C. Patch or grind out-of-tolerance foundation surfaces to receive mortar prior to starting masonry work.
- D. Clean reinforcement dowels and projecting embeds by removing laitance, spillage, or items that will adversely affect grout bond.
- E. Prevent surface damage to foundation concrete that will be exposed to view outside of contact area.

3.03 LAYING MASONRY UNITS

- A. General:
 - 1. Finish Tolerances (Measured on Interior Surfaces): Meet requirements of "Site Tolerance" requirements of Part 3, Execution, of the MSJC Specifications.

- 2. Place units with chipped edges or corners such that chipped area is not exposed to view.
- B. Wall Units:
 - 1. General:
 - a. If necessary to move a unit after once set in-place, remove from wall, clean, and set in fresh mortar.
 - b. Toothing of masonry units is not permitted.
 - 2. Running Bond:
 - a. Unless otherwise shown, lay up walls in straight, level, and uniform courses using a running bond pattern.
 - b. Place units for continuous vertical cells and mortar joints to prevent materials, such as grout and poured insulation, from escaping from cell being filled to adjacent cells where material is not intended to be placed.
 - c. Corners: Lay standard masonry bond for overlapping units and grout solid.
 - d. Intersecting Walls: Half unit appearance shall not extend and be visible on exterior side of intersecting wall. Provide hooked corner bars in bond beam units and joint reinforcement as shown on the Drawings.
 - 3. Glazed Concrete Masonry Units:
 - a. Single-faced units may be installed through wall where walls or partitions are shown to have glazed masonry unit finish on one side only.
 - b. Use facing for dimensional and plane reference in installation.
 - c. Where glazed masonry unit finish is indicated on both sides of a wall or partition, install coved bases of two-unit construction or two-faced units through the wall.
 - d. Install coved bases flush with finished surfaces above, except as otherwise specified.
 - 4. Special Shapes:
 - a. Provide and place such special units as corner block, doorjamb block, lintel block fillers, and similar blocks as may be required.
 - b. Use required shapes and sizes to work to corners and openings, maintaining proper bond throughout wall.

3.04 BUILT-IN ITEMS

- A. Position door frames, windows, vents, louvers, and other items to be built in wall, and construct wall around them.
- B. Install masonry anchors to secure items to wall.

- C. Fill spaces around items with grout except use mortar at mortar joints.
- Do not place electrical, instrumentation, or water conduits in a cell containing parallel reinforcement, unless approved in writing by Engineer. Additionally, pipes, sleeves, and conduits shall meet requirements of TMS 402/ACI 530/ASCE 5, Building Code Requirements for Masonry Structures (MSJC Code) and MSJC specification construction requirements.

3.05 MORTAR JOINTS

- A. General:
 - 1. Meet masonry erection requirements of MSJC, Part 3, Execution, 3.3B.
 - 2. As units are laid, remove excess mortar from grout space of cells to be filled. Final grout space, including any remaining mortar projections, shall be as required by MSJC Table "Grout Space Requirements".
 - 3. Place mortar before initial setting of cement takes place. Retemper only as required for it to remain plastic. Retempering of colored mortar is not allowed.
- B. Exposed Joints:
 - 1. Tool joints exposed to view after final construction, unless otherwise noted or shown.
 - 2. Cut joints flush and as mortar takes its initial set; tool to provide a concave joint.
 - 3. Perform tooling with tool that compacts mortar, pressing excess mortar out.
 - 4. Perform tooling when mortar is partially set, but still sufficiently plastic to bond rather than dragging it out.
 - 5. Rake out joints that are not tight at time of tooling, point, and then tool.
 - 6. Rake and tool joints at split-face surfaces, interior and exterior.
- C. Concealed Joints: Strike flush with no further treatment required.

3.06 CONTROL JOINTS

- A. Preformed Control Joints:
 - 1. Omit mortar from vertical joints.
 - 2. Place in units fabricated to receive rubber control joint material as wall is built.
 - 3. After wall is grouted, cured, and cleaned, install backing rod and sealant as specified in Section 07 92 00, Joint Sealants.
 - 4. Place and tool sealant to match depth of typical joint.

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3.07 REINFORCING

- A. Foundation Dowels:
 - 1. Locate first foundation dowel at end of wall in center of first cell; typically 4 inches from end of wall.
 - 2. Locate at each side of control joints and openings and below beam and joist seats, and then locate at maximum required spacing between these bars.
 - 3. Size, number, and location of foundation dowels shall match all typical and additional vertical wall reinforcing, unless otherwise noted.
 - 4. When foundation dowel does not line up with vertical core, do not slope more than 1 horizontal to 6 vertical to bring it into alignment.
- B. Vertical Reinforcing:
 - 1. Use deformed bars.
 - 2. Hold in position near ends of bars by wire ties to dowels or by reinforcing positioners.
 - 3. Lap reinforcing bars as shown or approved.
 - 4. Wire tie splices together.
 - 5. Minimum Bar Clearance: 1/2-inch from masonry for coarse grout from formed surfaces, and from parallel bars in same grout space.
- C. Horizontal Reinforcing:
 - 1. Use deformed bars.
 - 2. Lay on webs of bond beam units and place as wall is built. Increase web depth to ensure 1/2-inch cover over top of rebar.
 - 3. Lap reinforcing bars where spliced and wire tie together.
 - 4. Minimum Bar Clearance: 1/2-inch from masonry for coarse grout from formed surfaces, and from parallel bars in same grout space.
 - 5. Terminate reinforcing bars 2 inches clear from control joints except horizontal bars at roof and floor courses shall be continuous through joints.
- D. Horizontal Joint Reinforcement: Use where indicated on the Drawings.

3.08 MORTAR PRODUCTION

- A. Mix bulk materials in accordance with MSJC Specification.
- B. Mix prebagged materials with water to produce a workable consistency.
- C. Remix or retemper to maintain workability. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.

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3.09 GROUT PLACEMENT

- A. Do not mix, convey, or place with equipment constructed of aluminum.
- B. Secure vertical and horizontal reinforcement, ties, bolts, anchors, and other required embedments in place; inspect and verify before placing grout.
- C. Grout beams over openings in one continuous operation.
- D. Maintain vertical alignment in accordance with ACI 530.1, Table 7:
 - 1. Place grout within 1-1/2 hours of addition of water to mix.
 - 2. Use reinforcing positioners to secure vertical reinforcement.
- E. Grouting Requirements:
 - 1. Solid grout all walls.
 - 2. Fully embed horizontal steel with grout in an uninterrupted pour.
 - 3. Do not construct wall more than one course above top of grout pour prior to placing grout.
 - 4. Partial Grouting Requirements:
 - a. Fill cells containing reinforcing steel, anchor bolts, and other embedded items as shown with grout.
 - b. Construct cells to be filled to confine grout within cell.
 - c. Cover tops of unfilled vertical cells under a bond beam with metal lath to confine grout fill to bond beam section.
 - d. Form horizontal construction joints between pours by stopping grout pour 1-1/2 inches below a mortar joint, except at a bond beam; stop pour 1/2-inch below top of masonry unit.
- F. Vibration:
 - 1. Use internal "pencil" type, low energy vibrator to thoroughly consolidate grout and reduce amount of air voids. Do not use concrete vibrators.
 - 2. After initial water loss and settlement has occurred, but before it has taken any set, reconsolidate grout.
 - 3. Waiting period for reconsolidation will vary depending upon weather conditions and block absorption rates, but under "normal" weather conditions with average masonry units the waiting period should be between 30 minutes and 60 minutes.
- G. Cleanouts:
 - 1. Construct in accordance with MSJC Specification.

- 2. Provide for grout pours heights over 5 feet 4 inches in accordance with the IBC.
- 3. Provide of sufficient size to permit cleaning of cell, positioning of reinforcing, and inspection at bottom of every vertical cell containing reinforcing and maximum of 32 inches on center.
- 4. Location: Concealed from view after final construction, unless otherwise approved by Engineer.
- 5. After wall has been inspected and approved and prior to grouting, cap cleanouts in a manner that will seal them from grout leakage and provide a flush finish.

3.10 WATER REPELLENT MASONRY SEALER

- A. Remove efflorescence prior to applying water repellents. Dispose of waste generated.
- B. Apply to exposed exterior concrete masonry walls.
- C. Repoint loose, cracked, or disintegrating mortar at least 7 days prior to application. Ensure joint sealants and caulking are fully cured and wall surfaces are clean, dry, and free of chemical cleaners, efflorescence, dirt, oils, mortar smears, and other surface contaminants.
- D. Follow manufacturer's recommendations for weather conditions during application.
- E. Test a 5-foot by 5-foot wall area to ensure proper coverage, desired water repellency properties, and desired surface appearance when sealer is fully dried.
- F. Apply with spray, brush, or roller following manufacturer's recommendations, at a coverage rate of 50 square feet to 150 square feet per gallon, as determined by testing. Use two-coat application where recommended by manufacturer.

3.11 FIELD QUALITY CONTROL

- A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.
- B. Masonry shall be tested by independent testing agency, retained by Contractor.

- C. Provide adequate facilities for safe storage and proper curing of masonry prisms, mortar samples, and grout samples, as applicable, onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
- D. Masonry Testing:
 - 1. Masonry strength shall be determined using prism testing.
 - 2. Masonry test prisms, when required or desired, shall be constructed onsite with same materials and workmanship to be used for Project and in accordance with ASTM C1314. Method and frequency of prism testing shall be as shown on the Special Inspection and Testing Plan.
- E. Corrective Action: If compressive strength tests made prior to construction of permanent structure fail to meet Specifications, adjustments shall be made to mix designs for mortar, or grout, or both, as needed to produce specified strength.

3.12 CLEANING

- A. Immediately after completion of grouting, clean masonry surfaces of excess mortar, grout spillage, scum, stains, dirt, and other foreign substances using clean water and fiber brushes.
- B. Clean walls not requiring painting or sealing so there are no visible stains.

3.13 PROTECTION OF INSTALLED WORK

- A. Do not allow grout and mortar stains to dry on face of exposed masonry.
- B. Protect tops of walls at all times. Cover tops of walls with waterproof paper when rain or snow is imminent and when the Work is discontinued.
- C. Adequately brace walls until walls and roof are completed.
- D. Provide sufficient bracing to protect walls against damage from elements, including wind and snow.
- E. Protect masonry against freezing for minimum 72 hours after being laid.
- F. Protect masonry from damage until final acceptance of the Work. Damaged units will not be accepted.

END OF SECTION

SECTION 04 22 19 INSULATED CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: The section includes the installation of the following:
 - 1. Insulated concrete masonry units (ICMU).

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Concrete Institute (ACI):
 - a. 315, Details and Detailing of Concrete Reinforcement.
 - b. 530, Building Code Requirements and Specification for Masonry Structures.
 - c. 530/530.1-13, Building Code Requirements and Specification for Masonry Structures and Companion Commentaries.
 - d. ACI 530.1/ASCE 6/TMS 602, Specifications for Masonry Structures.
 - 2. ASTM International Standards (ASTM):
 - a. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - b. A153-B2, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. A580, Standard Specification for Stainless Steel Wire.
 - d. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - e. A641, Standard Specification for Zinc–Coated (Galvanized) Carbon Steel Wire.
 - f. A996, Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
 - g. C90, Standard Specification for Loadbearing Concrete Masonry Units.
 - h. C144, Standard Specification for Aggregate for Masonry Mortar.
 - i. C150, Standard Specification for Portland Cement.
 - j. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - k. C404, Standard Specification for Aggregates for Masonry Grout.
 - 1. C494, Standard Specification for Chemical Admixtures for Concrete.

- m. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- n. C979, Standard Specification for Pigments for Integrally Colored Concrete.
- o. C1329, Standard Specification for Mortar Cement.
- p. C1384, Standard Specification for Admixtures for Masonry Mortars.
- q. C1623, Standard Specification for Manufactured Concrete Masonry Lintels.
- r. D2000, Standard Classification System for Rubber Products in Automotive Applications.
- s. D2287, Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- t. D4637, Standard Specification for EPDM Sheet Used In Single-Ply Roof Membrane.
- u. E514/E514M, Standard Test Method for Water Penetration and Leakage Through Masonry.
- 3. ICMU(s): Insulated concrete masonry unit(s).
- 4. Structural CMU: Concrete masonry units (CMU) with open cells complying with ASTM C90, Standard Specification for Loadbearing Concrete Masonry Units, used in either load bearing or non-load bearing conditions.
- 5. National Contract Management Association (NCMA)

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct Preinstallation Meeting at location selected by Owner.

1.04 ACTION SUBMITTALS

- A. Product Data: Provide Manufacturer's Product Data for the following items:
 - 1. ICMU, including structural CMU and non-structural thin veneer components with insulation as a complete unit, including integral water repellant.
 - 2. Mortar, including integral water repellant.
 - 3. Grout.
 - 4. Prefabricated Flashing.
 - 5. Flashing.
 - 6. Weeps.

- B. Shop Drawings: Provide Shop Drawings indicating installation details, including the following:
 - 1. Provide drawings indicating sizes, configuration, and locations of special shapes.
 - 2. Reinforcing: Provide drawings indicating reinforcing that complies with ACI 315 and includes the following:
 - a. Provide elevations indicating steel reinforcing bar placement.
 - b. Provide details indicating steel reinforcing bar sizes, placement, bends, and laps dimensions.
- C. Samples: Submit samples for each type of product specified.
 - 1. ICMU, including structural CMU and non-structural thin veneer components with insulation as a complete unit.
- D. Samples, Selection Set: Submit complete series of manufacturer's standard colors, textures, and finishes, in manufacturer's standard size, for the following:
 - 1. Structural CMU.
 - 2. Non-Structural Thin Veneer.
 - 3. Colored Mortar with integral water repellant.
- E. Each product color, texture and finish selection to be made by the Owner from the Selection Set of Samples.
- F. Sustainable Design Submittals: For each product, submit the following item to the Project Sustainable Design Coordinator: Environmental Product Declaration (EPD).

1.05 INFORMATIONAL SUBMITTALS

- A. Certificates: For each of the following materials, submit documentation, on product manufacturer's letterhead, stating that materials comply with requirements of the Contract Documents.
 - 1. ICMU, including structural CMU and non-structural thin veneer components with insulation as a complete unit.
 - 2. Mortar with integral water repellant.
 - 3. Grout.
 - 4. Steel reinforcing.
- B. Delegated Design Submittals: Provide engineering design calculations.

- C. Test and Evaluation Reports:
 - 1. Compressive Strength Report: Submit report of the following properties for each combination of masonry unit type and mortar type to be incorporated in the Work calculated according to the standards of ACI 530.1/ASCE 6/TMS 602:
 - a. Average net area compressive strength of masonry units.
 - b. Average net area compressive strength of mortar types.
 - c. Resulting net area compressive strength of masonry construction.

1.06 QUALITY ASSURANCE

- A. Licensed Professionals: Owner to retain an experienced, professional, structural engineer who is legally qualified to practice in the jurisdiction where the Project is located to calculate design of masonry reinforcing requirements and to prepare construction documents for installation of reinforced masonry.
- B. Mockups: Construct mockup of typical exterior wall, as indicated on the Drawings, to exhibit aesthetic effects, to confirm product selections and placement, and to establish construction quality standards.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver CMUs and other cementitious materials neatly stacked on pallets.
- B. Storage and Handling Requirements: Store CMUs and other cementitious materials on elevated platforms in a dry, sheltered location.
 - 1. If sheltered location is not available, completely cover tops and side of stored CMUs and other cementitious materials with a waterproof tarp that is securely restrained from exposing covered materials to precipitation.

1.08 FIELD CONDITIONS

- A. Protection During Construction:
 - 1. Comply with protection recommendations of NCMA TEK 8-4A.
 - 2. At the end of each day's work, cover top of masonry construction with a waterproof tarp that is securely restrained from exposing covered work to precipitation.
 - a. Extend protective covering a minimum of 24 inches down each side of masonry construction.

- 3. Spread protective covering over ground and wall surfaces to protect in place masonry work from mud splatter.
- 4. Protect work adjacent to and below masonry work from grout and mortar droppings, including the following surfaces:
 - a. Sills.
 - b. Ledges.
 - c. Projections.
 - d. Window and door frames.
- 5. Immediately remove grout, mortar, and soil that comes in contact with exposed masonry work.
- B. Weather Conditions:
 - 1. Ambient Conditions: Comply with working recommendations of the International Masonry Industry All Weather Council (IMIAWC) regarding weather conditions.
 - 2. Cold Weather and Hot Weather Construction: Comply with recommendations of ACI 530 and IMIAWC, Recommended Practices and Guide Specifications for Cold Weather and Hot Weather Masonry Construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer:
 - 1. InsulTech products by Echelon, a member of the Oldcastle Company, "Or-equal," approved.
- B. Source Limitations: Obtain ICMUs from a single manufacturer.

2.02 PERFORMANCE CRITERIA

- A. Structural Performance Requirements: Provide reinforced masonry construction designed to comply with the following requirements:
 - 1. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
 - 2. Design Standards: Comply with the design recommendations of the following:
 - a. ACI 530/530.1-13.
 - b. NCMA TEK 12-4D.
 - c. NCMA TEK 14-19A.
 - d. NCMA TEK 16-3B.
 - 3. Dead Loads: As indicated on the Drawings.
 - 4. Live Loads: As indicated on the Drawings.

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- 5. Wind Loads: As indicated on the Drawings.
- 6. Seismic Loads: As indicated on the Drawings.
- B. Thermal Resistive Performance Requirements:
 - 1. R-Value: R-13.
- C. Fire Resistive Performance Requirements: Determine fire resistant rating according to testing complying with ASTM E 119 testing methods by equivalent concrete masonry thickness or by other means, as acceptable to authorities having jurisdiction.
- D. Water Penetration Resistance: CMU shows no visible water or leaks on back of test specimen after 24 hours when tested according to ASTM E514/E514M.

2.03 CONCRETE MASONRY UNITS, GENERAL

- A. Masonry Standard: Provide concrete masonry complying with ASTM C90.
 - 1. Compressive Strength: Provide ICMUs with a minimum average net area compressive strength of 2,500 psi.
 - 2. Density: Provide ICMU of the following density:
 - a. Lightweight CMU: Less than 105 lb/cu. ft.
 - b. Medium weight CMU: At least 105 lb/cu. ft. but less than 125 lb/cu. ft.
 - c. Normal weight CMU: 125 lb/cu. ft. or more.
- B. Pigments: ASTM C979, inorganic iron oxide pigments.
- C. Integral Water Repellant: Liquid polymeric, admixture that does not reduce flexural bond strength.
 - 1. Integral Water Repellant Product: Subject to compliance with requirements, provide the following:
 - a. RainBloc® Water Repellent Masonry Unit admixture, manufactured by ACM Chemistries, Inc.
- D. Integral Water Repellent. Certified by ICMU manufacturer to have been tested and suitable for use in ICMU.

2.04 INSULATED CONCRETE MASONRY UNITS

- A. ICMU: Preassembled, structural ICMU, consisting of a structural CMU and a thin, non-structural CMU veneer separated by a graphite polystyrene (GPS) molded insulation thermal break and held together as a single unit.
 - 1. Components:
 - a. Structural CMU: unfinished exposed interior face and dovetailed slots on the opposite face.
 - b. Insulation: Nominal 3 inches thick Molded GPS insulation.
 - c. Non-Structural Thin Veneer: Nominal 1-5/8 inches thick CMU with finished exposed exterior face and dovetailed slots on the opposite face.
 - 2. Non-Structural Thin Veneer CMU(CMUV):
 - a. Thin CMU Veneer
 - 1) Color: Integral color to match adjacent building or as selected by Owner.
 - 2) Finish:
 - a) CMUV-1: Textured Split-Faced.
 - b) CMUV-2: Ground.
 - c) CMUV-3: Ground
 - 3) Manufacturer: Echelon, Standard Masonry and Trenwyth Architectural Masonry, "Or-equal," approved.
 - 3. Insulation: Nominal 3 inches thick Molded GPS insulation.
 - 4. Structural CMU Backup:
 - a. Structural CMU
 - 1) Color: As selected by Owner.
 - 2) Finish: Smooth.
 - 3) Nominal Dimensions: 8 inches deep by 8 inches high by 16 inches long.
 - a) Actual Dimensions: 8-1/4 inches deep by 7-5/8 inches high by 15-5/8 inches long.

2.05 INSULATION

- A. Product: Subject to compliance with requirements, provide Neopor® by BASF.
- B. Graphite polystyrene (GPS): Closed cell, GPS insulation complying with ASTM C578, Type II insulation, molded to interlock with the structural CMU and non-structural thin veneer components of ICMU and with male and female connections to interlock with adjacent ICMU units.
 - 1. Density: 1.35 lb/cu. ft.
 - 2. Compressive Strength (Resistance): 15.0 psi.

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2.06 SPECIAL SHAPES

- A. Provide special shapes as required to complete the masonry work as indicated on the Drawings without requiring field cutting, including the following:
 - 1. Left and right hand corners units.
 - 2. Left and right hand corner continuation units.
 - 3. Open end stretcher units.
 - 4. Closed end stretcher units.
 - 5. Double sash units.
 - 6. Left and right hand half sash units.
 - 7. Veneer stretcher units.
 - 8. Veneer left and right hand corners units.
 - 9. Left and right hand 4-inch return jamb block units.

2.07 CONCRETE MASONRY LINTELS

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
- B. Bond Beam Units: Provide closed bottom CMU bond beams matching properties and dimension of ICMU structural CMU component, including color and finish of exposed ICMU faces.
 - 1. Provide Veneer stretcher units where required to match ICMU non-structural thin veneer.

2.08 CONCRETE LINTELS

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
- B. Precast Concrete Lintel: Provide steel reinforced, precast concrete lintels complying with ASTM C1623, with color, texture, and density matching ICMU.

2.09 STEEL LINTELS

- A. Comply with requirements of Sections 04 22 00, Concrete Unit Masonry and 05 50 00, Metal Fabrications.
- B. Provide galvanized steel angles and shapes as indicated on the Drawings.
 - 1. Size steel lintels to support dead loads over openings but not less than sizes indicated on the Drawings.
 - 2. Provide minimum of 8 inches of bearing on each side of opening but not less than required based on masonry's bearing capacity.

2.10 MORTAR AND GROUT MATERIALS

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry
- B. General: Comply with recommendations of the following:
 - 1. NCMA TEK 9-1A.
 - 2. NCMA TEK 9-4A.
- C. Portland Cement: Comply with ASTM C150, using one of the following portland cement Types:
 - 1. Type I, normal.
 - 2. Type II, moderate sulfate resistance.
 - 3. Type III, high early strength, maybe used for cold weather conditions.
- D. Hydrated Lime: Comply with ASTM C207, Type S (special).
- E. Aggregates:
 - 1. Aggregates for Mortar: Comply with ASTM C144.
 - 2. Aggregates for Grout: Comply with ASTM C404.
- F. Packaged Cement Mix: Packaged, factory blended mix of portland cement and hydrated lime with no other components included.
- G. Mortar Cement: Comply with ASTM C1329.
- H. Pigments: Comply with ASTM C979.
 - 1. Comply with quantity limitation specified ASTM C1384, when adding to mortar.
- I. Admixtures: Comply with quantity limitation specified ASTM C1384, when adding to mortar.
 - 1. Cold Weather: Comply with ASTM C494.
 - 2. Integral Water Repellant: Liquid polymeric, admixture that does not reduce flexural bond strength.
 - a. Integral Water Repellant Product: Subject to compliance with requirements, provide one of the following products:
 - 1) RainBloc® Water Repellent Masonry Unit admixture, manufactured by ACM Chemistries, Inc.
- J. Water: Clean and drinkable.

2.11 REINFORCEMENT

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
- B. Reinforcing Bars: Uncoated, deformed, steel reinforcing bars.
 - 1. Grade and Sizes: As indicated on the structural Drawings.
- C. Reinforcing Bar Positioners: Prefabricated wire elements configured to span masonry unit cells and hold reinforcing bars in position when cells are filled with grout. Provide reinforcing bar positioners configured to accommodate the masonry and reinforcing requirements indicated on the Drawings.
 - 1. Wire Material: Provide wire made of one of the following materials:
 - a. Cold-drawn steel wire conforming to ASTM A106.
 - b. Stainless steel wire conforming to ASTM A580 AISI Type 316.
 - 2. Wire Diameter: 0.148-inch minimum.
 - 3. Wire Finish: Galvanized according to one of the following methods:
 - a. Mill Galvanized: ASTM A641, 0.1 ounces per square foot minimum thickness.
 - b. Hot Dipped Galvanized after Fabrication: ASTM A153-B2, 1.5 ounces per square foot minimum thickness.
- D. Joint Reinforcement, Ladder or Truss Type: Prefabricated wire ladder type joint reinforcement consisting of 3 longitudinal rods with cross rods equally spaced, at a maximum of 16 inches on center, to avoid obstructing masonry unit cells.
 - 1. Ladder Width: Depth of structural CMU backup component of ICMU.
 - 2. Wire Material: Provide wire made of one of the following materials:
 - a. Cold-drawn steel wire conforming to ASTM A106,.
 - b. Stainless steel wire conforming to ASTM A580, AISI Type 316.
 - 3. Wire Finish: Galvanized according to one of the following methods:
 - a. Mill Galvanized: ASTM A641, 0.1 ounces per square foot minimum thickness.
 - b. Hot Dipped Galvanized after Fabrication: ASTM A153-B2, 1.5 ounces per square foot minimum thickness.
- E. Joint Reinforcement, Single Wire (Pencil Wire) Type:
 - 1. Wire Material: Provide wire made of one of the following materials:
 - a. Cold-drawn steel wire conforming to ASTM A106,.
 - b. Stainless steel wire conforming to ASTM A580, AISI Type 316.

- 2. Wire Finish: Galvanized according to one of the following methods:
 - a. Mill Galvanized: ASTM A641, 0.1 ounces per square foot minimum thickness.
 - b. Hot Dipped Galvanized after Fabrication: ASTM A153-B2, 1.5 ounces per square foot minimum thickness.

2.12 ACCESSORIES

- A. Field Applied, Water Repellant: Clear, water-based, penetrating water repellent for concrete and masonry.
- B. Prefabricated Flashing and Weeps:
 - 1. Product: Subject to compliance with requirements, provide "BlockFlashTM" as manufactured by Mortar Net SolutionsTM.
 - 2. Flashing Material: Provide prefabricated flashing pans made from recycled polypropylene, chemically stabilized to inhibit degradation by ultraviolet radiation.
 - 3. Flashing Configuration: Embeddable flashing device for exterior CMU construction with built-in slope to direct moisture to integrated weeps and prefabricated flashing manufacturer's attached drainage mats and 1-inch extended insect guards.
 - 4. Coordinate the flashing and weeps specified in the section with other flashing specified in Sections 04 22 00, Concrete Unit Masonry and 07 62 00, Sheet Metal Flashing and Trim.
- C. Flashing: Comply with requirements of Sections 04 22 00, Concrete Unit Masonry and 07 62 00, Sheet Metal Flashing and Trim.
- D. Weeps: Free-draining UV stabilized, open weave, polyester mesh inserts for open head joints of masonry walls.
 - 1. Do not install cotton chord drainage.
 - 2. Color: As indicated on the Drawings As selected by the Architect from the manufacturer's full range of standard colors
- E. Joint Sealants: Non-staining silicone sealant as specified in Section 07 92 00, Joint Sealants.
- F. Sealant Backer Rods: As specified in Section 07 92 00, Joint Sealants.
 - 1. Width and Thickness: As indicated on the Drawings.
- G. Masonry Control Joint Gasket: Provide preformed gasket strips designed to fit standard sash block and to maintain lateral stability in masonry walls, made of one of the following materials:
 - 1. Styrene-butadiene rubber compound, complying with ASTM D2000, Designation M2AA-805.
 - 2. PVC, complying with ASTM D2287, Type PVC-65406.

2.13 MASONRY CLEANER

A. Proprietary Acidic Cleaner: Standard strength cleaner designed to remove mortar and grout stains, efflorescence, and other construction related stains without discoloring and without damaging masonry and mortar surfaces and as approved by ICMU manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine in place construction, with mason present, to evaluate and verify the following:
 - 1. That substrates to receive masonry work are within specified dimensional tolerances.
 - 2. That substrates to receive masonry work are clean and have no conditions that would weaken bonding of mortar.
 - 3. That steel reinforcing is the specified size and in the required location.
- B. Correct unacceptable conditions before beginning installation.

3.02 PREPARATION

A. Prepare masonry and set reinforcement prior to grouting according to the recommendations of NCMA TEK 3-2A.

3.03 INSTALLATION OF ICMUS

- A. General:
 - 1. Comply with written recommendation of ICMU manufacturer.
 - 2. Do not install wet ICMUs.
 - 3. Brace walls under construction according to the recommendations of NCMA TEK 3-4B.
- B. Layout: Comply with requirements of NCMA TEK 3-8A.
 - 1. Set first course of ICMU using units with integral water repellant.

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- C. Bond Pattern: Lay ICMUs in a running bond pattern as indicated on the Drawings.
- D. Tolerances: Comply with requirements of NCMA TEK 3-8A.
- E. Setting in Mortar: Comply with recommendations of NCMA TEK 3-1C through TEK 3-14 as applicable to the type of masonry construction and project conditions.
 - 1. ICMU manufacturer's stainless-steel "Bridge tool" is mandatory to install mortar at a uniform 3/4-inch joint thickness with an inside mortar cant to prevent interior mortar roll in during mortar compression as part of the unit installation and to maintain the drainage channels.
 - 2. Take measures to minimize mortar droppings.
- F. Grouting of Cores: Place grout in cells of ICMUs according to the recommendation of NCMA TEK 3-2A.
- G. Control and Expansion Joints: Unless otherwise indicated on the Drawings, locate and install control and expansion joints according to one of the following standards:
 - 1. NCMA TEK 10-2C.
 - 2. NCMA TEK 10-3.
- H. Application of Water Repellant: Apply water repellant according to water repellant manufacturer's written recommendations.

3.04 INSTALLATION OF LINTELS

- A. Comply with requirements of in Section 04 22 00, Concrete Unit Masonry.
- B. Concrete Masonry Lintels: Install CMU lintels where indicated on the Drawings.
 - 1. Provide a minimum of 8 inches of bearing on each side of masonry opening, unless otherwise indicated on the Drawings.
 - 2. Temporary Bracing: Provide temporary bracing until grout has cured sufficiently to support applied loads, but not less than 7 days.
 - 3. Reinforcing: Install reinforcing as indicated on the Drawings, but not less than recommended in NCMA TEK 17-1D.

- C. Steel Angle Lintels: Install steel angle lintels where indicated on the Drawings.
 - 1. Provide a minimum of 8 inches of bearing on each side of masonry opening, unless otherwise indicated on the Drawings.
 - 2. Coordinate with Section 05 50 00, Metal Fabrications.

3.05 INSTALLATION OF FLASHING

- A. Prefabricated Flashing and Weeps: Install prefabricated flashing and weep units at base course, at bond beams, at lintels, and other horizontal locations where ICMU cores are grouted solid.
 - 1. Install prefabricated flashing and weep units according to manufacturer's written instructions.
 - 2. Coordinate installation of prefabricated flashing and weep units with installation of other flashing work.
- B. Comply with requirements of Sections 04 22 00, Concrete Unit Masonry and 07 62 00, Sheet Metal Flashing and Trim.
- C. Flexible Flashing: Locate and install flexible flashing according to the recommendations of the following standards:
 - 1. NCMA TEK 19-4A.
 - 2. NCMA TEK 19-5A.
- D. Weeps: Install weeps at the head joints of the non-structural thin veneer of the ICMUs directly above flashing.
 - 1. Space weeps no more than 16 inches o.c. horizontally.

3.06 REINFORCED ICMUS

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
- B. Install reinforcing in masonry construction according to the following standards:
 - 1. NCMA TEK 12-1B.
 - 2. NCMA TEK 12-2B.
 - 3. NCMA TEK 12-3C.
 - 4. NCMA TEK 12-4D.
 - 5. NCMA TEK 12-5.
 - 6. NCMA TEK 12-6.
 - 7. NCMA TEK 12-6A.

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- C. Ladder Type Joint Reinforcement: Set within the horizontal joints of the structural CMU components of the ICMU at a minimum of 16 inches on center vertical, unless otherwise indicated.
- D. Single Wire (Pencil Wire) Type Joint Reinforcement: Set within the horizontal joints of the non-structural thin veneer components of the ICMU at a minimum of 16 inches on center vertical, unless otherwise indicated.

3.07 CLEANING

- A. Progress Cleaning: Comply with cleaning during construction recommendations of NCMA TEK 8-4A.
 - 1. Remove mortar droppings which adhere to exposed faces of masonry units with a trowel or chisel after mortar has hardened.
 - 2. Remove remaining mortar with stiff fiber or bristle brush.
 - 3. Remove grout spills immediately by washing and brushing.
- B. Final Cleaning: Perform final cleaning according to ICMU manufacturer's recommendations.

END OF SECTION

SECTION 05 05 19 POST-INSTALLED ANCHORS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.
 - b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
 - c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
 - 2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
 - 3. American National Standards Institute (ANSI).
 - 4. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - c. A194/A194M, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - d. E488/E488M, Standard Test Methods for Strength of Anchors in Concrete Elements.
 - e. F436/F436M, Standard Specification for Hardened Steel Washers.
 - f. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - g. F594, Standard Specification for Stainless Steel Nuts.
 - h. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 - 5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
 - 6. International Code Council Evaluation Service (ICC-ES):
 - a. Evaluation Reports for Concrete and Masonry Anchors.
 - b. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
 - c. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.

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- 7. Specialty Steel Industry of North America (SSINA):
 - a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.
- C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.
- D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.
- B. Informational Submittals:
 - 1. Concrete and Masonry Anchors:
 - a. Manufacturer's product description and installation instructions.
 - b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
 - 2. Passivation method for stainless steel members.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.
 - 2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package stainless steel items in a manner to provide protection from carbon impregnation.
- B. Protect hot-dip galvanized finishes from damage because of metal banding and rough handling.

PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference				
Stainless Steel:					
Threaded Rods	F593, AISI Type 316, Condition CW				
Nuts*	F594, AISI Type 316, Condition CW				
Carbon Steel:					
Threaded Rods	F1554, Grade 36				
Flat and Beveled Washers (Hardened)	F436/F436M				
Nuts*	A194/A194M, Grade 2H				
Galvanized Steel:					
All	A153/A153M				
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.					

B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated.

2.02 POST-INSTALLED CONCRETE ANCHORS

- A. General:
 - 1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown.
 - 2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
 - 3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
 - 4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.
- B. Torque-Controlled Expansion Anchors (Wedge Anchors):
 - 1. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; KWIK Bolt-TZ2 Expansion Anchor Safe Set System with hollow drill bit and vacuum and SI-AT-A22 tool with adaptive torque for applicable sizes (ESR-4266).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-1771 and ESR-3037).
- C. Self-Tapping Concrete Screw Anchors:
 - 1. Do not use for equipment anchorage unless specifically shown on the Drawings.
 - 2. Manufacturers and Products:
 - a. DeWalt/Powers Fasteners, Brewster, NY; Screw-Bolt+ (ESR-3889).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Hangermate+ Rod Hanger Screw Anchor (ESR-3889).
 - c. DeWalt/Powers Fasteners, Brewster, NY; Snake+ Flush Mount Screw Anchor (ESR-2272).
 - d. Hilti, Inc., Tulsa, OK; Kwik HUS, KH-EZ, KH-EZ CRC, KH-EZ SS316, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ P Screw Anchor Safe Set System with hollow drill bit and vacuum (ESR-3027).
 - e. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713 and IAPMO UES-493).

POST-INSTALLED ANCHORS 05 05 19- 4

- D. Adhesive Anchors:
 - 1. Threaded Rod:
 - a. Diameter as shown on the Drawings.
 - b. Length as required to provide minimum depth of embedment indicated and thread projection required.
 - c. Clean and free of grease, oil, or other deleterious material.
 - 2. Adhesive:
 - a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
 - b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
 - 3. Packaging and Storage:
 - a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
 - b. Store adhesive on pallets or shelving in a covered storage area.
 - c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard
 - classification, and appropriate ANSI handling precautions.
 - d. Dispose of When:
 - 1) Shelf life has expired.
 - 2) Stored other than in accordance with manufacturer's instructions.
 - 4. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT-HY 200 V3 Safe Set System with (ESR-4868), HIT RE 500 V3 Safe Set System with HAS threaded rod (ESR-3814), or HIT-RE 500 V3 Safe Set System with Hilti Roughening Tool (HIT RT) with HAS threaded rod (ESR-3814) for diamond cored holes.
 - b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-3G Epoxy Adhesive Anchors. (ESR-4057).
 - c. DeWalt/Powers Fasteners, Brewster NY; Pure 220+ Epoxy adhesive anchor system with Dust X+ System (ESR-5144).
- E. Adhesive Threaded Inserts:
 - 1. Type 316 stainless steel, internally threaded inserts.
 - 2. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-RN Insert with HIT-RE 500-V3 or HIT-HY 200 adhesive.

ROGER SCOTT POOL FACILITIES

2.03 POST-INSTALLED MASONRY ANCHORS

- A. General: AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown.
- B. Current ICC Evaluation Report indicating acceptance for anchors at structural applications in masonry.
- C. Manufacturers and Products:
 - Hilti, Inc., Tulsa, OK; HIT-HY 270 Safe Set System with Hilti hollow drill bit and vacuum (ESR-4143) for solid grouted masonry, HIT-HY 200 V3 Safe Set System with Hilti hollow drill bit and vacuum (ESR-4878) for solid grouted masonry, HIT-HY 270 Safe Set System with Hilti hollow drill bit and vacuum (ESR-4144) for unreinforced three-wythe brick.
 - Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 (IAPMO ER 240) for grout filled CMU, Titen-HD (ESR-1056) for grout filled or hollow CMU, AT-XP (IAPMO ER-281) for grout filled CMU.
 - 3. DeWalt/Powers Fasteners, Brewster NY; Power-Stud+ SD1 (ESR-2966) for grout-filled masonry, Screw-Bolt+ (ESR-4042) for grout-filled masonry, AC100+ Gold with Dust X+ System for unreinforced threewythe brick (ESR-2966 2582).

PART 3 EXECUTION

3.01 CONCRETE AND MASONRY ANCHORS

- A. Begin installation only after concrete or masonry to receive anchors is a minimum of 21 days old or has attained design strength whichever requires a longer duration.
- B. Locate existing reinforcing with ground penetrating radar or other method approved by the Engineer prior to drilling. Coordinate with the Engineer to adjust anchor locations where installation would result in hitting reinforcing.
- C. Install in accordance with written manufacturer's instructions.
- D. Provide minimum embedment, edge distance, and spacing as indicated on the Drawings.
- E. Use only drill type, bit type, and diameter recommended by anchor manufacturer. Use rotary hammer drill unless otherwise approved by the Engineer. Core drilling may only be used if specifically allowed by the Engineer.

- F. Clean hole of debris and dust per manufacturer's requirements.
- G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify the Engineer for direction on how to proceed.
- H. Adhesive Anchors:
 - 1. Unless otherwise approved by the Engineer and adhesive manufacturer:
 - a. Do not install adhesive anchors when temperature of concrete or masonry is below 40 degrees F or above 100 degrees F.
 - b. Do not install prior to concrete attaining an age of 21 days.
 - c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
 - d. Do not disturb anchor during recommended curing time.
 - e. Do not exceed maximum torque as specified in manufacturer's instructions.
 - 2. For hollow-unit masonry, install screen tube in accordance with manufacturer's instructions.
 - 3. Prestressed Concrete: Do not use drilled-in anchors in prestressed or post-tensioned concrete members without the Engineer's prior approval unless specifically shown on the Drawings.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.03 FASTENER SCHEDULE

A. Unless indicated otherwise on the Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks					
 Post-Installed Anchors for Metal Components to Cast-in-Place Concrete (such as, Ladders, Handrail Posts, Electrical Panels, Platforms, and Equipment) 							
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application					

ROGER SCOTT POOL FACILITIES

Service Use and Location	Product	Remarks					
2. Anchors in Grout-Filled Concrete Masonry Units							
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).						
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel anchors						
3. Anchors in Hollow Concrete Masonry Units							
Interior Dry Areas	r Dry Areas Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment)						
Exterior, Interior Wet, and Corrosive Areas	Stainless steel anchors	Adhesive anchors shall be installed with screen tubes.					
4. All Others							
All service uses and locations	Stainless steel fasteners						

- B. Antiseizing Lubricant: Use on all stainless steel threads.
- C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

SECTION 05 05 23 WELDING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. BPVC SEC V, Nondestructive Examination.
 - b. BPVC SEC IX, Welding and Brazing Qualifications.
 - 2. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
 - 3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
 - 4. American Welding Society (AWS):
 - a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - b. A3.0, Standard Welding Terms and Definitions.
 - c. D1.1/D1.1M, Structural Welding Code—Steel.
 - d. D1.8/D1.8M, Structural Welding Code—Seismic Supplement.
 - e. D1.2/D1.2M, Structural Welding Code—Aluminum.
 - f. D1.3/1.3M, Structural Welding Code—Sheet Steel.
 - g. D1.4/D1.4M, Structural Welding Code—Reinforcing Steel.
 - h. D1.6/D1.6M, Structural Welding Code—Stainless Steel.
 - i. QC1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

- A. CJP: Complete Joint Penetration.
- B. CWI: Certified Welding Inspector.
 - 1. Contractor's Welding Inspector: Contractor's CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes. This type of Quality Control Inspection is not classified as Special Inspection.
 - 2. Verification Inspector: This independent inspection is the prerogative of the Owner, who may employ their own, independent CWI, or waive this supplementary, independent CWI inspection.

ROGER SCOTT POOL FACILITIES

- C. MT: Magnetic Particle Testing.
- D. NDE: Nondestructive Examination.
- E. NDT: Nondestructive Testing.
- F. PJP: Partial Joint Penetration.
- G. PQR: Procedure Qualification Record.
- H. PT: Liquid Penetrant Testing.
- I. RT: Radiographic Testing.
- J. UT: Ultrasonic Testing.
- K. VT: Visual Inspection/Testing.
- L. WPQ: Welder/Welding Operator Performance Qualification Record.
- M. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Shop and field WPSs and PQRs.
 - b. NDT procedure specifications prepared in accordance with ASME BPVC SEC V.
 - c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
 - 1) Show on Shop Drawings, or on a weld map, complete information regarding base metal ASTM specifications, and location, type, size, and length of welds.
 - 2) Identify WPS to be used, and NDE requirements in tail of welding symbol.
 - 3) Clearly distinguish between shop and field welds.
 - 4) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
 - 5) Welding and NDE Symbols shall be in accordance with AWS A2.4. Welding terms and definitions shall comply with AWS A3.0.

- B. Informational Submittals:
 - 1. WPQs.
 - 2. CWI credentials.
 - 3. Testing agency NDE inspector credentials.
 - 4. CWI visual inspection (VT) reports.
 - 5. Welding Documentation: Submit on forms provided in referenced welding codes.

1.04 QUALIFICATIONS

- A. WPSs: In accordance with AWS D1.1/D1.1M (Annex J Forms) for shop or field welding; or ASME BPVC SEC IX (Forms QW-482 and QW-483) for shop welding only.
- B. WPQs: In accordance with AWS D1.1/D1.1M (Annex J Forms); or ASME BPVC SEC IX (Form QW-484).
- C. CWI: Certified in accordance with AWS QC1 and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Engineer.
- D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

- A. Contractor's CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
 - 1. Verify conformance of specified job materials and proper storage.
 - 2. Monitor conformance with approved WPSs.
 - 3. Monitor welder performance and conformance with approved WPQs.
 - 4. Inspect weld joint fit-up and perform in-process inspections.
 - 5. Provide 100 percent visual inspection of completed welds.
 - 6. Coordinate with nondestructive testing personnel and review NDE results.

7. Maintain records and prepare reports documenting results of CWI VT and required NDE complies with the Work and referenced welding codes.

PART 3 EXECUTION

3.01 GENERAL

A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

- A. Quality Control Inspection:
 - 1. All Welds: 100 percent VT by Contractor's CWI.
 - 2. Acceptance Criteria:
 - a. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.
 - b. Stud Connections: AWS D1.1/D1.1M, Paragraph 9.8.1.
- B. Nondestructive Testing Requirements:
 - 1. NDT frequency shall be as specified below, as required by referenced fabrication or welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
 - a. Nontubular Connections:
 - 1) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
 - b. Tubular Connections:
 - 1) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
 - 2. NDT Procedures and Acceptance Criteria:
 - a. Nontubular Connections:
 - 1) RT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part E. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.12.1.
 - UT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part F. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.13.1.
 - 3) PT and MT:
 - a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.

- b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.
- b. Tubular Connections:
 - 1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraph 10.27, and Paragraph 10.28.
 - 2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraph 10.26, and Paragraph 10.29.
 - 3) PT and MT:
 - a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.
 - b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 10.24.

3.03 FIELD QUALITY CONTROL

- A. The Contractor's CWI shall be present whenever field welding is being done and shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
 - 1. Verify conformance of specified job materials and proper storage.
 - 2. Monitor conformance with approved WPS.
 - 3. Monitor welder performance and conformance with approved WPQs.
 - 4. Inspect weld joint fit-up and perform in-process inspection.
 - 5. Provide 100 percent visual inspection of all welds in accordance with Paragraph Quality Control Inspection.
 - 6. Coordinate with nondestructive testing personnel and review test results.
 - 7. Maintain records and prepare reports confirming results of inspection and testing comply with the Work.

3.04 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal have been deposited in accordance with appropriate welding codes.

3.05 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification.
 - 1. Welding and Nondestructive Testing Table.

END OF SECTION

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Welding and Nondestructive Testing									
Specification Section	Governing Welding Codes or Standards	Submit WPS	Submit WPQ	Onsite CWI Required?	Submit Written NDT Procedure Specification s	NDT Requirements			
05 21 19 Open Web Steel Joists Framing	AWS D1.1/D1.1M, Structural Welding Code—Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 21 19			
05 31 00 Steel Decking	AWS D1.1/D1.1M, Structural Welding Code—Steel or AWS D1.3/D1.3M, Structural Welding Code—Sheet Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 31 00			
05 41 00 Structural Metal Stud Framing	AWS D1.1/D1.1M, Structural Welding Code—Steel or AWS D1.3/1.3M, Structural Welding Code—Sheet Steel	No	No	Yes	No	100% VT; also see Section 05 41 00			
05 50 00 Metal Fabrications	AWS D1.1/D1.1M, Structural Welding Code–Steel or AWS D1.2/D1.2M, Structural Welding Code—Aluminum or AWS D1.6/D1.6M, Structural Welding Code—Stainless Steel	Yes	Yes	Yes	No	100% VT; also see Section 05 50 00			

SECTION 05 21 19 OPEN WEB STEEL JOIST FRAMING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Institute of Steel Construction (AISC):
 - a. Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design.
 - b. Allowable Stress Design Specification for Structural Joints using ASTM A325 or A490 Bolts.
 - c. Code of Standard Practice for Steel Buildings and Bridges.
 - 2. American Welding Society (AWS): D1.1, Structural Welding Code Steel.
 - 3. Steel Joist Institute (SJI):
 - a. Standard Specifications and Load Tables:
 - 1) Open-Web Steel Joists, K-Series.
 - Long Span Steel Joists, LH-Series, and Deep Long Span Steel Joists, DLH-Series.
 - 3) Super Longspan Steel Joists, SLH-Series.
 - 4) Joist Girders.
 - b. Recommended Code of Standard Practice for Steel Joists and Joist Girders.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Plan view layout of joists and bridging.
 - 2. Elevation view of each type of joist showing configuration, chord and web member sizes, panel point dimensions, and chord extensions.
 - 3. Connection and bearing details.
 - 4. Special joist reinforcing and connections for supported items, such as monorails and mechanical equipment.
 - 5. Bridging member sizes and connection details.
 - 6. Complete design, including stress and deflection calculations, for joists, joist members, and connections for design load and equipment weight as indicated, plus any construction loads applied by Contractor's operations.
 - 7. Calculations shall include check of joist chord bending stresses for concentrated loads applied between panel points.

- 8. Registered Professional Engineer's stamp, valid in same state as Project, on structural calculations.
- 9. Procedure for handling, erection, and bracing of steel joists.
- B. Informational Submittals:
 - 1. Joist manufacturer's installation requirements.
 - 2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.

1.03 QUALITY ASSURANCE

- A. General: Design and fabricate steel joists and bridging to meet requirements of SJI Standard Specifications and Load Tables.
- B. Certification: SJI Membership, with certification for joist types as indicated on the Drawings.
- C. Qualifications for Field Welding: As specified in Section 05 05 23, Welding.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Protect joist paint system from abrasion at steel bands and other joists.
- C. Store joists and bridging off ground on wood sleepers.
- D. Support joists so there is no danger of tipping, sliding, rolling, shifting or material damage.

PART 2 PRODUCTS

2.01 STEEL JOISTS AND BRIDGING

- A. Provide type of joist, chord configuration, and depth as indicated on the Drawings.
- B. Design and Manufacture:
 - 1. In accordance with the applicable SJI Standard Specifications.
 - 2. Chord Members: Rolled double angle sections only.
 - 3. Provide the following where indicated, in accordance with SJI Standard Specifications and Load Tables:
 - a. Bottom chord bracing and end anchorage for uplift design criteria.

OPEN WEB STEEL JOIST FRAMING 05 21 19 - 2

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- b. Ceiling extension to within 1-inch of finished wall surface, unless otherwise indicated.
- c. Top chord extension, S type, unless otherwise indicated.
- d. Bottom chord extension and stabilizer plates for joist girders.
- e. Full camber, unless otherwise indicated.

C. Joist Bridging:

- 1. In accordance with applicable SJI Standard Specifications for type of joist.
- 2. Furnish bridging of minimum size and type as indicated.
- 3. Provide anchorage connection to walls and girders at bridging lines as indicated.

2.02 SHOP PRIMER

A. Surface Preparation and Primer: As directed by the Architect.

PART 3 EXECUTION

- 3.01 EXAMINATION
 - A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel joists.

3.02 INSTALLATION

- A. Erection: SJI Standard Specifications and approved Shop Drawings.
- B. Welded Connections: As specified in Section 05 05 23, Welding.

3.03 TOUCHUP PAINTING

- A. Immediately following erection, remove debris from completed installation.
- B. Clean field welds, bolted connections, rust spots, and abraded areas.
- C. Repair damaged painted and galvanized surfaces as specified in accordance with Manufacturer specifications and as directed by the Architect.

3.04 FIELD QUALITY CONTROL

- A. Welding:
 - 1. Visually inspect field welds in accordance with AWS D1.1, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.

2. Repair defective welds as specified in Section 05 05 23, Welding.

END OF SECTION

OPEN WEB STEEL JOIST FRAMING 05 21 19 - 4

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SECTION 05 31 00 STEEL DECKING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Iron and Steel Institute (AISI): Specifications for the Design of Cold Formed Steel Structural Members.
 - 2. American Welding Society (AWS): D1.3, Structural Welding Code Sheet Steel.
 - 3. ASTM International (ASTM):
 - a. A611, Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled.
 - b. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - c. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - d. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 4. Steel Deck Institute (SDI):
 - a. Design Manual for Composite Decks, Form Decks and Roof Decks.
 - b. Diaphragm Design Manual.
 - 5. Factory Mutual (FM):
 - a. Factory Mutual Approval Guide.
 - b. FM Research Corporation (FMRC): Approval Requirements for Steel Roof Deck Construction.
 - 6. International Code Council Evaluation Service, Inc. (ICC-ES): Evaluation Reports for Deck Fasteners.
 - 7. UL: Fire Resistance Directory.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Plan view layout of decking showing type and section properties of deck panels, reinforcing channels, pans, special jointing, and accessories.
 - 2. Location of openings, deck laps, and deck attachment details.

ROGER SCOTT POOL FACILITIES

- B. Informational Submittals:
 - 1. Decking manufacturer's installation requirements.
 - 2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.
 - 3. Operation manuals for mechanical fastener installation tools.
 - 4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.03 QUALITY ASSURANCE

- A. General: For metal decking section properties, meet requirements of AISI Specifications for Design of Cold-Formed Steel Structural Members.
- B. Qualifications for Field Welding: As specified in Section 05 05 23, Welding.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
 - B. Store deck bundles on platforms or pallets, with one end elevated to provide drainage.
 - C. Protect bundles against condensation with a ventilated waterproof covering.
 - D. Stack bundles so there is no danger of tipping, sliding, rolling, shifting or material damage.

PART 2 PRODUCTS

- 2.01 METAL DECKING
 - A. Provide metal deck as shown in the Drawings:
 - B. Materials and Finishes:
 - 1. Galvanized Deck:
 - a. Sheet steel for galvanized deck and accessories shall conform to ASTM A653 Structural Quality Grade 33 or higher, as shown in Steel Deck Schedule.
 - b. Galvanizing shall conform to ASTM A924 with coating class of G60 or G90 as defined in ASTM A653 and as shown in Steel Deck Schedule.

- C. Manufacturers:
 - 1. Vulcraft Division of Nucor Co., Brigham City, UT.
 - 2. BHP Steel Building Products, USA, Inc., West Sacramento, CA.
 - 3. Verco Manufacturing, Inc., Phoenix, AZ.
 - 4. United Steel Deck, Inc., Summit, NJ.

2.02 ACCESSORIES

- A. Provide pour stops, column closures, end closures, cover plates, girder fillers, ridge and valley plates, finish strips, reinforcing channels, and other accessories as required for complete installation.
- B. Accessories shall be minimum 22-gauge, except edge forms shall be sized as required by the deck manufacturer, unless shown otherwise on the Drawings.

2.03 MECHANICAL FASTENERS

- A. Self-Drilling Screws:
 - 1. Self-drilling, self-tapping screws with hexagonal washer head and corrosion-resistant finish.
 - 2. Manufacturers and Products:
 - a. ITW Buildex, Itasca, IL; ICH Traxx Self-Drilling Fasteners with Climaseal Coating and Autotraxx Standup Installation Tool.
 - b. Hilti, Inc., Tulsa, OK; Kwik-Pro HWH Self-Drilling Screws with Kwik-Cote Treatment and Kwik-Tapper Screwdriver.
- B. Powder Driven Fasteners:
 - 1. Knurled shank, minimum 1/2-inch diameter steel washer, corrosion-resistant coating.
 - 2. Pin diameter and length to suit deck type and flange thickness of steel support member.
 - 3. Manufacturers and Products:
 - a. ITW Buildex, Itasca, IL; Buildex BX14 pins with yellow dichromate galvanizing and BX900 Installation Tool.
 - b. Hilti, Inc., Tulsa, OK; ENP-series fasteners with electroplated zinc coating and DX-750 Installation Tool.

ROGER SCOTT POOL FACILITIES

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.02 INSTALLATION

- A. Locate deck bundles to prevent overloading of support framing members.
- B. Install at right angles to supporting members in a three span minimum lay-up, unless shown otherwise, and in accordance with Specification and manufacturer's installation recommendation.
- C. Bearing: 1-1/2 inches, minimum.
- D. Endlaps: Minimum of 2 inches and located over supports.
- E. Do not stretch sidelaps.
- F. Closure Plates:
 - 1. Install closure and cover plate accessories as recommended by the metal deck manufacturer, unless shown otherwise on the Drawings.
 - 2. Floor Deck and Form Deck Closures:
 - a. Fasten column closures, cell closures, and zee closures to deck to provide tight fitting closures at open ends of ribs and sides of decking.
 - b. Fasten cell closures at changes of direction of deck units unless otherwise indicated.
- G. Holes and Openings
 - 1. Cut and fit around roof openings and other work projecting through or adjacent to decking.
 - 2. Locate holes and openings as shown to clear structural framing and bracing members.
 - 3. Reinforcement around openings:
 - a. Roof Deck: For hole sizes of at least 6 inches across, but not more than 12 inches across in roof deck, reinforce with 0.0474-inch design thickness steel plate, painted or galvanized to match deck coating. Extend plate at least 12 inches beyond opening in all directions and attach to top of roof deck with No. 10 self-drilling screws at 6-inch spacing and at all corners. For openings larger than 12 inches across, reinforce roof deck with framing as shown on the Drawings.

- b. Composite Floor Deck and Form Deck: Reinforce openings as indicated on the Drawings.
- H. Protect deck areas from heavy concentrated loads or wheel traffic with planking or other approved means.
- I. Install temporary shoring, if required, to meet strength and deflection limitations, before placing any concrete topping on deck panels.
- J. Completed Deck: Free from buckles and irregularities, and in accordance with FM and UL requirements.

3.03 DECK ATTACHMENT

- A. Fasten panels as shown on the Drawings.
- B. Welded Connections: Weld deck sidelaps, attachment to framing, and accessories in accordance with AWS D1.3 and as specified in Section 05 05 23, Welding.
- C. Mechanical Fasteners:
 - 1. Self-Drilling Screws:
 - a. Install screws in accordance with manufacturer's written instructions and with special installation tool. Do not over-torque.
 - b. Remove and redrive screws at sidelaps where upper sheet is not drawn tightly against lower sheet.
 - 2. Powder Driven Fasteners:
 - a. Install fasteners in accordance with manufacturer's written instructions and with special installation tool.
 - b. Minimum Sidelap Edge Distance: 3/8-inch.
 - c. Minimum End/End Lap Distance: 1-inch.
 - d. Head Projection: As specified by manufacturer for correct penetration into flange of steel support member.

3.04 TOUCHUP PAINTING

- A. Immediately following erection, remove unused deck edge trimmings, screws, fasteners, welding washers, butt ends of welding rods, and debris from completed installation.
- B. Clean field welds, bolted connections, rust spots, and abraded areas.
- C. Repair damaged painted surfaces in accordance with Manufacturer specifications.

- D. Repair damaged galvanized surfaces with zinc-rich spray paint in accordance with ASTM A780; color to match galvanized deck.
- E. Use magnetic gauge to determine that thickness of repair is equal to or greater than base painted or galvanized coating.

3.05 FIELD QUALITY CONTROL

- A. An independent testing agency shall be retained by Contractor and approved by Engineer to perform following inspections.
 - 1. Welded Connections: Visually inspect in accordance with AWS D1.3, Section 7, and as specified in Section 05 05 23, Welding.
 - 2. Mechanical Fasteners: Visually inspect, in accordance with manufacturer's instructions, for each type of fastener.
- B. Repair or replace defective welds and fasteners.

END OF SECTION

SECTION 05 41 00 STRUCTURAL METAL STUD FRAMING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Iron and Steel Institute (AISI):
 - a. Specification for the Design of Cold-Formed Steel Structural Members.
 - b. Cold-Formed Steel Design Manual.
 - c. Design Guide for Cold-Formed Steel Trusses.
 - d. Fasteners for Residential Steel Framing.
 - 2. American Welding Society, Inc. (AWS):
 - a. C1.1, Recommended Practices for Resistance Welding.
 - b. C1.3, Recommended Practices for Resistance Welding Coated Low Carbon Steels.
 - c. D1.3, Structural Welding Code-Sheet Steel.
 - 3. ASTM International (ASTM):
 - a. A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
 - b. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Structural Tubing in Rounds and Shapes.
 - c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - d. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - e. C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - f. C955, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
 - 4. Center for Cold-Formed Steel Structures (CCFSS): Technical Bulletin, Vol. 2, No. 1, February 1993, Screw Connections.
 - 5. International Code Council (ICC): Evaluation Reports for Cold-Formed Steel Framing and Fasteners.

ROGER SCOTT POOL FACILITIES

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Plan and elevation views of all metal framing systems, including location and framing of all openings.
 - 2. Material specifications, member sizes, and properties.
 - 3. Details of track, web stiffeners, stud bracing, blocking, bridging, and other members as required to provide a complete installation.
 - 4. Details of connections including welding, mechanical fasteners, and accessory items.
 - 5. Installation and erection instructions, including sequence of operations and requirements for temporary bracing and bridging.
- B. Informational Submittals:
 - 1. Manufacturer's installation requirements.
 - 2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.
 - 3. Operation manuals for mechanical fastener installation tools.

1.03 QUALITY ASSURANCE

- A. General: For member section properties, meet requirements of AISI, Specification for the Design of Cold-Formed Steel Structural Members.
- B. Qualifications for Welding: As specified in Section 05 05 23, Welding.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver to Site in bundles marked with name of manufacturer, section type, thickness, grade of material, and length.
 - B. Store bundles on wood blocking, flat and off ground, to keep clean and to prevent any damage or permanent distortion.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Provide size and type of members as indicated on the Drawings.
 - B. Sheet Steel: ASTM A653/A653M, with G-60 galvanized coating.
 - C. Cold-Formed Members and Accessories: ASTM C955.

D. Dimensions and Properties: Calculate section properties in accordance with AISI Cold-Formed Steel Design Manual.

2.02 STUDS AND JOISTS

- A. Material:
 - 1. ASTM A653/A653M, Structural Steel (SS) Grade 33, or High-Strength Low-Alloy Steel (HSLAS), Type A or B, Grade 50.
 - 2. Section: Type, size, and thickness as indicated on the Drawings.
 - 3. Flanges: Stiffened with return lip.
 - 4. Webs:
 - a. Studs: Punched.
 - b. Joists: Unpunched, unless indicated otherwise on the Drawings.
- B. Accessories:
 - 1. Track: Size as required to fit over studs, same thickness as stud material, unpunched.
 - 2. Blocking, Bridging, and Fire Stops: Same depth as studs or joists, 0.0566-inch minimum design thickness, unpunched.
 - 3. Bracing Straps, Angle Bracing, Clip Angles: Size and thickness as indicated on the Drawings.
 - 4. Mounting Plates: 0.0566-inch minimum design thickness by 8 inches by 18 inches.
 - 5. Accessories shall be from same manufacturer as studs and joists.
- C. Manufacturers and Products:
 - 1. AMS, Los Angeles, CA; Angeles Metal Systems.
 - 2. Clark Steel, Middleton, OH; Steel Framing Systems.
 - 3. Dale Industries; Dearborn, MI; Dale/Incor Steel Framing.
 - 4. Dietrich Industries, Pittsburgh, PA; Lightgauge Metal Framing Products.
 - 5. Knorr Steel Framing Systems, Salem, OR; Light Gauge Steel Framing.
 - 6. Marino/Ware, South Plainfield, NJ; Stud-Rite Lightweight Steel Framing Systems.
 - 7. Unimast Incorporated, Schiller Park, IL; Steel Framing Systems.

2.03 MECHANICAL FASTENERS

- A. Self-Drilling Screws:
 - 1. Self-drilling, self-tapping screws with hexagonal washer head and corrosion-resistant finish.

- 2. Manufacturers and Products:
 - a. ITW Buildex, Itasca, IL; ICH Traxx Self-Drilling Fasteners with Climaseal Coating and Autotraxx Standup Installation Tool.
 - b. Hilti, Inc., Tulsa, OK; Kwik-Pro HWH Self-Drilling Screws with Kwik-Cote Treatment and Kwik-Tapper Screwdriver.
- B. Powder-Driven Fasteners:
 - 1. Knurled shank, minimum 1/2-inch diameter steel washer, corrosion-resistant coating.
 - 2. Pin diameter and length to suit deck type and flange thickness of steel support member.
 - 3. Manufacturers and Products:
 - a. ITW Buildex, Itasca, IL; Buildex BX14 pins with yellow dichromate galvanizing and BX900 Installation Tool.
 - b. Hilti, Inc., Tulsa, OK; ENP-series fasteners with electroplated zinc coating and DX-750 Installation Tool.

2.04 CONCRETE ANCHORS

A. Drilled anchors, size and type as shown on the Drawings and as specified in Section 05 50 00, Metal Fabrications.

2.05 PREFABRICATION

- A. Structural wall framing panels may be prefabricated prior to erection.
- B. Prefabricated assemblies shall be not more than 1/8-inch out of square within length of assembly and shall be braced against racking. Use jig templates for layout and fabrication.
- C. Protect prefabricated panels from damage during handling.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect all prefabricated assemblies and repair any damage.
- B. Examine bearing support surfaces for compliance with requirements for installation tolerances and other conditions affecting performance of metal framing systems.
- C. Provide smooth level bearing surfaces for bottom track of load-bearing walls.
- D. Clean all member and bearing surfaces that will be in contact after assembly.

3.02 INSTALLATION

- A. General:
 - 1. Install framing systems as indicated on the Drawings, complete and in accordance with manufacturer's recommendations.
 - 2. Provide temporary bracing for support of all construction loads until framing system is installed complete with sheathing or decking.
 - 3. Install framing in true line, plumb, level, and in proper alignment.
 - 4. Cut ends of framing members with saw or shear to bear uniformly against abutting members. Flame cutting is not permitted.
 - 5. All structural framing members shall be full-length without splices, unless indicated otherwise.
 - 6. Fasten members together in accordance with AISI, Cold-Formed Steel Design Manual, Part IV, Connections. Wire tying is not permitted.
- B. Stud Bearing Walls:
 - 1. Secure bottom track to floor slab with concrete anchors as indicated on the Drawings.
 - 2. Seat studs squarely and firmly within track before securing with fasteners. Gap between end of stud and track shall be less than 1/16-inch.
 - 3. Install studs with spacing as shown and not more than 2 inches from abutting walls.
 - 4. Provide double studs at jambs of openings wider than stud spacing.
 - 5. Provide triple studs at corners and at jambs of openings wider than 48 inches, unless indicated otherwise.
 - 6. Track shall be continuous. Center splices between studs and splice with stud section full length between studs.
 - 7. Frame wall penetrations for pipes and ducts larger than stud spacing to avoid cutting structural members.
 - 8. Fire stop stud walls and partitions with unpunched blocking full width of stud at midpoint or where required for nailers, in conformance with applicable building code.
 - 9. Provide blocking for support of mechanical items.
 - 10. Do not remove the web knockouts within 10 inches of either end of load-bearing studs.
 - 11. Provide bracing straps with gusset plates and anchor holddown assemblies where indicated on the Drawings.
 - 12. Tolerances:
 - a. Stud Plumbness: 1/8-inch in 10 feet.
 - b. Stud Spacing: Plus or minus 1/8-inch.
- С. Joists:
 - Position joists directly over bearing studs and attach to track. 1.
 - Joists shall be one-piece within a single span. For multiple spans, lap 2. joists and splice as shown on the Drawings.
 - Immediately install bridging and solid blocking to support joists. 3. Maximum spacing of bridging shall be 5 feet.
 - Install web stiffeners where indicated 4.
 - 5. Web Penetrations:
 - Drilled holes for other trades shall be limited to the middle 1/3 of a. the joist depth within the middle 1/3 of the span, unless indicated otherwise. Minimum spacing between drilled holes shall be 1-1/2 times the joist depth. Notching of joist flanges and flame cutting of holes are not permitted.
 - 6. Tolerances:
 - Joist Spacing: Plus or minus 1/8-inch. a.
 - Joist Levelness: Plus or minus 1/8-inch in 10 feet. b.

3.03 **FASTENERS**

- Self-Drilling Screws: A.
 - 1. Install in accordance with manufacturer's written instructions and with special installation tool.
 - Screw type, diameter, and length shall be in accordance with AISI, 2. Fasteners for Residential Steel Framing, minimum two screws per connection unless indicated otherwise.
 - 3. Use clamp to hold members together. Drive screw from lighter to heavier gauge, to allow plies to be pulled together without stripping metal. Do not over torque. A minimum of three exposed threads shall extend through steel.
 - Minimum screw spacing, end distance, and edge distance shall be 4. 3 diameters.
- Β. **Powder-Driven Fasteners:**
 - 1. Use only for connecting cold-formed steel to structural steel members, unless indicated otherwise.
 - Install in accordance with manufacturer's written instructions and with 2. special installation tool.
- C. Welded Connections:
 - 1. Welding shall not be used for material thinner than 0.0451-inch.
 - Weld framing members and accessories in accordance with AWS D1.3. 2.

- 3. Resistance welding for prefabricated framing shall be in accordance with AWS C1.1 and AWS C1.3.
- 4. Repair galvanized surfaces damaged by welding with zinc-rich spray paint in accordance with ASTM A780.
- D. Concrete Anchors: Install in accordance with Section 05 50 00, Metal Fabrications.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency shall be retained by Contractor and approved by Engineer to perform following inspections.
 - 1. Welded Connections: Visually inspect in accordance with AWS D1.3, Section 7, and as specified in Section 05 05 23, Welding.
 - 2. Mechanical Fasteners: Visually inspect, in accordance with manufacturer's instructions, for each type of fastener.
- B. Repair or replace defective welds and fasteners.

END OF SECTION

SECTION 05 50 00 METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
 - 2. American Galvanizers Association (AGA):
 - a. Inspection of Hot-Dip Galvanized Steel Products.
 - b. Quality Assurance Manual.
 - 3. American Iron and Steel Institute (AISI): Stainless Steel Types.
 - 4. American Ladder Institute (ALI): A14.3, Ladders Fixed Safety Requirements.
 - 5. American National Standards Institute (ANSI).
 - 6. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
 - 7. American Welding Society (AWS):
 - a. D1.1/D1.1M, Structural Welding Code Steel.
 - b. D1.2/D1.2M, Structural Welding Code Aluminum.
 - c. D1.6/D1.6M, Structural Welding Code Stainless Steel.
 - 8. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A48/A48M, Specification for Gray Iron Castings.
 - c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - d. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - e. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - f. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

- j. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- k. A276, Standard Specification for Stainless Steel Bars and Shapes.
- 1. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- m. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
- o. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
- p. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- q. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- r. A489, Standard Specification for Carbon Steel Lifting Eyes.
- s. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- t. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- u. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- v. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- w. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- x. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
- y. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
- z. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
- aa. A992/A992M, Standard Specification for Structural Steel Shapes.
- bb. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
- cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- dd. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- ee. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

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- ff. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
- gg. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- hh. D1056, Standard Specification for Flexible Cellular Materials -Sponge or Expanded Rubber.
- ii. F436, Standard Specification for Hardened Steel Washers.
- jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
- kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- 11. F594, Standard Specification for Stainless Steel Nuts.
- mm. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
- nn. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 9. NSF International (NSF): 61, Drinking Water System Components— Health Effects.
- 10. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.27, Fixed Ladders.
 - b. 29 CFR 1926.105, Safety Nets.
 - c. 29 CFR 1926.502, Fall Protection Systems Criteria and Practices.
- 11. Specialty Steel Industry of North America (SSINA):
 - a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.
- B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- C. Exterior Area: Location not protected from weather by building or other enclosed structure.
- D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

- E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Metal fabrications, including welding and fastener information.
 - 2. Samples: Color samples of abrasive stair nosings.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.
- B. Package stainless steel items to provide protection from carbon impregnation.
- C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.
- D. Store fabricated items in dry area, not in direct contact with ground.

PART 2 PRODUCTS

2.01 GENERAL

A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

Item	ASTM Reference
Steel Wide Flange Shapes	A992/992M
Other Steel Shapes and Plates	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Steel Pipe	A500, Grade B
Hollow Structural Sections (HSS)	A500/A500M, Grade C
Aluminum:	
Aluminum Plates	B209, Alloy y6061-T6
Aluminum Structural Shapes	B308/B308M, Alloy 6061-T6
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (316L for welded connections)
Shapes	A276, AISI Type 304 (304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections)
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Group 2, Condition SH
Nuts	F594, AISI Type 316, Condition CW
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	A325, Type 1 bolts, with A563 nuts

B. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Anchor Bolts and Rods	F1554, Grade A: 36, with weldability supplement S1.
Eyebolts	A489
Threaded Rods	A36/A36M
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Thrust Ties for Steel Pipe:	
Threaded Rods	A193/A193M, Grade B7
Nuts	A194/A194M, Grade 2H
Plate	A283/A283M, Grade D
Welded Anchor Studs	A108, Grades C-1010 through C-1020
Aluminum Bolts and Nuts	F468, Alloy 2024-T4
Cast Iron	A48/A48M, Class 35

C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zincplated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

- A. Cast-In-Place Anchor Bolts:
 - 1. Headed type, unless otherwise shown on the Drawings.
 - 2. Material type and protective coating as shown in Fastener Schedule at end of this section.
- B. Anchor Bolt Sleeves:
 - 1. Plastic:
 - a. Single unit construction with corrugated sleeve.
 - b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
 - c. Material: High-density polyethylene.
 - 2. Fabricated Steel: ASTM A36/A36M.

2.03 POST-INSTALLED CONCRETE AND MASONRY ANCHORS

A. See Section 05 05 19, Post-Installed Anchors.

2.04 STUD SHEAR CONNECTORS

- A. Headed anchor studs (HAS), or threaded anchor studs (TAS), or stud shear connectors, as indicated on the Drawings.
 - Carbon Steel: ASTM A108, Standard Quality Grades 1010 through 1020, inclusive either semikilled or killed aluminum or silicon dioxidation, unless indicated otherwise.
 - 2. Stainless Steel: ASTM F593, AISI Type 316, Condition CW, where indicated.
- B. Manufacturers:
 - 1. Nelson Stud Welding, FabriSteel Co., Elyria, OH.
 - 2. Stud Welding Associates, Inc., Elyria, OH.

2.05 ABRASIVE NOSING FOR STAIRS

- A. Unless otherwise shown on the Drawings, furnish flush type abrasive nosings on stairs.
- B. Nosing Components:
 - 1. Homogeneous epoxy abrasive, with minimum 50 percent aluminum oxide content, formed and cured upon an extruded aluminum base.
 - 2. Epoxy abrasive shall extend over and form curved front edge of nosing.
 - 3. Base of Nosing: Extruded aluminum alloy, 6063-T5, heat-treated.
- C. Anchoring System: Double-set anchors consisting of two rows of integrally extruded anchors.
- D. Size: 3 inches wide by 1/4-inch to 3/8-inch thick by length as shown.
- E. Color: Selected by Engineer from manufacturer's standard color range.
- F. Manufacturers and Products:
 - 1. Wooster Products, Inc., Wooster, OH.
 - 2. American Safety Tread Co., Inc., Helena, AL.

ROGER SCOTT POOL FACILITIES

2.06 FABRICATION

A. General:

- 1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
- 2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
- 3. Conceal fastenings where practical; where exposed, flush countersink.
- 4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
- 5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
- 6. Fit and assemble in largest practical sections for delivery to Site.
- B. Materials:
 - 1. Use steel shapes, unless otherwise noted.
 - 2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
 - 3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures–Allowable Stress Design.
- C. Welding:
 - 1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
 - 2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
 - 3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
 - 4. Aluminum: Meet requirements of AWS D1.2/D1.2M.
 - 5. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
 - 6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer's instructions.
 - 7. Complete welding before applying finish.
- D. Painting:
 - 1. Shop prime with rust-inhibitive primer, unless otherwise indicated.
 - 2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

- E. Galvanizing:
 - Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
 - 2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
 - 3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
 - 4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
 - 5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
 - 6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
 - 7. Galvanized steel sheets in accordance with ASTM A653/A653M.
 - 8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.
- F. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.
- G. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.07 SOURCE QUALITY CONTROL

- A. Visually inspect all fabrication welds and correct deficiencies.
 - 1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
 - 2. Aluminum: AWS D1.2/D1.2M.
 - 3. Stainless Steel: AWS D1.6/D1.6M.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

- A. General:
 - 1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.

ROGER SCOTT POOL FACILITIES

- 2. Install rigid, substantial, and neat in appearance.
- 3. Install manufactured products in accordance with manufacturer's recommendations.
- 4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.
- B. Aluminum:
 - 1. Do not remove mill markings from concealed surfaces.
 - 2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
 - 3. Fabrication, mechanical connections, and welded construction shall be in accordance with the AA Aluminum Design Manual.
- C. Pipe Sleeves:
 - 1. Provide where pipes pass through concrete or masonry.
 - 2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
 - 3. Provide center flange for water stoppage on sleeves in exterior or waterbearing walls.
 - 4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.
- D. Steel Lintels and Shelf Angles: Provide as required for support of masonry and other construction not attached to structural steel framing, unless otherwise shown on the Drawings.

3.02 CAST-IN-PLACE ANCHOR BOLTS

- A. Locate and hold anchor bolts in place with templates at time concrete is placed.
- B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.
- C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.03 ABRASIVE NOSINGS

A. Provide abrasive nosings on concrete steps not being supplied or coated with another type of nosing or nonskid material.

3.04 PAINTING

- A. Repair of Damaged Hot-Dip Galvanized Coating:
 - 1. Conform to ASTM A780/A780M.
 - 2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
 - 3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
 - 4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

3.05 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor-Furnished Quality Control:
 - 1. Inspection and testing required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 05 52 16 ALUMINUM RAILINGS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Aluminum Association, Incorporated (AA): DAF45, Designation System for Aluminum Finishes.
 - 2. American Concrete Institute (ACI) 318, Building Code Requirements for Structural Concrete.
 - 3. American Iron and Steel Institute (AISI).
 - 4. ASTM International (ASTM):
 - a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - b. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - c. E894, Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
 - d. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
 - e. E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
 - 5. International Code Council (ICC): International Building Code (IBC).
 - 6. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.02 DEFINITIONS

- A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.
- B. Railings: This term includes guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

- C. Special Inspection: As defined by the FBC (FLORIDA BUILDING CODE), 2023.
- D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.03 DESIGN REQUIREMENTS

- A. Structural Performance of Railing Systems: Design, test, fabricate, and install railings to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in railing system components.
 - 1. Railing System: Capable of withstanding the following load cases applied:
 - a. Concentrated load of 200 pounds applied at any point and in any direction in accordance with FBC and OSHA.
 - b. Uniform load of 50 pounds per linear foot applied in any direction in accordance with FBC.
 - c. Concentrated load need not be assumed to act concurrently with uniform loads in accordance with FBC.
 - 2. In-Fill Area of Railing Systems:
 - a. Capable of withstanding a horizontally applied normal load of 50 pounds applied to 1 square foot at any point in system including panels, intermediate rails, balusters, and openings and space between railings.
 - b. Horizontal concentrated load need not be assumed to act concurrently with loads on top rails of railings.
 - 3. Calculated lateral deflection at top of posts shall not exceed 1-inch.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
 - 2. Samples:
 - a. Rail sections, 6 inches long showing each type of proposed connection, proposed finish, and workmanship.
 - b. Each fitting including wall brackets, castings, toeboard, and rail expansion joints.

- B. Informational Submittals:
 - 1. Manufacturer's assembly and installation instructions.
 - 2. Special Inspection: Manufacturer's instructions for Special Inspection of post-installed anchors.
 - 3. Design Data: Calculations or test data using specified design performance loads and including the following:
 - a. Bending stress in, and deflection of, posts in accordance with ASTM E985 as modified herein.
 - b. Design of post base connection.
 - c. Manufacturer's literature and catalog data of railing and components.
 - 1) Documentation that concrete anchors have been designed in accordance with one of the following:
 - a) ACI 318.
 - b) ICC Evaluation Services Report for selected anchor.
 - 4. Test Reports: Test data may supplement load calculations providing data covers complete railing system, including anchorage:
 - a. Test data for railing and components showing load and deflection as a result of load, in enough detail to prove railing is strong enough and satisfies national, state, local standards, regulations, code requirements, and OSHA 29 CFR 1910, using design loads specified. Include test data for the following:
 - 1) Railing and post connections.
 - 2) Railing wall connections.
 - 3) Railing expansion joint connections.
 - 4) Railing system gate assembly, including latch, gate stop, and hinges. Both gate latch and stop to support required loads applied independent of each other.
 - 5) Railing picket panel clamps and connections.
 - b. Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with FBC.
 - c. Deflection Criteria: In accordance with ASTM E985 and design loads specified, except as follows: maximum calculated lateral deflection at top of posts shall not exceed 1-inch.
 - d. Aluminum Rail Piping: Test data showing yield strength of pipe as delivered equals or exceeds specified values.
 - 5. Manufacturer's written recommendations describing procedures for maintaining railings including cleaning materials, application methods, and precautions to be taken in use of cleaning materials.

1.05 QUALITY ASSURANCE

A. Qualifications: Calculations required for design data shall be stamped by a registered civil or structural engineer licensed in state where Project will be constructed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package and wrap railings to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.
- B. Delivery:
 - 1. Shop assemble into practical modules of lengths not exceeding 24 feet for shipment.
 - 2. Deliver toeboards loose for field assembly.
 - 3. Deliver clear anodized railing pipe and posts with protective plastic wrap.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Thermal Movements: Allow for thermal movement resulting from the following maximum range in ambient temperature in design, fabrication, and installation of railings to prevent buckling, opening up of joints, over stressing of components, connections and other detrimental effects. Base design calculation on actual surface temperature of material as a result of both solar heat gain and night time sky heat loss. Temperature change is difference between high or low temperature and installation temperature.
 - 1. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

PART 2 PRODUCTS

2.01 ALUMINUM RAILINGS

- A. General:
 - 1. Furnish pre-engineered and prefabricated railing systems as shown on the Drawings.
 - 2. Railing systems using pop rivets or glued railing construction are not permitted.
 - 3. Sand cast accessories and components are not permitted.
 - 4. Fasteners shall be AISI Type 316 stainless steel, unless otherwise noted.

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- B. Rails, Posts, and Formed Elbows:
 - 1. Extruded Alloy 6105-T5, 6061-T6, or equivalent.
 - 2. Tensile Strength: 38,000 psi, minimum.
 - 3. Yield Strength: 35,000 psi, minimum.
 - 4. Wall Thickness: 0.145-inch, minimum.
 - 5. Posts and railings shall be nominal 1-1/2-inch diameter (1.90-inch outside diameter).
- C. Accessories:
 - 1. Fittings and Accessories:
 - a. Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements.
 - b. Gauge metal components are not acceptable for load-resisting components.
 - c. Fittings shall match color of pipe in railings.
 - 2. Miscellaneous Extruded Aluminum Parts: Alloys 6063-T6, 6061-T6, or 6105 T5 aluminum, or equivalent, and of adequate strength for all loads.
 - 3. Castings for Railings:
 - a. Cast Al-mag with sufficient strength to meet load and test requirements.
 - b. Anodizable grade finish with excellent resistance to corrosion when subjected to exposure of sodium chloride solution intermittent spray and immersion.
 - 4. Post Anchorages:
 - a. Refer to standard details for types of post anchorages and minimum requirements.
 - b. Bolts at anchorages shall be minimum 1/2-inch diameter.
 - 5. Wall Brackets: Adjustable wall fitting, with provision for minimum three 3/8-inch diameter AISI Type 316 stainless steel bolts or concrete anchors.
 - 6. Rail Terminals (including Wall Returns): Aluminum wall fitting with provision for three 3/8-inch Type 304 fasteners.
 - 7. Railing System Gate:
 - a. Extruded aluminum rail components.
 - b. Hardware Manufacturers and Products:
 - 1) Julius Blum & Co., Inc., Carlstadt, NJ; No. 782/3 gate hinges with springs, and No. 784 gate latch and stop.
 - CraneVeyor Corp., South El Monte, CA; No. C4370b gate hinges with spring, No. C4369 gate latch, and No. C4368 gate stop.
 - Moultrie Manufacturing Co., Moultrie, GA; Part No. W60006.

- 8. Railing Picket Panels and Clamps:
 - a. 1/2-inch Schedule 40 aluminum pipe (picket).
 - b. Extruded aluminum 1-1/2-inch by 7/8-inch by 1/8-inch channel.
 - c. Furnish neoprene plug for each end of picket.
 - d. Fasteners: Stainless steel.
- 9. Toeboards:
 - a. Molded or extruded Alloy 6063-T6 or 6061-T6 aluminum.
 - b. Provide slotted holes for expansion and contraction where required.
- 10. Fasteners: Stainless steel.
- D. Metal Supports Embedded in Concrete: In accordance with Section 05 50 00, Metal Fabrications.
- E. Finishes:
 - 1. Pipe and Post: In accordance with AA DAF45, designation AA-M32-C22-A41.
 - 2. Cast Fittings and Toeboards: In accordance with AA DAF45, designation AA-M10-C22-A41.

2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

- A. Locknuts, Washers, and Screws:
 - 1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): AISI Type 316 stainless steel.
 - 2. Flat Washers: Molded nylon.
- B. Bolts and Nuts for Bolting Railing to Metal Beams: ASTM A193/A193M and ASTM A194/A194M, Type 316 stainless steel.
- C. Concrete Anchors:
 - 1. Stainless steel, AISI Type 316.
 - 2. Post-installed anchors in accordance with Section 05 50 00, Metal Fabrications, unless otherwise specified herein.
 - 3. Bolt Diameter: 1/2-inch, minimum.

2.03 FABRICATION

- A. Shop Assembly:
 - 1. Post Spacing: Maximum 6-foot horizontal spacing.
 - 2. Railing Posts Bolted to Metal or Concrete:
 - a. In lieu of field cutting, provide approved fitting with sufficient post overlap, containing provisions for vertical adjustment.
 - b. Field fit-up is required.
 - 3. Free of burrs, nicks, and sharp edges when fabrication is complete.
 - 4. Welding is not permitted.
- B. Shop/Factory Finishing:
 - 1. Use same alloy for uniform appearance throughout fabrication for railings.
 - 2. Railing and Post Fittings: Match fittings with color of pipe in railing.
- C. Shop Assembly:
 - 1. Shop assemble rails, posts, and formed elbows with a close tolerance for tight fit.
 - 2. Fit dowels tightly inside posts.
- D. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Field fabrication of aluminum railing systems is not permitted.
 - B. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.
 - C. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.
 - D. Modification to supporting structure is not permitted where railing is to be attached.

- E. Mount railings only on completed walls. Do not support railings temporarily by means not satisfying structural performance requirements.
- F. Protection from Entrapped Water:
 - 1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
 - 2. For posts mounted in concrete, bends, and elbows occurring at low points, drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.02 RAILING INSTALLATION

- A. Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.
- B. Expansion Joints:
 - 1. Maximum intervals of 54 feet on center and at structural joints.
 - 2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
 - 3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
 - 4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.
- C. Posts and Rails:
 - 1. Surface Mounted Posts:
 - a. Bolt post baseplate connectors firmly in place.
 - b. Shims, wedges, grout, and similar devices for railing post alignment not permitted.
 - 2. Set posts plumb and aligned to within 1/8-inch in 12 feet.
 - 3. Set rails horizontal or parallel to slope of steps to within 1/8-inch in 12 feet.
 - 4. Install posts and rails in same plane.
 - 5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
 - 6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
 - 7. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

- D. Wall Brackets: Support wall rails on brackets spaced maximum 5 feet on centers as measured on the horizontal projection.
- E. Toeboard:
 - 1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or at stairways unless shown otherwise.
 - 2. Accurately measure in field for correct length; after railing post installation cut and secure to posts.
 - 3. Dimension between bottom of toeboard and walking surface not to exceed 1/4-inch.
 - 4. Install plumb and aligned to within 1/8-inch in 12 feet.
- F. Railing System Gate: Install in accordance with manufacturer's installation instructions.

3.03 FIELD FINISHING

A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces.

3.04 FIELD QUALITY CONTROL

- A. Post-installed anchors supporting railing systems require special inspection.
- B. Owner-Furnished Quality Assurance, in accordance with ICC IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on the Drawings. Contractor responsibilities and related information are included in the Drawings.
- C. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.05 CLEANING

- A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.
- B. Do not use acid solution, steel wool, or other harsh abrasive.
- C. If stain remains after washing, restore in accordance with railing manufacturer's recommendations or replace stained railings.

END OF SECTION

SECTION 06 10 00 ROUGH CARPENTRY

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Wood Preservers' Association (AWPA):
 - a. U1, User Specification for Treated Wood.
 - b. M4, Standard for the Care of Preservative-Treated Wood Products.
 - 2. APA The Engineered Wood Association (APA):
 - a. PRP-108, Performance Standards and Qualification Policy for Structural-Use Panels (Form E445).
 - b. Form B445, APA Quality Assurance Policies for Structural-Use Panels Qualified to PRP-108.
 - 3. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - c. F1667, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
 - 4. International Code Council (ICC): Florida Building Code (FBC).
 - 5. National Fire Protection Association (NFPA): 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - 6. UL: 723, Standard for Safety Test for Surface Burning Characteristics of Building Materials.
 - 7. U.S. Department of Commerce—Product Standards (DOC): PS 1, Structural Plywood.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Construction panels.
 - b. Metal framing anchors.
 - c. Construction adhesives.
 - d. Construction panel thickness where not shown.

- B. Informational Submittals:
 - ICC Evaluation Service Reports, including the following as a minimum:

 Connections and Fasteners.
 - b. Wood Treatment.
 - 2. Wood treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material.
 - 3. Material test reports from testing laboratory showing and interpreting test results in accordance with test methods UL 723, NFPA 255, and ASTM E84, relative to fire-retardant treated wood products.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Immediately upon delivery to Site, place materials in area protected from weather. Do not store seasoned materials in wet or damp areas.
- B. Protect sheet materials from breaking corners and damaging surfaces while unloading.
- C. Store materials a minimum of 6 inches above ground on framework or blocking and cover with waterproof covering, providing for adequate air circulation and ventilation. Store sheet materials flat, not on edge.
- D. Protect fire-retardant materials against high humidity and moisture during storage and erection.
- E. Store materials for which a maximum moisture content is specified in areas where humidity can be controlled.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Each plywood panel identified with designated grade trademark of APA.

2.02 CONSTRUCTION PANELS

- A. Plywood:
 - 1. General:
 - a. Where construction panels are shown on the Drawings for the following concealed types of applications, provide APA Performance-Rated Panels complying with requirements designated under each application for grade designation, span rating, exposure durability classification, edge detail, and thickness.

- b. Construction Panel Standards: Comply with DOC PS 1 for plywood construction panels and for products not manufactured under DOC PS 1 provisions, in accordance with APA PRP-108 and APA Form B445.
- c. Trademark: Each construction panel factory-marked with APA trademark evidencing compliance with grade requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

3.02 GENERAL

- A. Lay out, cut, fit, and install rough carpentry items. Anchor sufficiently to ensure rigidity and permanence.
- B. Install items accurate to dimension, true to line, level, and square unless shown otherwise on the Drawings. Provide for installation and support of other Work.
- C. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- D. Make provisions for temporary construction loads and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

END OF SECTION

SECTION 06 40 00 ARCHITECTURAL MILLWORK

PART 1 GENERAL

1.01 INCLUDED IN THIS SECTION

- A. Ticketing Building:
 - 1. Breakroom kitchenette cabinets.
 - 2. Tickets office wall hung countertop.
- B. Restroom Building: Wall hung sink vanity.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Architectural Woodwork Institute (AWI): Architectural Woodwork Quality Standards.
 - 2. ASTM:
 - a. ASTM D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - b. ASTM D5420, Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
 - c. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - d. ASTM E228, Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer.
 - 3. Builders Hardware Manufacturers Association (BHMA):
 - a. 201, Cabinet Hardware.
 - b. 156.11, Cabinet Locks.
 - 4. Federal Specifications (FS): MMM-A-130B, Adhesive, Contact.
 - 5. National Electrical Manufacturers' Association (NEMA): LD 3, High-Pressure Decorative Laminates.
 - 6. Product Standards (PS)-U.S. Department of Commerce: 51-71, Hardwood and Decorative Plywood.
 - 7. Woodwork Institute of California (WIC): Manual of Millwork.

1.03 DEFINITIONS

A. Trim: Includes baseboards, chair rails, interior cornices, door frames, and door and window casings and Millwork scribes.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Mandatory.
 - a. Show details and dimensions not controlled by job conditions and required field measurements. Sections through each special function portion of Millwork item.
 - b. Describe and illustrate all features of design showing field measurements, construction details, dimensions, materials, hardware and finish. Use full-size or 1/4-size scale Drawings. Reference Shop Drawings to Contract Document Drawings.
 - c. Furnish manufacturer's descriptive literature of specialty items not manufactured by woodwork manufacturer.
 - 2. Samples:
 - a. Finished Samples of each finish to be applied by woodwork manufacturer.
 - b. Sample casework unit complete with hardware, including locks and accessories, and top. Unit may be incorporated in the Work.
- B. Informational Submittals:
 - 1. Proof of woodwork manufacturer qualifications.
 - 2. Written confirmation of compliance to AWI standard required.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Successful completion of comparable work on similar size project within 2 years before start of construction on this Project.
 - 2. Current member of Architectural Woodwork Institute.
 - 3. Architect reserves right to approve woodwork manufacturer selected to furnish work.
- B. Casework and Paneling: "Quality Standards" of Architectural Woodwork Institute (AWI).
 - 1. Reference to Premium, Custom, or Economy Grade: As defined in AWI "Quality Standards."
 - 2. Provide Custom Grade unless otherwise specified.

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- C. Cabinet Hardware: In accordance with BHMA 201 and BHMA 156.11.
- D. Work in this section shall be accomplished under the Quality Certification Program of the Architectural Woodwork Institute (AWI).

1.06 ENVIRONMENTAL REQUIREMENTS

- A. For a minimum of 72 hours prior to installation, allow woodwork to come to equilibrium onsite in space where it is to be installed.
- B. Humidity: For 24 hours before, during, and after installation, maintain relative humidity between 25 and 55 percent.
- C. Temperature: For 24 hours before, during, and after installation, maintain ambient temperature between 65 and 75 degrees F.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Defer delivery to the Project Site until the installation and storage areas are complete and dry of all wet type construction, and excessive moisture has been out of the building for at least 10 days.
- B. Protect casework and paneling from damage and dampness. Store in weathertight, well-ventilated areas. Do not subject to extreme changes of temperature or humidity.

PART 2 PRODUCTS

2.01 CASEWORK WITH PLASTIC LAMINATE FINISH

- A. Meet the requirements of AWI Quality Standards Section 400 for laminate clad cabinets.
- B. Furnish casework exposed surfaces, including top, edges, front face, and backsplashes, with plastic laminate in colors indicated in Interior Finish Schedule.

2.02 CASEWORK HARDWARE

- Concealed Hinges: Stanley No. 1511 or Knape and Vogt No. 2661; No. 626 finish.
- B. Catches: Stanley No. 46 or McKinney No. 2911; 628 aluminum finish, magnetic.
- C. Pivot Door Slides: Knape and Vogt No. 8085, medium duty.

- D. Pulls/Handles: Solid brass or bronze, Stanley No. 4484, Baldwin No. 4676;
 626 satin chrome finish.
- E. Heavy-Duty Drawer Slides: Knape and Vogt No. 1429 or Grant No. 4930.
- F. Shelf Supports: Knape and Vogt No. 255/256 or Grant No. 120/121, nickel-plated finish.
- G. Shelf and Rod Support: Stanley No. 7046 or Knape and Vogt No. 1194.
- H. Heavy-Duty Pivot Door Slides: HAWA-Turnaway 35/X3, pivot sliding door fitting.

2.03 PLASTIC LAMINATE

- A. Cabinets/Backsplashes/Counter Tops: NEMA LD 3, Grade GP 50; solid color, standard velvet finish. Manufacturer and color as indicated in Interior Finish Schedule.
- B. No unfinished surfaces of casework, cabinets, backsplash, or table are to be exposed.
- C. See Drawings for requirements of the Millwork.

2.04 SOLID SURFACE

- A. Counter tops and backsplashes:
 - 1. Provide non-porous, homogeneous material.
 - 2. Manufacturer:
 - a. Corian
 - b. Wilsonart
 - 3. Adhesive for Bonding to Other Products: One component silicone to ASTM C920.
 - 4. Sealant: A standard mildew-resistant, FDA/UL® and NSF/ANSI 51 compliant in Food Zone area, recognized silicone color matched sealant or clear silicone sealants.
 - 5. See Drawings for requirements of the millwork items.

2.05 ANCILLARY MATERIALS

- A. Adhesives:
 - 1. For Plastic Laminate: Contact cement; Federal Specification MMM-A-130B.
- B. Woodwork Putty: Color to match finish.

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C. Fasteners: Furnish as necessary.

2.06 FABRICATION

- A. Moisture Content: Prior to fabrication, lumber shall be kiln-dried to an average moisture content range as follows:
 - 1. Exterior Work: 9 to 12 percent.
 - 2. Interior Work: 6 to 11 percent.
- B. Casework Construction: AWI Quality Standards Custom Grade, flush overlay.
- C. Casework Fronts: Plastic laminate.
- D. Casework Units: Shop assembled for field installation.
- E. Install concealed hinges on doors.
- F. Drawer Slides: Use side-mounted, heavy-duty type.
- G. Install casework hardware in accordance with manufacturer's instructions.
 - 1. Provide items where indicated and as required for a complete installation.
 - 2. Provide pulls and catches on casework doors unless indicated otherwise.

PART 3 EXECUTION

3.01 PREPARATION

- A. Field verification of field dimensions to be made by millworker prior to commencement of fabrication.
- B. Examine grounds, stripping, and blocking for cabinet attachment.
- C. Do not proceed to install until conditions are acceptable to installer.
- D. Verify that surfaces to receive architectural woodwork items are properly prepared.

3.02 CASEWORK INSTALLATION

- A. Coordinate installation of, and cut openings for mechanical, electrical, and other items that penetrate casework surfaces and tops.
- B. Install all casework in true alignment, level, and plumb.

- C. Secure units with nails or screws to cleats that have been anchored to building structure or wall framing.
- D. Install wall-hung cabinets to rigidly support cabinet weight plus normally expected weight of cabinet contents.
- E. Accurately scribe and closely fit faceplates, filler strips, and trim strips to irregularities of adjacent surfaces.
- F. Adhere plastic laminate as recommended by the laminate manufacturer.
 - 1. Apply with as few cross joints as possible and no longitudinal joints.
 - 2. Scribe neatly to vertical surfaces.
- G. Toe Space at Front of kitchenette cabinets: Provide by installing front face of cabinets 3 inches in front of base face.

3.03 ADJUSTING AND CLEANING

- A. Adjust hardware and leave in smooth working condition.
- B. Adjust doors and drawers to operate without restriction.
- C. Surfaces: Clean and ready for use.

END OF SECTION

SECTION 07 21 01 THERMAL INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - b. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - c. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - d. D4397, Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 - e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.02 DESIGN REQUIREMENTS

- A. Roof Insulation:
 - 1. Coordinate roof insulation with roof system for a complete tested assembly.
 - 2. Wind Uplift Performance: Roof system is designed to withstand wind uplift forces as calculated using the current revision of ASCE-7 10.
 - 3. Thermal Performance: Roof system will achieve an average R-value not less than 30.
 - 4. Building Codes: Roof system will meet the requirements of all bodies having jurisdiction.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Manufacturer's product literature identifying products proposed for use.
1.04 MATERIAL STORAGE

A. Store off ground and keep dry at all times. Protect against weather condensation and damage.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Batt Insulation: ASTM C665, Type III, Class B, fiberglass batts with aluminum foil vapor retarder; R-value on Drawings.
- B. Vapor Retarder: ASTM D4397 plastic sheeting, 6 mils minimum.
- C. Roof Insulation:
 - 1. Formaldehyde-free fiberglass batt or fiberglass blanket complying with ASTM C 991 Type 1 and ASTM E84 with a thermal resistance of R-30.
 - 2. Color: White.
 - 3. Manufacturers and Products:
 - a. Simple Saver System.
 - b. Lamtec Corp.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Batt Insulation:
 - 1. Install in accordance with the manufacturer's instructions.
 - 2. Fasten flanges to the sides of framing members with the vapor retarder facing the warm side. Fit tightly to ensure a continuous seal.
 - 3. Where electrical outlets, ducts, pipes, vents, or other utility items occur, place insulation on the cold weather side of the obstruction.
 - 4. Provide fasteners, adhesive, tape, and sealant as recommended by insulation manufacturer.
- B. Vapor Retarder:
 - 1. Apply to exterior wall and ceiling framing in sheets as large as possible, lapping all joints 6 inches and sealing with sealant and tape recommended by manufacturer.
 - 2. Fit tightly and seal around all penetrations.
 - 3. Replace torn and punctured sheets.
 - 4. Repair minor tears or holes with tape.

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- 5. Repair by replacement major tears or holes that require more than a 6-inch length of tape to repair.
- C. Roof Insulation:
 - 1. Install pre-engineered building insulation system in accordance with manufacturer's installation instructions and the approved Shop Drawings.
 - 2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
 - 3. Install in exterior spaces without gaps or voids. Do not compress insulation.
 - 4. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
 - 5. Fit insulation tight in spaces and tight to exterior side of the sealed liner.

3.02 CLEANUP AND PROTECTION

- A. Remove from Site all containers, wrappings, and scrap insulation material. Leave floors broom clean.
- B. Protect installed insulation from tears or other damage until covered with finish material. Replace damaged material.

END OF SECTION

SECTION 07 41 13 METAL ROOF PANELS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - b. A792/A792M, Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - c. C1311, Standard Specification for Solvent Release Sealants.
 - d. D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - e. E1646, Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
 - f. E1680, Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.
 - 2. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Architectural Sheet Metal Manual.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements: Provide professional engineering services needed to design roof system and assume engineering responsibility.
- B. Performance Requirements:
 - 1. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/square foot of roof area when tested in accordance with ASTM E1680 at the following test pressures:
 - a. Test Pressure:
 - Roof slope greater than 30 degrees: Positive and negative 1.57 lbf/square feet.
 - b. Preload Test-Pressure Difference:
 - 1) Positive: Greater than or equal to 15 lbf/square feet and the greater of 75 percent of building live load or 50 percent of building design positive wind pressure difference.
 - 2) Negative: 50 percent of design wind uplift pressure difference.

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- 2. Water Penetration: No water penetration when tested in accordance to ASTM E1646 at the following test pressures:
 - a. Test Pressure:
 - 1) Roof slope greater than 30 degrees: 20 percent of positive design pressure, but not less than 6.24 lbf/square feet and not more than 12 lbf/square feet.
 - b. Preload Test-Pressure Difference:
 - 1) Positive: Greater than or equal to 15 lbf/square feet and the greater of 75 percent of building live load or 50 percent of building design positive wind pressure difference.
 - 2) Negative: 50 percent of design wind uplift pressure difference.
- 3. Structural Performance:
 - a. Provide metal roof panel assemblies capable of withstanding the design loads specified on the Structural Drawings.
 - b. Deflection Limits: An engineered roof panel assemblies to withstand design loads with vertical deflections no greater than 1/180 of span.
- 4. Thermal Movement: Provide metal roof panel assemblies that allow for thermal movement resulting from temperature change of 120 degrees F (67 degrees C), ambient and 180 degrees F (100 degrees C), material surface.

1.03 SUBMITTALS

- A. Action Submittals:
 - Shop Drawings: Drawings showing thickness and dimensions of parts and accessories, fastening and anchoring methods, details, and locations of seams, joints, and other provisions for thermal movement. Distinguish between factory-assembled and field-assembled work. Include drawings at not less than 1/4-inch to 1-foot scale and details at not less than 3-inch to 1-foot scale.
 - 2. Samples: 12-inch square Samples of specified metal. Samples will be reviewed for color and texture only.
- B. Informational Submittals:
 - 1. Manufacturer's printed installation instructions.
 - 2. A letter from roofing manufacturer stating roofer is approved by manufacturer to apply the roof.
 - 3. Preinstallation Conference meeting minutes.
 - 4. Special guarantee.

5. Certificate of Proper Installation test results or calculations, that assure item's and its anchorage's design criteria meets requirements for loads provided in Section 01 61 00, Common Product Requirements.

1.04 QUALITY ASSURANCE

- A. Applicator's Qualifications: Approved and trained by materials manufacturer.
- B. Preinstallation Conference:
 - 1. Before starting metal roof installation, conduct a conference with Design-Builder, roofing applicator, roofing system materials manufacturer, Subcontractors likely to be on roof, and installers whose work affects metal roof installation.
 - 2. Items to be reviewed and discussed include, but are not limited to, the following items:
 - a. Examine roof deck or substrate conditions for compliance with requirements for flatness and tolerance of structural members.
 - b. Review structural loading limitations of roof deck or purlins and rafters during roofing installation.
 - c. Review flashing details, roof drainage, roof insulation, roof penetrations, roof-mounted mechanical equipment, and other construction and conditions that might affect metal roof panel installation.
 - d. Review governing regulations and requirements for insurance, certificates, and testing and inspecting as applicable.
 - e. Review temporary protection requirements for metal roof panels during and after installation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver components and metal roof panels so as not to be damaged or deformed. Package for protection during transportation and handling.
- B. Storage and Handling:
 - 1. Protect against damage and discoloration.
 - 2. Handle panels with nonmarring slings.
 - 3. Do not bend panels.
 - 4. Store panels aboveground on pallets or platforms, with one end elevated for drainage.
 - 5. Protect strippable protective covering from exposure to sunlight except as necessary for metal roof installation.
 - 6. Stack panels to prevent twisting, bending, or abrasion, and to provide ventilation.

- 7. Protect panels against standing water and condensation between adjacent surfaces.
- 8. If panels become wet, immediately separate sheets, wipe dry with clean cloth, and separate sheets for air-drying.
- 9. During storage prevent contact with materials that may cause discoloration or staining.

1.06 COORDINATION

- A. Coordinate installation of roof curbs, equipment support, and other roof accessories as specified in Section 07 70 01, Roof Specialties and Accessories.
- B. Coordinate metal roof installation with flashing and trim as specified in Section 07 62 00, Sheet Metal Flashing and Trim.
- C. Coordinate work with construction of decks and other adjoining work.

PART 2 PRODUCTS

- 2.01 ROOFING PANELS
 - A. Material: Steel, galvanized, ASTM A653/A653M, coating designation G90, or ASTM A792/A792M coated steel, 24-gauge minimum metal thickness.
 - B. Surface: Smooth, flat finish.
 - C. Finish:
 - 1. Polyvinylidene Fluoride: Kynar 500.
 - D. Color: As selected by Owner from manufacturer's standard color range.
 - E. Standing Seam, Seamed-Joint:
 - 1. Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically space between vertical ribs designed for sequential field installation by mechanically attaching panels to supports using concealed clips located under one side of panel and engaging opposite edge of adjacent panels and mechanically seaming panels together.
 - 2. Panel Coverage: 16 inches.
 - 3. Panel Height: 2 inches.

- 4. Manufacturers and Products:
 - a. AEP-SPAN; SpanSeam.
 - b. Berridge; Double-Lock Zee-Lock Panel.
 - c. CENTRIA Architectural Systems; SDP200.
 - d. Englert, Inc.; S2500.

2.02 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be fieldassembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fastening in side laps; included accessories for a complete, weathertight installation.
- B. Flush Profile: Solid panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges with flush joint between panels.
 - 1. Material: Aluminum-zinc alloy coated sheet 24 -gauge or Aluminum sheet 0.032-inch minimum metal thickness.
 - 2. Finish: Fluoropolymer.
 - 3. Color: As selected from manufacturer's standard color range.
 - 4. Panel Coverage: 12 inches.
 - 5. Panel Height: 1-inch.
 - 6. Manufacturers and Products:
 - a. AEP Span; Flush Panel.
 - b. PAC-CLAD; Flush Solid.

2.03 ACCESSORIES

- Underlayment: Cold applied, self-adhering, polyethylene-faced sheet, consisting of slip-resisting polyethylene-film reinforcing top surface laminated to SBS-modified asphalt adhesive with release-paper backing, 40-mil minimum thickness meeting ASTM D1970.
- B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, endwelded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal by means of plastic caps or factory-applied coating.
 - 1. Fasteners for Roof Panels: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head with EPDM or PVC washer.
 - 2. Fasteners for Flashing and Trim: Self-drilling screws with hex washer head or blind fastener rivets of high-strength aluminum or stainless steel.

- C. Holddown Clips: System manufacturer's ASTM A792/A792M standard shape steel.
- D. Closures: Manufacturer's standard neoprene blocks shaped to fit roof metal profile.
- E. Sealant:
 - 1. Joint Sealant: Type 5 as specified in Section 07 92 00, Joint Sealants.
 - 2. Silicone Sealant: Type 1 as specified in Section 07 92 00, Joint Sealants.
 - 3. Tape Sealant: Type 13 as specified in Section 07 92 00, Joint Sealants.
 - 4. Butyl Sealant: Butyl-rubber based, solvent-release sealant per ASTM C1311.
- F. Isolation Paint: ASTM D1187, asphalt.

2.04 FABRICATION

- A. Fabricate and finish metal roof panels and accessories at factory to the greatest extent possible.
- B. Provide panel profile, including major ribs and any intermediate stiffening ribs for full panel length.
- C. Panel Length: Roof panels shall be full length from eave to ridge, unless otherwise indicated or limited by shipping limitations.
- D. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact.
- E. Form and fabricate sheets, battens, strips, cleats, valleys, ridges, edge treatments, integral flashings, gutters, downspouts, and other components of specified metal roofing panels to profiles, patterns, and drainage arrangement shown, and as required for permanent leakproof construction, and as recommended by SMACNA's "Architectural Sheet Metal Manual."
- F. Provide for thermal expansion and contraction of Work.
- G. Conceal fasteners and methods of expansion where possible. Do not use exposed fasteners on faces of accessories where exposed to view.

H. Finishes:

- 1. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half the range of approved sample. Noticeable variations within same piece are not acceptable. Variations in other component appearances are acceptable if within range of approved samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with alignment tolerances required by metal roof panel manufacturer.
- B. Prior to beginning installation, examine rough-in location for items penetrating metal roof panels and coordinate with seam locations.

3.02 PREPARATION

- A. Deck: Firm, dry, free of foreign materials, and smooth. Report immediately to Design -Builder, cracks, breaks, holes, or other unusual irregularities in surface.
- B. Layout Pattern:
 - 1. Lay out to place seams equidistant from corners and aligned with seams on other side of hip or ridge.
 - 2. Coordinate Work of this section with flashing, trim, and other construction to provide a permanently leakproof, secure, and noncorroding installation.

3.03 INSTALLATION

- A. General:
 - 1. Apply roofing only in dry weather and where weather conditions permit.
 - 2. Install in accordance with manufacturer's written instructions and warranty requirements.
 - 3. Comply with recommendations of the SMACNA "Architectural Sheet Metal Manual."
 - 4. Install metal roofing and soffit system consisting of nonstructural sheet metal panels held to substrate with concealed fasteners.

- 5. Conceal expansion joint provisions wherever possible in exposed Work; locate so as to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- 6. Closures and Trim:
 - a. Provide ridges, hips, valleys, eaves, rakes, fascia, coping, gutters, downspouts, and other exposed trim and flashing for a weather-tight roofing and fascia system.
 - b. Provide metal closures at rake edges and each side of ridge and hip caps.
 - c. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of openings. Fasten with self-tapping screws.
- 7. Install ridge and hip caps as the metal roof panel work proceeds.
- 8. Dissimilar Metals:
 - a. Separate from each other where electrolysis might occur.
 - b. Separate metal panels where contact with corrosive substrates may occur.
 - c. Separation is satisfactorily accomplished by coating metals with isolation Paint.
 - d. Comply with various metals producers' recommendations for other forms of protection against contamination from corrosive materials or agents.
- 9. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.
- 10. Cutting and Fitting: Neat, square, and true. Saw cut panels, deburr, and use touchup paint immediately as recommended by roofing panel manufacturer. Torch cutting is prohibited.
- 11. Gutters, Downspouts, and Flashings:
 - a. Straight, weather-tight, exposed surfaces free of dents, scratches, abrasions, stains, and other visible defects.
 - b. Extend gutter lining under metal roofing 6 inches minimum and terminate in 3/4-inch folded edge secured by cleats.
- 12. Valleys:
 - a. Form of sheets not exceeding 10 feet in length. Lap joints 6 inches in direction of drainage.
 - b. Extend valley sheet minimum 6 inches under roofing sheets.
 - c. At valley, double fold valley and roofing sheets, and secure with cleats spaced 18 inches on center.
- B. Underlayment:
 - 1. Install underlayment and slip sheet on roof sheathing, unless otherwise recommended by metal roof panel manufacturer.
 - 2. Apply underlayment single-ply lapped shingle fashion, 3 inches at head and 6 inches at sides.

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- 3. Cover with loose-laid slip sheet similarly lapped and with joints staggered.
- 4. Install no more than can be covered by metal roofing or other approved protection, in same day.
- 5. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal roof panels.
- C. Standing-Seam Metal Roof:
 - 1. Install as recommended by metal roof panel manufacturer's installation instructions and recommendations.
 - 2. Begin at eaves. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction.
 - 3. Install clips in panel side joints at location, spacing, and with fasteners as recommended by manufacturer for type of substrate and wind loading specified.
- D. Metal Soffit Panels: Provide full width of soffit. Install perpendicular to support framing. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of openings and joints.

3.04 CLEANING AND PROTECTION

- A. Cleaning:
 - 1. At the end of each day sweep metal clean of foreign materials, especially metal particles and scrap.
 - 2. Peel off strippable film.
 - 3. Where needed, clean metals in conformance with metals industry recommendations or use Basic-H cleaner, Shaklee Corp., Pleasanton, CA.
- B. Protection:
 - 1. Protect material from exposure to chlorides, hydrochloric-based and muriatic acids. If contaminated, wash affected areas immediately with 5 percent soda and water solution and rinse with clear water.
 - 2. Avoid walking on roof after completion.
- C. Final Cleanup:
 - 1. Remove debris, metal clips, nails, and other materials that could prevent adequate drainage or produce corrosion products through electrolysis.
 - 2. Repair and touch up damage.
 - 3. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair.

END OF SECTION

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SECTION 07 62 00 SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C920, Standard Specification for Elastomeric Joint Sealants.
 - c. C1311, Standard Specification for Solvent Release Sealants.
 - d. D1187/D1187M, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - e. D4586/D4586M, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
 - 2. Federal Specifications (FS): QQ-L-201F(2), Lead Sheet.
 - 3. FM Global (FM): Loss Prevention Data Sheet 1-49, Perimeter Flashing.
 - 4. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): 1793, Architectural Sheet Metal Manual.

1.02 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Thermal Movements:
 - 1. Provide sheet metal flashing and trim that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures for preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
 - a. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.
 - 2. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.
 - 3. Base engineering calculation on surface temperatures of materials as a result of both solar heat gain and nighttime-sky heat loss.
- C. Water Infiltration: Provide sheet metal flashing and trim that does not allow water infiltration to building interior.

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1.03 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA 1793. Conform to dimensions and profiles shown, unless more stringent requirements are indicated.

1.04 DESIGN REQUIREMENTS

A. Wind Loads: Provide sheet metal and trim assemblies and their anchorage to the building structure that are capable of withstanding the positive and negative wind load pressures shown on the Components and Cladding Wind Surface Pressures table on the Structural Drawings.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Show joints, types and location of fasteners, and special shapes.
 - b. Catalog data for stock manufactured items.
 - 2. Samples: Color Samples for items to be factory finished.
- B. Informational Submittals: Third party testing documentation or manufacturer's literature qualifying sheet metal and trim assemblies and their anchorage to the building structure as meeting the required developed wind pressures for Project as shown on the Components and Cladding Wind Surface Pressures table on the Structural Drawings.

1.06 DELIVERY, HANDLING, AND STORAGE

- A. Inspect for damage, dampness, and wet storage stains upon delivery to Site.
- B. Remove and replace damaged or permanently stained materials that cannot be restored to like-new condition.
- C. Carefully handle to avoid damage to surfaces, edges, and ends.
- D. Do not open packages until ready for use.
- E. Store materials in dry, weathertight, ventilated areas until immediately before installation.

1.07 SPECIAL GUARANTEE

- A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction or, at the option of the Owner, removal and replacement of factory-applied fluoropolymer coating, finish, and accessories found defective during a period of 20 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.
- B. Conditions:
 - 1. Finish: No cracking, blistering, flaking, chipping, checking, chalking, peeling, or fading.
 - 2. All Components: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

- 2.01 METAL
 - A. Prefinished Aluminum Sheet: ASTM B209, alloy and temper as required for application and finish: 0.032-inch thick; mill finish; shop precoated with fluoropolymer coating (Kynar polyvinylidene fluoride resin) coating; color as selected from manufacturer's standard color range.
- 2.02 GUTTERS AND DOWNSPOUTS
 - A. Fabricated from prefinished aluminum sheet specified in this section.

2.03 ANCILLARY MATERIALS

- A. Sealing Tape: Polyisobutylene sealing tape specifically manufactured for setting flanges on bituminous roofing.
- B. Isolation Paint: ASTM D1187/D1187M, asphalt.
- C. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil thick minimum polyester.
- D. Plastic Roof Cement: ASTM D4586/D4586M, Type II.
- E. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

- F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- G. Fasteners:
 - 1. Aluminum Work: Stainless steel or aluminum.
 - 2. Stainless Steelwork: Stainless steel.

2.04 FABRICATION OF FLASHING

- A. Field measure prior to fabrication.
- B. Fabricate in accordance with SMACNA 1793 that applies to design, dimensions, metal, and other characteristics of item indicated.
- C. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- D. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
- E. Seams:
 - 1. Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- F. Reinforcements and Supports: Provide same material as flashing, unless other material is shown. Steel, where shown or required, shall be galvanized or stainless.
- G. Rigid Joints and Seams: Make mechanically strong. Seal aluminum joints with sealant.
- H. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- I. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with butyl sealant concealed within joints.

- J. Fabricate sheet metal in 10-foot maximum lengths, unless otherwise indicated.
- K. Provide watertight closures at exposed ends of counterflashing.
- L. Fabricate corners in one-piece with legs extending 30 inches each way to field joint. Lap, rivet, or solder corner seams watertight. Apply sealant if necessary.
- M. Solvent clean sheet metal. Surfaces to be in contact with roofing or otherwise concealed shall be coated with isolation paint.
- N. Pipe Penetrations through Roof: Flash with lead.
- O. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- P. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA 1793 and FM Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

2.05 FABRICATION OF GUTTERS AND DOWNSPOUTS

- A. Form downspouts in maximum lengths as practicable to sizes and shapes indicated on the Drawings:
 - 1. Telescope end joints 1-1/2 inches and lock longitudinal joints of downspouts.
 - 2. Provide elbows at bottom where downspouts empty onto splash blocks.
 - 3. Fit downspouts into cast iron boots or drainpipes where indicated on the Drawings; neatly caulk or cement joints.
- B. Form scuppers and conductor heads to shapes and sizes indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set and cant strips and reglets in place.
- B. Verify nailing strips and blocking are properly located.
- C. Verify membrane termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

- A. Flashing:
 - 1. General:
 - a. Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA 1793.
 - b. Provide concealed fasteners where possible, set units true to line, and level as indicated.
 - c. Install work with laps, joints, and seams that will be permanently watertight.
 - 2. Isolate metal from wood and concrete and from dissimilar metal with isolation tape or two coats of isolation paint.
 - 3. Use only stainless steel fasteners to connect isolated dissimilar metals.
 - 4. Joints: 10-foot maximum spacing and 2-1/2 feet from corners, butted with 3/16-inch space centered over matching 8-inch long backing plate with sealing tape in laps.
 - 5. Set flanges of flashings and roof accessories on continuous sealing tape or in plastic roof cement on top of envelope ply of roofing. Nail flanges through sealing tape and at 3-inch maximum spacing. Touch up isolation paint on flanges.
 - 6. Joints, Fastenings, Reinforcements, and Supports: Sized and located as required to preclude distortion or displacement as a result of thermal expansion and contraction.
 - 7. Provide continuous holddown clips at counterflashing and gravel stops.
 - 8. Conceal fastenings wherever possible.
 - 9. Set flashing and sheet metal to straight, true lines with exposed faces aligned in proper plane without bulges or waves.
- B. Downspouts, Scuppers, and Conductor Heads: Anchor downspouts to wall with straps of same material as downspouts. Install scuppers, and conductor heads as indicated on the Drawings.

3.03 FINISH

A. Exposed Surfaces of Flashing and Sheet Metalwork: Free of dents, scratches, abrasions, or other visible defects, and clean and ready for painting where applicable.

3.04 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.

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- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 70 01 ROOF SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Movement and Control Association International (AMCA).
 - 2. American Architectural Manufacturers Association (AAMA).
 - 3. ASTM International (ASTM):
 - a. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - b. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
 - 4. FM (Factory Mutual) Global (FM).
 - 5. UL.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings of each item specified showing materials, details, flashing, anchorage, and relation to adjacent structure.
 - 2. Catalog cuts of each item specified item.
- B. Informational Submittals: Manufacturer's Certificate of Compliance or alternately, test results or calculations that assure items and its anchorage's design criteria meets requirements for loads provided in Section 01 61 00, Common Product Requirements.

1.03 SEQUENCING AND SCHEDULING

A. Coordination: Schedule and coordinate work of this section with work of Section 07 41 13, Metal Roofing Panels and Section 07 62 00, Sheet Metal Flashing and Trim.

PART 2 PRODUCTS

- 2.01 VENT PIPE FLASHING
 - A. Prefabricated flashing with elastomeric collar and 0.032-inch aluminum base, sized to fit vent pipe.
 - B. Manufacturer and Product: Oatey; No-Caulk Roof Flashing.

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2.02 ANCILLARY MATERIALS

- A. Isolation Paint: ASTM D1187, asphalt.
- B. Coat aluminum surfaces in contact with concrete or dissimilar metals.
- C. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil-thick minimum polyester.
- D. Fasteners: Stainless steel of type required.

PART 3 EXECUTION

3.01 PREPARATION

- A. Examine surfaces and structures to receive the Work of this section.
- B. Take measurements at Site and fabricate work to suit. No changes shall be made in supporting structure to accommodate this Work.

3.02 INSTALLATION

- A. General:
 - 1. Install roof specialties and accessories as detailed in approved Shop Drawings and in conformance with manufacturer's instructions, recommendations, and standards.
 - 2. Use appropriate vent pipe flashing where pipes penetrate roofing.
 - 3. Use appropriate flashing where ductwork connects to existing roof curbs.
 - 4. Where support curbs are installed on existing roofing provide appropriate flashing in accordance with the existing roofing system manufacturer for a weathertight installation.
 - 5. Factory Finished Units: Place color variations in pieces so no extremes are next to each other.
 - 6. Make Work weathertight and free of expansion and contraction noise.
 - 7. Maintain separation between aluminum surfaces and concrete or dissimilar metals with isolation paint.

END OF SECTION

SECTION 07 92 00 JOINT SEALANTS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. C661, Standard Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer.
 - b. C834, Standard Specification for Latex Sealants.
 - c. C920, Standard Specification for Elastomeric Joint Sealants.
 - d. C1193, Standard Guide for Use of Joint Sealants.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Surface preparation instructions. Indicate where each product is proposed to be used.
 - 2. Samples: Material proposed for use showing color range available.
- B. Informational Submittals:
 - 1. Installation instructions.
 - 2. Documentation showing applicator qualifications.
 - 3. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 4. Special guarantee.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum of 5 years' experience installing sealants in projects of similar scope.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 degrees F and 80 degrees F (4 degrees C and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

1.05 SPECIAL GUARANTEE

- A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction or, at the option of the Owner, removal and replacement of Work specified in this section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.
- B. Conditions: No adhesive or cohesive failure of sealant.
- C. Sealed Joints: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

2.01 SEALANT MATERIALS

- A. Characteristics:
 - 1. Uniform, homogeneous.
 - 2. Free from lumps, skins, and coarse particles when mixed.
 - 3. Nonstaining, nonbleeding.
 - 4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
 - 5. Immersible may be substituted for nonimmersible.
- B. Color: Unless specifically noted, match color of the principal wall material adjoining area of application.
- C. Type 1—Silicone, Nonsag, Nonimmersible:
 - 1. Silicone base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
 - 2. Capable of withstanding movement up to 50 percent of joint width.
 - 3. Manufacturers and Products:
 - a. Dow Corning Corp.; No. 790.
 - b. General Electric; Silpruf.
 - c. BASF; Sonneborn, Omniseal-50.
- D. Type 2—Multipart Polyurethane, Self-leveling, Immersible:
 - 1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade P, Class 25.
 - 2. Capable of being continuously immersed in water.

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- 3. Manufacturers and Products:
 - a. BASF; Sonneborn, SL-2.
 - b. Pecora Corp.; Urexspan NR-200.
 - c. Tremco; THC-900/901.
 - d. Sika Chemical Corp.; Sikaflex 2c SL.
- E. Type 3—Multipart Polyurethane, Nonsag, Immersible:
 - 1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25.
 - 2. Capable of being continuously immersed in water.
 - 3. Manufacturers and Products:
 - a. Pecora; DynaTrol II.
 - b. Tremco; Dymeric 240.
 - c. BASF; Sonneborn NP-2.
 - d. Sika Chemical Corp.; Sikaflex 2c NS.
- F. Type 5—One-part Polyurethane, Immersible:
 - 1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
 - 2. Capable of being continuously immersed in water.
 - 3. Manufacturers and Products for Nonsag:
 - a. Sika Chemical Corp.; Sikaflex-1a.
 - b. Tremco; Vulkem 116.
 - 4. Manufacturers and Products for Self-leveling:
 - a. BASF; Sonneborn, SL-1.
 - b. Tremco; Vulkem 45.
 - c. Sika Chemical Corp.; Sikaflex 1c SL.
- G. Type 8—One-Part Polysulfide, Nonsag, Nonimmersible:
 - 1. Polysulfide base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 12 1/2.
 - 2. Capable of withstanding movement up to 20 percent of joint width.
 - 3. Manufacturer and Product: W. R. Meadows; Deck-O-Seal, one-part.
- H. Type 10—Sanitary Sealant:
 - 1. Silicone sealant similar to Type 1, above, formulated to resist mold growth and repeated exposure to high humidity while retaining adhesion, flexibility, and color.
 - 2. Manufacturers and Products:
 - a. Dow Corning; 786.
 - b. General Electric; Sanitary Sealant SCS1700.

- I. Type 12—One-Part Polycarbonate, Immersible:
 - 1. Polycarbonate base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
 - 2. Capable of being continuously immersed in water.
 - 3. Manufacturer and Product: Pro-Seal Products, Inc.; Pro-Seal 34.
- J. Type 13—Tape Sealant:
 - 1. Compressible polyurethane foam impregnated with polybutylene or polymer-modified asphalt.
 - 2. Color: Black.
 - 3. Size: 3/4-inch wide by length required by expanded thickness recommended by manufacturer for particular application.
 - 4. Manufacturers and Products:
 - a. Emseal Joint Systems, Ltd.; AST—High Acrylic.
 - b. Dayton Superior; Polytite Standard.
 - c. PARR Technologies; PARR Sealant EP-7212-T.

2.02 BACKUP MATERIAL

- A. Nongassing, extruded, closed-cell round polyurethane foam or polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.
- B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16-inch wide.
- C. Manufacturers and Products:
 - 1. Sonneborn; Sonolastic Closed-cell Backing Rod.
 - 2. Tremco; Closed-cell Backing Rod.
 - 3. Pecora Corporation; Green Rod.

2.03 ANCILLARY MATERIALS

- A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Primer: Nonstaining type recommended by sealant manufacturer to suit application.

2.04 PREFORMED SEALS

- A. Preformed Compressible Joint Seals:
 - 1. Widths Up to 5 inches:
 - a. BASF, Watson Bowman Acme Div.; Wabo Weatherseal II.
 - b. Emseal Joint Systems Limited; Colorseal.
 - c. LymTal International; Iso-flex Joint System.
 - 2. Other Widths: Series or model recommended by seal manufacturer.

PART 3 EXECUTION

3.01 GENERAL

- A. Use of more than one material for the same joint is not allowed unless approved by sealant manufacturer.
- B. Install joint sealants in accordance with ASTM C1193.
- C. Horizontal and Sloping Joints up to 1 Percent Maximum Slope: Use selfleveling (Grade P) joint sealant.
- D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use nonsag (Grade NS) joint sealant.
- E. Use joint sealant as required for the applicable application and as follows:

Joint Size	Sealant Type	
Less than 1"	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 12	
Less than 2"	1, 2, 3, 4, or 7	
Over 2"	Follow manufacturer's recommendation	

3.02 PREPARATION

- A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.
- B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.
 - 1. Mask adjacent surfaces where necessary to maintain neat edge.
 - 2. Starting of work will be construed as acceptance of subsurfaces.
 - 3. Apply primer to dry surfaces as recommended by sealant manufacturer.
- C. Verify joint shaping materials and release tapes are compatible with sealant.

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- D. Examine joint dimensions and size materials to achieve required width/depth ratios.
- E. Follow manufacturer's instructions for mixing multi-component products.

3.03 INSTALLATION

- A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.
 - 1. Install backup material as recommended by sealant manufacturer.
 - 2. Where possible, provide full length sections without splices; minimize number of splices.
 - 3. Tape sealant may be used as joint filler if approved by sealant manufacturer.
- B. Use bond breaker where recommended by sealant manufacturer.
- C. Seal joints around window, door and louver frames, expansion joints, control joints, and elsewhere as indicated.
- D. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.
- E. Joints: Tool slightly concave after sealant is installed.
 - 1. When tooling white or light color sealant, use a water wet tool.
 - 2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.
- F. Tape Sealant: Compress to 50 percent of expanded thickness and install in accordance with manufacturer's instructions.

3.04 PREFORMED SEALS

- A. Prepare joint surfaces clean and dry, free from oil, rust, laitance, and other foreign material.
- B. Construct joints straight and parallel to each other and at proper width and depth.
- C. Apply joint sealant manufacturer's approved primer and adhesive in accordance with manufacturer's instructions.
- D. Install seal in accordance with manufacturer's instructions.

3.05 CLEANING

- A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.
- B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

3.06 JOINT SEALANT SCHEDULE

A. This schedule lists the sealant types acceptable for each joint location. Use as few different sealant types as possible to meet the requirements of Project.

Joint Locations	Sealant Type(s)	
Expansion/Contraction and Control Joints At:		
Concrete Floor Slabs (except for water-holding Structures)	2, 5	
Slabs Subject to Vehicle and Pedestrian Traffic	2, 5	
Ceramic Tile Floors	1, 2, 5, 10	
Ceramic Tile Walls	1, 3, 5, 10	
Material Joints At:		
Metal Door, Window, and Louver Frames (Exterior)	1, 5, 6, 8, 12	
Metal Door, Window, and Louver Frames (Interior)	1, 5, 8,	
Wall Penetrations (Exterior)	1, 5, 8, 12	
Wall Penetrations (Interior)	1, 5, 8	
Floor Penetrations	5	
Ceiling Penetrations	1, 3, 5,	
Roof Penetrations	5	
Sheet Metal Flashings	5, 13	
Sheet Metal Roofing and Siding	5, 13	
Precast Concrete Wall Panels	1, 3, 5, 12, 13	
Other Joints:		
Threshold Sealant Bed	5	
Between Counter Tops and Backsplashes	10	

ROGER SCOTT POOL FACILITIES

Joint Locations	Sealant Type(s)
Around Plumbing Fixtures	10
Openings Around Pipes, Conduits, and Ducts Through Fire-Rated Construction	11
Concrete Form Snap-Tie Holes	1, 5

END OF SECTION

SECTION 08 11 16 ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. The Aluminum Association, Incorporated (AA): Designation System for Aluminum Finishes.
 - 2. American Architectural Manufacturers Association (AAMA): 605.2, Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
 - 3. ASTM International (ASTM): B209/B209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Applicable information for each type of door and frame, including:
 - a. Frame conditions and complete anchorage details, supplemented by suitable schedules covering doors and frames.
 - b. Glass and louver opening sizes and locations in doors.
 - c. Connections of door frames to structural steel framing concealed in frames.
 - d. Submitted third party testing documentation or signed and sealed engineering of door assemblies to meet required developed positive and negative pressures.
 - e. Location and field splice joints for frames too large to ship in one piece; indicate complete instructions for making field splices.
 - f. Joints required to accommodate expansion joint movement.
 - g. Relate to door numbers used in the Contract Drawings.
 - h. Include all hardware provided and/or installed by door manufacturer.
- B. Informational Submittals: Certificate of Compliance or alternately, test results or calculations, that assure items and its anchorages design criteria meets requirements for loads provided in Section 01 61 00, Common Product Requirements.

ROGER SCOTT POOL FACILITIES

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Properly identify each item with number used in Contract Drawings.
- B. Store doors upright, in protected dry area, at least 1-inch off ground or floor and at least 1/4-inch between individual pieces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers product must be able to meet developed positive and negative door assembly pressures for each exterior door assembly either by testing or engineering by a qualified Florida licensed engineer.
- B. Manufacturers:
 - 1. Cline Aluminum Doors, Inc., Bradenton, FL; Series 100BE.
 - 2. United States Metals and Manufacturing Corp., South Bend, IN; D9 Series.

2.02 MATERIALS

- A. Aluminum Frames:
 - 1. Extruded from 6063-T5 aluminum alloy meeting ASTM B209.
 - 2. Minimum Wall Thickness: 0.125-inch.
 - 3. Mechanically fastened corners.
 - 4. Reinforcements: 6061-T6 aluminum of 1/4-inch minimum thickness.
 - 5. Size and Profile: 5 inches by 1-3/4 inches, with open or closed back and applied stop with integral weatherstripping.
 - 6. Concealed fasteners or welding are preferred to through-the-face fasteners.
- B. Flush Aluminum Doors: 6063-T5 extrusions and 5005-H14, smooth face sheets.
 - 1. Minimum component thicknesses as follows:
 - a. Base Sheets: 0.090-inch.
 - b. Beveled Lock Rail Edge: 0.125-inch.
 - c. Hinge Rail Edge: 0.190-inch.
 - d. Internal Grid Sections: 0.080-inch.

2.03 MISCELLANEOUS ITEMS

- A. Filler or Transom Panels: Furnish of same construction and finish as door.
- B. Furnish manufacturer's standard core filler, anchors, fasteners, and other ancillary items.
- C. Glazing: Accommodate glass of type and thickness indicated and as specified in Section 08 80 00, Glazing.

2.04 FACTORY FINISHING REQUIREMENTS

A. Aluminum Door and Frame Finish: Color as scheduled.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Frames:
 - 1. Installation: Maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.
 - 2. Secure anchorages and connections to adjacent construction.
 - 3. Wherever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached.
 - 4. Install following manufacturer's recommendations.

B. Doors:

- 1. Follow manufacturer's recommendations.
- 2. Hardware: In accordance with manufacturer's templates and instructions.
 - a. Adjust operable parts for correct function.
 - b. Remove hardware, with exception of prime coated items, tag, box, and reinstall after finish paint work is completed.

3.02 PROTECTION

A. Protect installed doors and frames against damage from other construction Work.

3.03 SCHEDULES

A. For tabulation of door and frame characteristics, such as size, type, detail, and finish hardware requirements, see Door and Hardware Schedule on the Drawings.

END OF SECTION

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SECTION 08 14 00 WOOD DOORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. American National Standards Institute (ANSI):
 - a. A250.8, Recommended Specifications for Standard Steel Doors and Frames.
 - b. A250.11, Recommended Erection Instructions for Steel Frames.
 - c. A117.1 Specifications for making buildings and facilities usable by physically handicapped people.
 - 2. ASTM International (ASTM):
 - a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - b. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 3. Window and Door Manufacturers Association (WDMA):
 - a. Industry Standard I.S.1-A, Architectural Wood Flush Doors.
 - b. Industry Standard I.S.6-A, Architectural Wood Stile and Rail Doors.
 - 4. UL: Building Materials Directory.
 - 5. Warnock Hersey Certification Listings.
 - 6. DHI-Door and Hardware Institute.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Prepare specifically for this Project, indicating location and size of each door, veneer species, type and characteristics, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, factory finishing, if any, glass and glazing, and other pertinent data.
 - a. For factory-premachined doors, also indicate dimensions and locations of cutouts for finish hardware and cutouts for light and louver openings.
 - b. Use same reference numbers for door openings and details as Contract Drawings.

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- 2. Samples-Manufacturers samples of the following door components:
 - a. Door veneer samples.
 - b. Aluminum specialty frame components.
- B. Informational Submittals:
 - 1. Manufacturer's instructions for care and handling.
 - 2. Maintenance instructions for sealing door edges.
 - 3. Certificate of Compliance or alternately, test results or calculations, to document that item and anchorage design criteria meets for loads provided in Section 01 61 00, Common Product Requirements.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver doors to jobsite after moisture-producing construction operations are complete and building has reached average prevailing relative humidity of locality.
 - 2. Deliver doors clearly marked with manufacturer's name, brand name, size, thickness, and identifying symbol.
 - 3. Seal edges of doors before delivery to jobsite.
- B. Storage:
 - 1. Store doors in area where there will be no variation greater than plus or minus 5 percent in heat and humidity.
 - 2. Stack flat on wood blocking, laid 12 inches from ends and across center.
 - 3. Under bottom door and over top of stack provide plywood or corrugated cardboard to protect door surface.
- C. Handling:
 - 1. Handle with clean gloves.
 - 2. Do not drag doors across one another or across other surfaces.

1.04 SPECIAL GUARANTEE

- A. Provide as special guarantee, manufacturer's extended guarantee or warranty, with Owner named in writing as beneficiary. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of flush doors specified in this Specification section found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.
- B. Conditions: Free of warp more than 1/4 inch in plane of door and no delamination of veneers.

PART 2 PRODUCTS

2.01 FLUSH WOOD DOORS

- A. Solid Core Wood Doors:
 - 1. Premium grade, five-ply, heavy duty.
 - 2. Staved wood core or particleboard core.
 - 3. Type I glue.
 - 4. Thickness: 1-3/4 inches.
 - 5. Faces: Plastic laminate finished faces High pressure decorative laminate.
 - 6. Doors to be factory finished stain with satin gloss Enviroclad UV finish "Or-equal."
 - 7. Manufacturer: Masonite Architectural "Or-equal," approved.
- B. Glass Stops:
 - 1. Nonfire-Rated Doors: Hardwood to match door face.
 - 2. Fire-Rated Doors: Metal with veneer cover to match door face.

2.02 FABRICATION OF FLUSH WOOD DOORS

- A. Manufacture in accordance with WDMA Industry Standard I.S.1-A.
- B. Moldings: Factory install in configuration indicated.
- C. Prefitting and Premachining of Doors: At Contractor's option.
 - 1. Within tolerances specified herein.
 - 2. Coordinate with Finish Hardware Schedule and door frames.

ROGER SCOTT POOL FACILITIES

2.03 STEEL DOOR FRAMES

- A. Wood doors are to be installed in painted steel frames.
- B. Frames are to be hot-dipped zinc coated steel that complies with ASTM A924, A60, 16 gauge.
- C. Zinc-coated steel conforming to ASTM A 653/A 653M, CS, Type B.
- D. All frames are to have back welded face seams only at the frame corner or intersections. Grind and dress smooth the weld area. Apply a factory baked-on zinc rich primer over the grind area and finish with factory applied pre-finished paint coating.

2.04 SOUND-RESISTANT DOORS

A. Solid core doors with minimum Sound Transmission Class (STC) of 40 decibels or better when tested in accordance with ASTM E90.

PART 3 EXECUTION

- 3.01 INSPECTION
 - A. Verify door frames are of type required for door and are installed as required for proper installation of doors.
 - B. Do not install doors in frames that would hinder operation of doors.

3.02 INSTALLATION

- A. Fit doors for width by planing; for height by sawing.
- B. Tolerances:
 - 1. From Bottom to Floor Covering: 1/2-inch.
 - 2. From Bottom to Top of Threshold: 1/4-inch.
 - 3. Maximum From Top: 1/8-inch.
 - 4. Bevel Lock and Hinge Edges: 1/8-inch in 2 inches.
 - 5. Clearance of Meeting Stiles of Pairs of Doors: 1/8-inch.
- C. Seal Job Site cut surfaces with two coats of door manufacturer's standard sealer before final hanging of doors.

3.03 ADJUST AND CLEAN

A. Replace or rehang doors that are hinge-bound and do not swing or operate freely.

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- B. Replace prefinished doors damaged during installation.
- C. Refinish or replace job-finished doors damaged during installation.

3.04 SCHEDULE

A. For tabulation of door and frame characteristics, such as size, type, detail, and finish hardware requirements, see Section 08 71 00, Door Hardware Schedule on the Drawings.

END OF SECTION

SECTION 08 41 13 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 GENERAL

A. Aluminum and glass door and frame located in the following buildings: Ticketing Building

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. The Aluminum Association, Incorporated (AA): Designation System for Aluminum Finishes.
 - 2. American Architectural Manufacturers Association (AAMA): 800, Voluntary Specification and Test Method for Sealants.
 - 3. ASTM International (ASTM):
 - a. C509, Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - b. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - c. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen.
 - d. E330, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - e. E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Provide a thermally isolated aluminum framing system that uses straight-in glazing without projecting stops. Position glass near exterior of frame.
 - 2. System shall have interior flashing to provide continuous flashing to exterior through pressure relieved horizontal weep holes.
 - 3. Face Clip Design:
 - a. Engaged by pushing straight into the clip.
 - b. Easily removed for deglazing.

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- c. Reusable for reglazing.
- 4. Entrances and glass framing shall be compatible in appearance.
- 5. See the Drawings for Door Types and Schedules.
- B. Performance Requirements: Meet requirements of Article Performance Tests.
- C. Provide door assemblies capable of withstanding the design loads specified on the Structural Drawings.
- D. The door and window assemblies shall be impact resistant assemblies designed to safely resist the positive and negative loads as required for the location and type of project designed according to the requirements of the Florida Building Code (FBC).

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Elevations and details of doors, framing, and anchorage to structure.
 - b. Manufacturer's brochures or catalogs, specifications, recommendations, and standard details illustrating and specifying products proposed for use on this Project.
 - c. Show field measurements.
 - d. Anchorage and bracing drawings and/or catalog information, as required for anchorage and bracing and loads provided in Section 01 61 00, Common Product Requirements.
 - 2. Samples: At least 3-inch-long Samples of anodized extruded aluminum, showing probable range of variation in color.
 - 3. Product/Code Certification:
 - a. Provide written verification that submitted door assemblies and installation method meet or exceed Project Performance Requirements, in this section, by one, or more, of the following methods as allowed for by the (FBC):
 - Rational Comparative Analysis: Testing data, calculations and verification documents signed and sealed by a professional engineer registered in the State of Florida.
 - 2) Local product approval by Authority Having Jurisdiction (AHJ).

- B. Informational Submittals:
 - 1. Anchorage and bracing calculations as required for loads provided in Section 01 61 00, Common Product Requirements. Submit with Action Submittal for the same item.
 - 2. Evidence of installer's qualifications.
 - 3. Certified test reports showing compliance with specified performance tests.
 - 4. Manufacturer's Certificate of Compliance: In accordance with Section 01 33 00, Submittal Procedures.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Entity specializing in the installation of aluminum glazing systems, with a minimum of 3 years' experience and approved by the system manufacturer.
- B. Preinstallation Meeting: Conduct to discuss and verify project requirements, substrate conditions, and manufacturer's installation instructions and warranty requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store materials as recommended by manufacturer, in inside designated areas, free of dust and corrosive fumes, as close as possible to point of installation.
- C. Prevent contaminants from contacting aluminum.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Framing systems and entrance doors shall be the products of a single manufacturer.
- B. Materials and products specified in this section shall be products of:
 - 1. Kawneer Co.
 - 2. United States Aluminum Corp.
 - 3. Tublite, Inc.

2.02 BASIC MATERIALS

- A. Basic Aluminum Extrusions: 6063-T5 aluminum not less than 0.094-inch thick; door extrusions not less than 0.125-inch thick.
- B. Framing Members: 4-1/2 to 6 inches in depth with thermal break and face width of 2 to 2-1/2 inches or less unless noted otherwise on the Drawings to resist developed wind pressure.
- C. Swing Entrance Doors:
 - 1. Thickness: 1-3/4 inches.
 - 2. Stile and Rail Construction:
 - a. Medium 3-1/2-inch stiles and top rails, and 6-inch bottom rail.
 - b. Mechanically fastened and welded.
 - c. Hook-in type glazing stops.
 - d. Configuration indicated.
 - 3. Flush Construction:
 - a. Face sheets of plain unpatterned architectural quality 5005 alloy aluminum, 0.050-inch thick, interlocked with stiles and rails.
 - b. Aluminum stiles and rails, mechanically fastened and welded.
 - c. Core of froth-in-place urethane foam, free of chlorofluorocarbon (CFC) blowing agents.
 - d. Aluminum framed vision lights.
 - e. Configuration indicated.
- D. Glazing Gaskets: Framing manufacturer's standard elastomeric extrusion, conforming to ASTM C509.
- E. Glass and Glazing: As specified in Section 08 80 00, Glazing.
- F. Concealed Fastening Devices, Reinforcements, and Other Internal Components: Of aluminum alloy, stainless steel, or corrosion-resistant plated.
- G. Screws: Stainless steel, factory finished color to match aluminum finish.
- H. Hardware: As specified in Section 08 71 00, Door Hardware.
- I. Sealants:
 - 1. AAMA 800, to seal metal to metal, nonworking joints.
 - 2. Color to be compatible with adjacent materials.

- J. Isolation Tape:
 - 1. Manufacturers and Products:
 - a. Tremco; 440.
 - b. 3M; EC1202.
 - c. Presstite; 579.6.

2.03 FINISH

- A. Exposed Framing Members: Free of scratches and other serious surface blemishes.
- B. Treatment and Color:
 - 1. Caustic etch and anodic oxide.
 - 2. Color: To match window frames and flush aluminum doors.
 - 3. Meet requirements of: Clear Anodized Aluminum (Aluminum Association AA M10C22A41) Class I.

2.04 FABRICATION

- A. Methods of Fabrication and Assembly: Manufacturer's discretion, unless otherwise specified.
- B. Reinforcement for Surface Hardware: Manufacturer's standard.
- C. Wind Load: Reinforce mullions as necessary to limit deflection to 1/175 of span when wind load on wall is as stipulated on Door and Hardware Schedule on the Drawings in addition to dead loads.
- D. Assembly: As far as practicable, do fitting and assembly work in shop.

PART 3 EXECUTION

3.01 PREPARATION

- A. Substrate Conditions: Verify acceptability for product installation in accordance with manufacturer's instructions.
- B. Field Measurements: Verify actual opening sizes prior to fabrication.

3.02 INSTALLATION

- A. In accordance with manufacturer's installation instructions.
- B. Set items straight, level, square, plumb, and at proper elevations and in alignment with other work.

- C. Securely anchor units to surrounding structure to resist wind loads and to withstand the normal loads imposed by the operation of the doors.
- D. Fasten framing members in place using screws and backing, anchor plugs, or straps.
 - 1. Accurately cut and fit framing and moldings to result in tightly closed flush, hairline weathertight joints.
 - 2. No visible unfinished aluminum.
 - 3. Provide concealed attachments and fasteners.
- E. Door Operation:
 - 1. Swing freely, and without rattle when closed.
 - 2. Swing Type Doors: Head and jamb clearance of 3/32 inch, plus or minus 1/32-inch.
- F. Coat aluminum surfaces in contact with concrete, cement plaster, or stucco with isolation paint, sealant, or isolation tape cut to neat line.
- G. Seal all joints.
- H. Glazing: As specified in Section 08 80 00, Glazing.

3.03 PERFORMANCE TESTS

- A. Air Leakage Through Assembly: Maximum 0.06 cfm per minute per square foot of wall area at 6.24 psf, as measured in accordance with ASTM E283.
- B. Resistance to Water Infiltration: No leaks in the complete system when tested in accordance with ASTM E331 at test pressure of 8 psf.
- C. Performance Under Uniform Loading:
 - 1. Test in accordance with ASTM E330 for a wind load of 30 psf.
 - 2. Maximum Deflection: Not to exceed 1/175 of member span.
 - 3. When Load is Removed: No permanent deformation or damage.

3.04 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site for preinstallation meeting, installation assistance, inspection and certification of proper installation, and performance testing of specified equipment.

3.05 CLEANING

- A. After erection, protect exposed portions from damage by machines, plaster, lime, paint, acid, cement, or other harmful compounds.
- B. Remove protective materials and clean with plain water, water with soap, or household detergent.

3.06 PROTECTION

A. Protect adjacent areas and finish surfaces from damage during product installation.

3.07 SCHEDULES

A. For tabulation of door and frame characteristics, such as size, type, detail, and finish hardware requirements, see Door and Hardware Schedules on the Drawings.

END OF SECTION

SECTION 08 51 13 ALUMINUM WINDOWS

PART 1 GENERAL

1.01 INCLUDDED IN THIS SECTION

- A. Fixed windows.
- B. Sliding flush-mount transaction window.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. 101, Voluntary Specifications for Aluminum and Poly (Vinyl Chloride) (PVC) Prime Windows and Glass Doors.
 - b. 606.1, Voluntary Guide Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.
 - c. 701, Combined Voluntary Specification for Pile Weather Strip.
 - d. 800, Voluntary Specification and Test Methods for Sealants.
 - 2. ASTM International (ASTM):
 - a. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. B456, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - c. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - d. C509, Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - e. C864, Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - f. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - g. D3656, Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.
 - h. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - i. E330, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

- j. E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- k. E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.
- 3. Glass Association of North America (GANA): Glazing Manual.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Large scale details and layout of windows, operators, anchorages, and adjoining construction with all materials indicated accurately to scale.
 - b. Manufacturer's literature including brochures or catalogs, specifications, instructions, and standard details illustrating products proposed for use and other window products available.
 - 2. Samples: Finish on aluminum in sets of two, indicating light and dark extremes, to be used in evaluating products furnished.
- B. Informational Submittals:
 - 1. Manufacturer's Certification of Compliance.
 - 2. Reports of factory quality control tests.
 - 3. Product/Code Certification: Provide written verification that submitted louver assembly and installation method meet or exceed Project Design Requirements, in this section, by one, or more, of the following methods as allowed for by FBC:
 - a. Florida Product Approval for complete window assembly.
 - b. Rational Comparative Analysis: Testing data, calculations, and verification documents signed and sealed by a professional engineer registered in the State of Florida.
 - c. Local product approval by Authority Having Jurisdiction (AHJ).

1.04 QUALITY ASSURANCE

- A. All Units: Meet construction and testing requirements of AAMA 101 and carry the quality certified label of AAMA.
- B. Design Requirements:
 - 1. Provide a thermally isolated aluminum framing system that uses straight-in glazing without projecting stops. Position glass near exterior of frame and provide in-swinging operable vents where shown.

2. Window assemblies shall be impact resistant assemblies designed to safely resist the positive and negative loads as required for the location and type of project designed according to the requirements of the Florida Building Code (FBC).

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store window units in vertical upright position and off the ground on dunnage, preferably inside a building.
- B. Protect units from weather, abuse, defacement, and damage.
- C. Store units inside in areas free of dust and corrosive fumes, as close as possible to point of installation.
- D. Prevent contaminants from contacting aluminum.
- E. Keep water away from stored units and assemblies.
- F. Handle units according to recommendations of AAMA.

1.06 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of Work specified in this Specification section found defective during period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Fixed window:
 - 1. Kawneer Co.
 - 2. United States Aluminum Corp.
- B. Sliding transaction window: Ready Access, 600 series, "Or-equal," approved.

2.02 MATERIALS

- A. Aluminum: Proper alloy and temper to meet specified requirements.
- B. Hardware: Corrosion-resistant and compatible with aluminum; suitable for intended use and the same as used on the tested units.

- C. Anchors and Fasteners:
 - 1. Exposed: Aluminum, Type 304 stainless steel, or ASTM B456 nickelplated brass.
 - 2. Concealed: Aluminum, cadmium-plated steel, ASTM B633 or ASTM A123 zinc-plated steel, or Type 304 stainless steel.
 - 3. Concealed anchors may be of carbon steel, painted after fabrication with zinc chromate primer.
 - 4. Other Fasteners and Components: Carbon steel or ASTM B456 Nickel plus Chromium plated.
- D. Sealants:
 - 1. AAMA 800 to seal metal to metal, nonworking joints.
 - 2. Color to be compatible with adjacent materials.
- E. Weatherstripping: High-quality materials capable of meeting environmental exposure and performance requirements.
 - 1. Pile Weatherstrip: AAMA 701.
 - 2. Closed Cell Elastomer: ASTM C509.
 - 3. Dense Elastomer: ASTM C864.
- F. Glass and Glazing:
 - 1. Double Pane Insulating Glass (IG-DP):
 - a. ASTM E2190 certified by Insulating Glass Certification Council; with glass elastomer edge seal; purge interpane space with dry hermetic air.
 - b. Total Unit Thickness: 1-inch.
 - c. Outer Pane:
 - 1) Annealed, clear float glass.
 - 2) Minimum Thickness: 1/4-inch.
 - 3) Low E coating on No. 2 surface.
 - d. Inner Pane:
 - 1) Clear laminated glass made up of two liters of clear tempered glass with plastic interlayer.
 - 2) Minimum Total Thickness: 1/4-inch.
 - Plastic Interlayer: Manufacturer's standard, of minimum thickness required to meet FBC impact resistance requirement for Project site.
- G. Service panel:
 - 1. Operation: Manual open/self-closing.
 - 2. One (1) sliding panel.

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- 3. Opening direction: Left to right.
- 4. Security: Self-latching each time panel closes.
- 5. Lock: Mortise thumbturn. Keyed mortise cylinder.
- 6. Handle: Stainless Steel.
- 7. Window sneeze guard: 1/4-inch clear tempered glass protective shield.

2.03 FABRICATION

- A. Fabricate and assemble frame, sash, and ventilator members into windows and window systems in accordance with reviewed Shop Drawings, and as required by AAMA 101.
- B. Mechanical fasteners, welded components, and hardware items shall not bridge thermal barriers unless the window units tested also have thermal bridges.
- C. Sealing Insulating Glass Units: Designed so that water entering space around unit will drain and not remain in contact with edge seal of the glass.
- D. Glazing Beads:
 - 1. Sloped and coped to uniformly tight hairline joints at corners.
 - 2. Material may be prefinished.

2.04 FINISH

- A. Finish components after fabrication, except those that may be prefinished as specified.
- B. Exposed framing members shall be free of scratches and other surface blemishes.
- C. Anodic Coating: Conform to AAMA 606.1, dark bronze.
- D. Frames:
 - 1. Extruded aluminum alloy and chloroprene rubber components.
 - 2. Continuously weld corners of the aluminum.
 - 3. Provide matching aluminum subframes.

2.05 ANCILLARY MATERIALS

- A. Isolation Tape:
 - 1. Manufacturers and Products:
 - a. Tremco; 440.
 - b. 3M; EC1202.

- c. Presstite; 579.6
- B. Isolation Paint: Bituminous coating conforming to ASTM D1187.
- C. Screens:
 - 1. Furnish rigid metal frame screens to match window frames for operating vents and sash.
 - 2. ASTM D3656, Class 1, 18 by 16 mesh.

2.06 FIXED WINDOWS

- A. Meet requirements of AAMA 101 Designation AW-80 operable and AW-100 fixed.
- B. Provide polyvinyl chloride thermal break separator between inside and outside for all frames.
- C. Ventilators:
 - 1. Project-out type with crank operators and hook or cam type latch.
 - 2. Anderberg stainless steel, adjustable friction, four-arm mechanisms for ventilators operated directly or by pole.
 - 3. Provide pole operator where ventilators are more than 6 feet above floor.

2.07 SOURCE QUALITY CONTROL

- A. Tests:
 - 1. Resistance to Air Infiltration: No greater than 0.06 cfm per square foot of fixed area, as tested in accordance with ASTM E283.
 - 2. Resistance to Water Infiltration: No leakage in frame at test pressure difference of 8 psf, as tested in accordance with ASTM E331.
 - 3. Resistance to Uniform Loading: When tested under load of 20 psf, in accordance with ASTM E330:
 - a. Maximum Deflection: No greater than 1/175 times span for any member.
 - b. When load is removed, no evidence of permanent deformation or damage.

PART 3 EXECUTION

- 3.01 PREPARATION
 - A. Verify dimensions by taking measurements at the Site.

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- B. Verify that openings are within allowable dimensional tolerances, are plumb, level, clean, and provide a solid anchoring surface.
- C. Verify conformance with Shop Drawings and that dimensions and conditions are correct before installing windows.

3.02 INSTALLATION

- A. Window and Window Components:
 - 1. Plumb and align window faces in a single plane for each wall plane.
 - 2. Erect windows and materials square and true and in proper alignment with other work, anchored to maintain position when subjected to normal thermal and building movement and specified wind loads.
 - 3. Install in accordance with manufacturer's instructions.
 - 4. Installation shall be weathertight as specified under Article Source Quality Control.
- B. Coat aluminum surfaces in contact with concrete, cement plaster, or stucco with isolation paint, sealant, or isolation tape cut to neat line.

3.03 GLAZING

- A. Glass may be factory or field installed.
- B. Install in accordance with GANA "Glazing Manual," and glass manufacturer's instructions.

3.04 INSTALLATION OF ACOUSTICAL VISION PANELS

- A. Conform to manufacturer's instructions.
- B. Seal perimeter between frame and structure with permanently nonhardening, synthetic elastomer sealant, as recommended or approved by panel manufacturer.

3.05 ADJUSTING AND CLEANING

- A. Remove protective materials and clean windows with potable water, or water with household soap or detergent.
- B. Inspect and readjust glazed ventilators as necessary for free operation at completion.
- C. Adjust windows for proper operation after installing.
- D. Lubricate hardware and movable units.

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E. Leave windows in closed position after adjusting and cleaning.

3.06 **PROTECTION**

A. Protect installed window units from materials that could cause damage, such as lime, mortar, runoff from concrete and copper, careless handling of tools, weld splatter, acids, roofing asphalt, solvents, and abrasive cleaners.

3.07 SCHEDULE

A. For window types, sizes, glass, and other requirements, see Window Schedule on the Drawings.

END OF SECTION

SECTION 08 71 00 DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
 - 1. Door hardware for other doors indicated.
 - 2. Master Keying System and keyed cylinders.
- B. Related Sections:
 - 1. Section 08 11 16, Aluminum Doors and Frames.
 - 2. Section 08 14 00, Wood Doors and Steel Frames.
 - 3. Section 08 41 13, Aluminum-Framed Entrances and Storefronts.
- C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.
 - 1. Builders Hardware Manufacturing Association (BHMA).
 - 2. NFPA 101 Life Safety Code.
 - 3. NFPA 80 Standard for Fire Doors and Other Opening Protectives.
 - 4. ANSI-A156.xx- Various Performance Standards for Finish Hardware.
 - 5. UL10C Positive Pressure Fire Test of Door Assemblies.
 - 6. ANSI-A117.1 Accessible and Usable Buildings and Facilities.
 - 7. DHI /ANSI A115.IG Installation Guide for Doors and Hardware.
 - 8. ICC International Building Code.
 - 9. Florida Building Code, 2017 with amendments.
 - 10. Florida Accessibility Code, 2017 with amendments.
- D. Intent of Hardware Groups:
 - 1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
 - 2. Exterior Doors meet developed wind pressures and applicable third party testing documentation include specific hardware. Hardware sets for exterior doors will be modified as required to match testing requirements.

- 3. Where items of hardware are not definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by Addendum; or, furnish such items in the type and quality established by this Specification, and appropriate to the service intended.
- E. Allowances: Refer to Division 01, General Requirements for allowance amount and procedures.
- F. Alternates: Refer to Division 01, General Requirements for Alternates and procedures.

1.02 SUBSTITUTIONS

A. Comply with Division 01, General Requirements.

1.03 SUBMITTALS

- A. Comply with Division 01, General Requirements.
- B. Special Submittal Requirements: Combine submittals of this section with sections listed under paragraph 1.01B ensure the "design intent" of the system/assembly is understood and can be reviewed together.
- C. Product Data: Manufacturer's specifications and technical data including the following:
- D. Detailed specification of construction and fabrication.
 - 1. Manufacturer's installation instructions.
 - 2. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
 - 3. Submit 6 copies of catalog cuts with hardware schedule.
 - 4. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2.
- E. Shop Drawings Hardware Schedule: Submit six complete reproducible copy of detailed hardware schedule in a vertical format.
 - 1. List groups and suffixes in proper sequence.
 - 2. Completely describe door and list architectural door number as it appears in construction documents.
 - 3. Manufacturer, product name, and catalog number and cut sheets.
 - 4. Function, type, and style.
 - 5. Size and finish of each item.

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- 6. Mounting heights.
- 7. Explanation of abbreviations and symbols used within schedule.
- 8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.
- F. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
 - 1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.
- G. Samples: (If requested by the Architect):
 - 1. 1 sample of Lever and Rose/Escutcheon design, (pair).
 - 2. 3 samples of metal finishes.
- H. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.
 - 1. Operating and maintenance manuals: Submit three sets containing the following.
 - a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, Address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.
 - 2. Copy of final hardware schedule, edited to reflect, "As installed".
 - 3. Copy of final keying schedule.
 - 4. As installed "Wiring Diagrams" for each piece of hardware connected to power, both low voltage and 110 volts.
 - 5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.04 QUALITY ASSURANCE

- A. Comply with Division 01, General Requirements.
 - 1. Statement of qualification for distributor and installers.
 - 2. Statement of compliance with regulatory requirements and single source responsibility.

- 3. Distributor's Qualifications: Firm with 3-years' experience in the distribution of commercial hardware.
 - a. Distributor to utilize full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
 - b. Hardware Schedule shall be prepared and signed by an AHC.
- 4. Installer's Qualifications: Firm with 3-years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
- 5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
 - a. Provide UL listed hardware for labeled and 20-minute openings in conformance with requirements for class of opening scheduled.
 - b. UL requirements have precedence over this specification where conflict exists.
- 6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.
- B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Comply with Division 01, General Requirements.
 - 1. Deliver products in original unopened packaging with legible manufacturer's identification.
 - 2. Package hardware to prevent damage during transit and storage.
 - 3. Mark hardware to correspond with "reviewed hardware schedule".
 - 4. Deliver hardware to door and frame manufacturer upon request.
- B. Storage and Protection: Comply with manufacturer's recommendations.

1.06 PROJECT CONDITIONS

- A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.
- B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

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1.07 WARRANTY

- A. Refer to Conditions of the Contract.
- B. Manufacturer's Warranty:
 - 1. Closers: Ten years.
 - 2. Exit Devices: Five Years.
 - 3. Locksets and Cylinders: Three years.
 - 4. All other Hardware: Two years.

1.08 OWNER'S INSTRUCTION

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.09 MAINTENANCE

- A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 01, General Requirements.
 - 1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
 - 2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
 - 3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.
- B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1, General Requirements.

<u>Item</u> :	Manufacturer:	Approved:
Hinges	Stanley	Bommer, McKinney
Locksets	Best	
Cylinders	Best	
Exit Devices	Precision Apex	Von Duprin 98/99
Closers	Stanley D4550	Norton 7500

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Item:	Manufacturer:	<u>Approved</u> :
Protection Plates	Trimco	Burns, Rockwood
Flush Bolts	ABH	Trimco, Burns
Coordinator and	Trimco	ABH, Burns
Brackets		
Threshold and	National Guard	Reese, Zero
Gasketing		

2.02 MATERIALS:

- A. Hinges:
 - 1. Template screw hole locations.
 - 2. Minimum of two permanently lubricated non-detachable bearings.
 - 3. Equip with easily seated, non-rising pins.
 - 4. Sufficient size to allow 180-degree swing of door.
 - 5. Furnish hinges with five knuckles and flush concealed bearings.
 - 6. Provide hinge type as listed in schedule.
 - 7. Furnish 3 hinges per leaf to 7-foot 6-inch height. Add one for each Additional 30 inches in height or fraction thereof.
 - 8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish.
 - 9. UL10C listed for Fire rated doors.
- B. Mortise Type Locks and Latches:
 - 1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C.
 - 2. Furnish UL or recognized independent laboratory certified mechanical operational testing to 4 million cycles minimum.
 - 3. Provide 9001-Quality Management and 14001-Environmental Management.
 - 4. Fit ANSI A115.1 door preparation.
 - 5. Functions and design as indicated in the hardware groups.
 - 6. Solid, one-piece, 3/4-inch (19 mm) throw, anti-friction latchbolt made of self-lubricating stainless steel.
 - 7. Deadbolt functions shall have 1-inch (25 mm) throw bolt made of hardened stainless steel.
 - 8. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8-inch (9.5 mm) when fully extended.
 - 9. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated.
 - 10. Provide sufficient curved strike lip to protect door trim.

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- 11. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable.
- 12. Lock shall have self-aligning, thru-bolted trim.
- 13. Levers to operate a roller bearing spindle hub mechanism.
- 14. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
- 15. Spindle to be designed to prevent forced entry from attacking of lever.
- 16. Provide locksets with seven-pin removable and interchangeable core cylinders.
- 17. Each lever to have independent spring mechanism controlling it.
- C. Door Closers shall:
 - 1. Tested and approved by BHMA for ANSI 156.4, Grade 1.
 - 2. UL10C certified.
 - 3. Provide 9001-Quality Management and 14001-Environmental Management.
 - 4. Closer shall have extra-duty arms and knuckles.
 - 5. Conform to ANSI 117.1.
 - 6. Maximum 2-7/16-inch case projection with non-ferrous cover.
 - 7. Separate adjusting valves for closing and latching speed, and backcheck.
 - 8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions.
 - 9. Full rack and pinion type closer with 1-1/2 inches minimum bore.
 - 10. Mount closers on non-public side of door, unless otherwise noted in Specification.
 - 11. Closers shall be non-handed, non-sized and multi-sized.
- D. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1-inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- E. Mop plates: Provide with four beveled edges ANSI J103, 4 inches high by width less 1-inch on single doors and 1-inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- F. Door Bolts: Flush bolts for wood or metal doors.
 - 1. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
 - 2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.

- 3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
- 4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.
- G. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.
 - 1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
 - 2. Provide mounting brackets for soffit applied hardware.
 - 3. Provide hardware preparation (cutouts) for latches as necessary.
- H. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.
 - 1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone).
 - 2. UL10C Positive Pressure rated seal set when required.
- I. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.
 - 1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone).
 - 2. UL10C Positive Pressure rated seal set when required.
- J. Thresholds: Thresholds shall be aluminum beveled type with maximum height of 1/2-inch for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

2.03 FINISH

- A. Designations used in Schedule of Finish Hardware paragraph 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products.
- B. Powder coat door closers to match other hardware, unless otherwise noted.
- C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.04 KEYS AND KEYING

- A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.
- B. Cylinders, removable and interchangeable core system: Best CORMAXTM Patented seven-pin.
- C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."
- D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.
- E. Furnish keys in the following quantities:
 - 1. One each Grand Masterkeys.
 - 2. Four each Masterkeys.
 - 3. Two each Change keys each keyed core.
 - 4. Fifteen each Construction Masterkeys.
 - 5. One each Control keys.
- F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.
- G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish three typed copies of keying and programming schedule to Architect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
 - 1. Do not proceed until unsatisfactory conditions have been corrected.

3.02 HARDWARE LOCATIONS

- A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
 - 1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
 - 2. Recommended locations for Architectural Hardware for flush wood doors (DHI).
 - 3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.03 INSTALLATION

- A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- B. Conform to local governing agency security ordinance.
- C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.
 - 1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.
- D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

3.04 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

- A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final Shop Drawings.
 - 1. Check and adjust closers to ensure proper operation.
 - 2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
 - a. Verify levers are free from binding.
 - b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

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3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.05 SCHEDULE OF FINISH HARDWARE

A. Manufacturer List:

Name
ABH Manufacturing Inc.
Adams Rite
Best Access Systems
National Guard
Precision
Stanley Door Closers
By Others
Stanley
Trimco

B. Finish List:

<u>Code</u>	Description
AL	Aluminum
606	Satin Brass, Clear Coated
625	Bright Chromium Plated
626	Satin Chromium Plated
628	Satin Aluminum, Clear Anodized
630	Satin Stainless Steel
689	Aluminum Painted
626W	Weatherized Satin Chrome
628C	Nylon Silver Coated
GREY	Grey
BLACK	Black
US32D	Stainless Steel, Dull

C. Option List:

Code	Description
CD	Cylinder Dogging
FL	Fire Exit Hardware
M5	Galvanized Steel Chain
WC	Padlock Weather Covers
CSK	Counter Sinking Kick / Mop Plates

D. Hardware Sets:

SET #1 – Wood Doors (Privacy Set with key)

BHMA Function # 04 Office with thumb turn and entry lock Doors: 003, 005

3 EA Hinge1 EA Privacy Lockset1 EA Wall Stop3 EA Silencer

SET #2 – Wood Doors (Storage set with key)

BHMA Function # 04 Office with thumb turn and entry lock Doors: 013

3 EA Hinge1 EA Storage Lockset1 EA Wall Stop3 EA Silencer

SET #3 –Aluminum and Glass Entrance Doors

Specification Section 08 41 13, Aluminum-Framed Entrances and Storefronts Exterior-provide testing and impact resistant tested assembly Doors: 001

1 EA Parallel Door Closer with stop
3 EA Hinge
1 EA Entrance Lockset with Lever Handle
Jamb and head door Weather-stripping
1 EA Door Sweep
1 EA Threshold, aluminum anodized serrated
1 EA Pull

SET #4– Aluminum Flush Single Exterior Door

BHMA Function # 04 Storage lock function Exterior-provide testing and impact resistant tested assembly Doors: 004, 011, 012, 014

EA Parallel Door Closer with integral stop
 EA Hinge
 EA Lockset with Lever Handle
 EA Keyed Deadlock on exterior, operated by lever

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- 1 Set jamb and head seals
- 1 EA Rain Drip
- 1 EA Door Sweep
- 1 EA Threshold Clear Aluminum serrated

END OF SECTION

SECTION 08 80 00 GLAZING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI): Z97.1, Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test.
 - 2. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
 - 3. ASTM International (ASTM):
 - a. C509, Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - b. C864, Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - c. C920, Standard Specification for Elastomeric Joint Sealants.
 - d. C1036, Standard Specification for Flat Glass.
 - e. C1048, Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
 - f. C1115, Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
 - g. C1172, Standard Specification for Laminated Architectural Flat Glass.
 - h. C1193, Standard Guide for Use of Joint Sealants.
 - i. C1376, Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
 - j. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
 - k. D2843, Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
 - 1. D4802, Standard Specification for Poly(Methyl Methacrylate) Acrylic Plastic Sheet.
 - m. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - n. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - o. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
- p. E1300, Standard Practice for Determining Load Resistance of Glass in Buildings.
- q. E1425, Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylight, and Glazed Wall Systems.
- r. E1886, Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
- s. E1996, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
- t. E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.
- 4. Consumer Product Safety Commission (CPSC) Code of Federal Regulations (CFR): 16 CFR 1201, Safety Standard for Architectural Glazing Materials.
- 5. Glass Association of North America (GANA):
 - a. Glazing Manual.
 - b. Sealant Manual.
- 6. National Fenestration Rating Council Incorporated (NFRC):
 - a. 100, Procedure for Determining Fenestration Product U-Factors.
 - b. 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
 - c. 300, Standard Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.
- 7. National Fire Protection Association (NFPA):
 - a. 80, Safety Standard for Fire Doors and Other Opening Protectives.
 - b. 252, Safety Standard Methods of Fire Tests of Door Assemblies.
 - c. 257, Safety Standard on Fire Test for Window and Glass Block Assemblies.
- 8. South Coast Air Quality Management District: SCAQMD Rule 1168 Adhesive and Sealant Applications.
- 9. Underwriters Laboratories, Inc. (UL):
 - a. 752, Standard for Bullet-Resisting Equipment.
 - b. Building Materials Directory.
 - c. 10C, Standard for Safety for Positive Pressure Fire Tests of Door Assemblies.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Complete schedule of glass and glazing material to be used for each purpose.

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- b. Indicate sizes, layout, thicknesses, and loading conditions for glass.
- 2. Product Data:
 - a. Catalog cuts of glazing materials with inclusion of glass edge cutting procedures.
 - b. Glass: Provide structural, physical, and thermal and solar optical performance characteristics, size limitations, special handling or installation requirements.
 - c. Glazing Sealants, Compounds, and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.
- 3. Samples:
 - a. Glass: Two samples 12 by 12 inches in size of each type of glass, illustrating each glass units, coloration and design properly labeled.
- B. Notice of Acceptance (NOA):
 - 1. Impact-Resistant Glazing Units and Insulated Impact-Resistant Glazing Units: Provide Miami-Dade NOA number and test documentation for glazing assembly units showing manufacturer's name, missile impact ratings, anchoring, materials and minimum and maximum design pressures clearly identified for each required assembly type. Provide NOA with valid expiration date.
 - 2. NOA Labeling: Each unit assembly shall bear a permanent label with the manufacturer's name and logo, city, state, and the following statement, "Miami-Dade County Product Control Approved", unless otherwise noted.
- C. Informational Submittals:
 - 1. Design calculations for glass thicknesses. Signed and sealed by professional engineer registered in Florida.
 - 2. Manufacturer's Certificate of Compliance for each type of glazing, in accordance with Section 01 61 00, Common Product Requirements.
 - 3. Details and methods of glazing for each type of glazing condition; include manufacturer's recommendations for setting, sealing materials, and installing each type of glazing.
 - 4. Documentation declaring compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants and other glazing materials.
 - 5. Documentation of glazer's previous experience and manufacturer's approval.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing Work of this section with minimum 3 years' documented experience approved by manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Storage:
 - 1. Support cases on both sides when stored vertically.
 - 2. After unpacking, place interleaving protection between lites.
 - 3. Keep glass and interleaving dry by storing inside where temperatures are above dewpoint, or if outside storage is necessary, cover glass interleaving with opaque tarpaulins or plastic and inspect periodically. Wet interleaving can stain glass.
 - 4. Avoid exposing stored glass to direct sunlight.
- B. Handling:
 - 1. Stack individual lites on edge and lean them against sturdy uprights at a slope of 5 degrees to 7 degrees from vertical.
 - 2. Cushion bottom edges with soft, firm pads free of dirt, grit, glass chips, or other foreign material.
 - 3. Do not rotate or cartwheel insulating glass units over their corners. Use turning device such as a rolling block if units must be rotated.

1.05 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction, or at option of Owner, removal and replacement of Work specified in this Specification section found defective during a period of 10 years for vertical application insulating glass after date of Substantial Completion. Guarantee to cover deterioration because of normal conditions of use and not because of handling installing and cleaning practices performed contrary to glass manufacturer's published instructions. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Single Source Fabrication Responsibility: Fabrication processes including Low-E and reflective coatings, insulating, laminating, silkscreen, and tempering, shall be fabricated by a single fabricator.

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- B. Performance/Design Criteria:
 - 1. Provide glass and glazing materials for continuity of building enclosure vapor retarder and air barrier:
 - a. In conjunction with vapor retarder and air barrier materials described in section.
 - b. To utilize inner pane of multiple pane sealed units for continuity of air barrier and vapor retarder seal.
 - c. To maintain continuous air barrier and vapor retarder throughout glazed assembly from glass pane to heel bead of glazing sealant.
 - 2. Glass Thickness: Select minimum thickness in accordance with ASTM E1300 to resist specified design loads with the following maximum probability of breakage:
 - a. Vertical Glass: Eight lites per 1,000 for wind loads with 60 seconds maximum load duration.
 - b. Minimum Thickness: 1/4-inch for exterior glass.
- C. Structural Design: Design in accordance with Florida Building Code for most critical combination of wind, snow, seismic, and dead loads.
- D. Wind Loads: Design and size glass to withstand positive and negative wind loads acting normal to plane of wall, including increased loads at building corners.
 - 1. Design Wind pressures for components and cladding as shown on the Structural Drawings.
 - 2. Wind-Borne Debris Loads: Design and size glass located less than 60 feet (18.288 m) abovegrade to withstand the following loads:
 - a. Glass Within 30 Feet (9.144 m) of Grade: ASTM E1886 and ASTM E1996; large missile impact test.
 - b. Glass Greater than 30 Feet (9.144 m) Abovegrade: ASTM E1886 and ASTM E1996; small missile impact test.
 - 3. Exterior Glass Deflection: Maximum of 1/175 of glass edge length or 3/4 inch (19 mm), whichever is less with full recovery of glazing materials.
 - 4. Interior Glass Deflection: Maximum differential deflection for two adjacent unsupported edges when 50 plf (730 N/m) force is applied to one panel at any point up to 42 inches (1067 mm) above finished floor less than thickness of glass.
 - 5. Thermal and Solar Optical Performance: Measured or calculated in accordance with the following:
 - a. U-Values: NFRC 100.
 - b. Solar Heat Gain Coefficients: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

- E. Recycled Content Materials: Furnish materials with recycled content including post-consumer and pre-consumer recycled content.
 - 1. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles (800 km) of Project Site.

2.02 FLOAT GLASS PRODUCTS

- A. Clear Glass:
 - 1. Heat strengthened (FG-CH) or Tempered (FC-CT) float glass as specified; Class 1 clear.
 - 2. Minimum Thickness: 1/4-inch.
- B. Low E Glass:
 - 1. Heat strengthened, tinted (FG-ETH) or tempered float glass as specified; Class 2 tinted.
 - 2. Minimum Thickness: 1/4-inch.
 - 3. Tint: Gray.
 - 4. Coating: ASTM C1376; pyrolytic.
 - C. Manufacturers:
 - 1. Viracon.
 - 2. ACH Glass Operations
 - 3. AFG Industries, Inc.
 - 4. Oldcastle Glass.

2.03 INSULATING GLASS PRODUCTS

- A. Laminated Insulating Glass:
 - 1. ASTM E2190 certified by Insulating Glass Certification Council and Insulating Glass Manufacturers Alliance; with glass elastomer edge seal; place reflective film within unit; purge interpane space with dry hermetic air.
 - 2. Total Unit Thickness: 1-5/16-inch unless otherwise indicated.
 - 3. Insulating Glass Unit Edge Seal Construction: Stainless steel, thermally broken, bent and soldered corners.
 - 4. StormGuard by Viracon "Or-equal," approved.

2.04 GLAZING SEALANTS

- A. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, insulating glass seals, and glazing channels.
 - 1. Silicone Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component curing; capable of water immersion without loss of properties; nonbleeding, nonstaining, cured Shore A Hardness Range 15 to 25.
- B. Dense Gaskets:
 - 1. Resilient extruded shape to suit glazing channel retaining slot; black.
 - 2. Neoprene: ASTM C864.
 - 3. EPDM: ASTM C864.
 - 4. Silicone: ASTM C1115.
- C. Soft Gaskets:
 - 1. ASTM C509 Type II; resilient extruded shape to suit glazing channel retaining slot; black.
 - 2. Neoprene.
 - 3. EPDM.
 - 4. Silicone.
- D. Preformed Glazing Tape:
 - 1. Size to suit application.
 - 2. Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.
 - 3. Butyl Corner Sealant: ASTM C920 single component nonskinning butyl compatible with glazing tape; color to match tape.

2.05 GLAZING ACCESSORIES

- A. Setting Blocks: Elastomeric material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3-inch (75-mm) long by one half the height of glazing stop by thickness to suit application self-adhesive on one face.

C. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings for glazing are correctly sized and within acceptable tolerance.
- B. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear and ready to receive glazing.

3.02 PREPARATION

- A. Do not perform glazing work in damp, foggy, or rainy weather, or when temperatures are not within range recommended by GANA "Glazing Manual".
- B. Surfaces:
 - 1. Smooth, even, sound, dry, and clean.
 - 2. Clean contact surfaces with solvent and wipe dry.
- C. Priming:
 - 1. Complete and cured.
 - 2. Prime surfaces scheduled to receive sealant.
- D. Measure size of frames to receive glass and compute actual glass size allowing for edge clearances.
- E. Verify functioning weep system is present.
- F. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.03 GLAZING INSTALLATION

- A. General: Follow recommendations of glass manufacturer GANA "Sealant Manual, GANA "Glazing Manual" and the following:
 - 1. Glazing Sealants: Comply with ASTM C1193.
 - 2. Fire Rated Openings: Comply with NFPA 80.

- B. Exterior Wet/Dry Method (Preformed Tape and Sealant) Installation:
 - Cut glazing tape to length and set against permanent stops, 3/16-inch (5 mm) below sight line. Seal corners by butting tape and dabbing with compatible butyl sealant.
 - 2. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapor seal.
 - 3. Place setting blocks at 1/4 points with edge block no more than 6 inches (150 mm) from corners.
 - 4. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
 - 5. Fill gap between glazing and stop with elastomeric glazing sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch (9 mm) below sight line.
 - 6. Apply cap bead of elastomeric glazing sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
- C. Interior Dry Method (Tape and Tape) Installation:
 - 1. Cut glazing tape to length and set against permanent stops, projecting 1/16-inch (1.6 mm) above sight line.
 - 2. Place setting blocks at 1/4 points with edge block no more than 6 inches (150 mm) from corners.
 - 3. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
 - 4. Place glazing tape on free perimeter of glazing in same manner described above.
 - 5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
 - 6. Knife trim protruding tape.

3.04 FIELD QUALITY CONTROL

- A. Hose Test:
 - 1. Use 3/4-inch minimum hose without nozzle. With full stream, flood glazing from bottom to top.
 - 2. Correct leaks disclosed by hose test by reglazing and retesting until eliminated.

ROGER SCOTT POOL FACILITIES

3.05 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's representative at Site for installation assistance and inspection.

3.06 CLEANING

- A. Leave glass and glazing in undamaged condition and ready for final cleaning.
- B. Remove excess glazing compound from installed glass.
- C. Remove labels from glass surface at time of final cleaning.
- D. Wash and polish both faces of glass.
- E. Clean adjacent surfaces of glass.

3.07 PROTECTION OF COMPLETED WORK

- A. Protection:
 - 1. Keep glass free from contamination by materials capable of staining glass.
 - 2. Install tape across lights secured to frames or structure.
 - 3. No tape or marking allowed on glass.
- B. Replacements and Repairs: Prior to Substantial Completion, replace broken, defective, or scratched glass and repair damaged compounds.

END OF SECTION

SECTION 08 90 00 LOUVERS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Movement and Control Association (AMCA): 500-L, Laboratory Methods of Testing Louvers for Rating.
 - 2. The Aluminum Association, Incorporated (AA): Designation System for Aluminum Finishes.
 - 3. ASTM International (ASTM):
 - a. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - b. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 4. UL: Building Materials Directory.

1.02 DESIGN REQUIREMENTS

A. Wind Loads: Provide louver assemblies and their anchorage to the wall structure that are capable of withstanding the positive and negative wind load pressures shown on the Components and Cladding Wind Surface Pressures table on the Structural Drawings.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Large scale details of louvers, anchorage, and relationship to adjoining construction.
 - a. Manufacturer's Literature: Descriptive and performance data of louvers, including standard drawings and louver-free area.
 - 2. Samples: Manufacturer's standard finishes and colors.
 - 3. Product/Code Certification: Provide written verification that submitted louver assembly and installation method meet or exceed Project Design Requirements, in this section, by one, or more, of the following methods as allowed for by FBC:
 - a. Florida Product Approval for complete louver assembly.
 - b. Rational Comparative Analysis: Testing data, calculations, and verification documents signed and sealed by a professional engineer registered in the State of Florida.
 - c. Local product approval by Authority Having Jurisdiction (AHJ).

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- B. Informational Submittals:
 - 1. Factory test data.
 - 2. Certificates of AMCA ratings.
 - 3. Installation instructions.
 - 4. Parts list, if applicable.
 - 5. Maintenance procedures.
 - 6. Special Guarantee.
 - 7. Third party testing documentation or manufacturer's literature qualifying louver assembly as meeting required developed wind pressures for Project as shown on the Components and Cladding Wind Surface Pressures table on the Structural Drawings.

1.04 SPECIAL GUARANTEE

A. Manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction, or at option of Owner, removal and replacement of special fluorocarbon or baked-on finish found defective during a period of 20 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Hurricane-rated louver sizes are based on 46 percent free area and 500 fpm maximum velocity through free area.
- B. Water Penetration Rate: No greater than 0.02 ounce per square foot.
- C. Louvers: Rated and tested in accordance with AMCA 500-L.
- D. Furnish louvers with interior duct collars.

2.02 FIXED STORMPROOF LOUVERS (TYPE SP)

- A. Frame: Extruded aluminum channel, 0.081-inch thick, 6 inches deep, with concealed mullions.
- B. Blades: Extruded aluminum, 0.081-inch thick, Z-shaped, 35-degree to 45-degree pitch angle, spaced 3 inches to 4.25 inches on center.
- C. Pressure Loss: AMCA certified rating of no greater than 0.10-inch WC.

- D. Sizes: As shown on the Drawings.
- E. Screen: Inside mounted, painted aluminum, 1/2-inch mesh.
- F. Finish: Kynar 500 fluorocarbon coating.
- G. Manufacturers and Products:
 - 1. Ruskin; Model ELF6375DXD 6-inch Deep Horizontal Drainable Hurricane Louver "Or-equal," approved.

2.03 ACCESSORIES

- A. Anchors and Fasteners: Stainless steel.
- B. Flashings: Match louver frame.
- C. Isolation Tape: Tremco 440, 3M EC1202, or Presstite 579.6.
- D. Isolation Paint: ASTM D1187, bituminous coating.

2.04 SOURCE QUALITY CONTROL

- A. Factory Performance Tests:
 - 1. Airflow versus pressure loss.
 - 2. Rain penetration data.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Check openings to ensure dimensions conform to the Drawings.
- B. Ensure openings are free of irregularities that would interfere with installation.
- C. Do not install louvers until defects have been corrected.

3.02 INSTALLATION

- A. Install louvers as shown on reviewed Shop Drawings. Coordinate with heating or ventilation ductwork to be connected.
- B. Follow procedures in manufacturer's recommended installation instructions.
- C. Separate aluminum from other metals with isolation tape or paint.

3.03 CLEANING

- A. After erection, protect exposed portions from damage by machines, paint, lime, acid, cement, or other harmful compounds.
- B. Remove protective materials and clean with plain water, water with soap, or household detergents.

END OF SECTION

SECTION 09 29 00 GYPSUM BOARD

PART 1 GENERAL

1.01 GENERAL:

- A. Section includes:
 - 1. Gypsum Board.
 - 2. Non-Structural Framing.
- B. Related sections:
 - 1. Section 07 21 01, Thermal Insulation.
 - 2. Section 09 90 05 Architectural Painting.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI): A118.9, Test Methods and Specifications for Cementitious Backer Units.
 - 2. ASTM International (ASTM):
 - a. A641/A641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - b. C208, Standard Specification for Cellulosic Fiber Insulating Board.
 - c. C475/C475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - d. C514, Standard Specification for Nails for the Application of Gypsum Board.
 - e. C645, Standard Specification for Nonstructural Steel Framing Members.
 - f. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - g. C754, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - h. C840, Standard Specification for Application and Finishing of Gypsum Board.
 - i. C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

- j. C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- k. C1177/C1177M, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- 1. C1178/C1178M, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel.
- m. C1396/C1396M, Standard Specification for Gypsum Board.
- n. D4977, Standard Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion.
- o. D5420, Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
- p. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- q. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- r. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
- s. E413, Classification for Rating Sound Insulation.
- t. E695, Standard Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading.
- 3. Gypsum Association (GA):
 - a. 214, Recommended Levels of Gypsum Board Finish.
 - b. 216, Application and Finishing of Gypsum Panel Products.
- 4. UL: UL Fire Resistance Directory.

1.03 SUBMITTALS

- A. Submittals:
 - 1. Control joint pattern proposed for gypsum board.
 - 2. Control joint pattern proposed for gypsum soffit.
 - 3. Manufacturer's list of items and materials proposed for use, with descriptive literature for each system used.
 - 4. Manufacturer's product data for adhesives and sealants including printed statement of VOC content and material safety data sheets.

1.04 QUALITY ASSURANCE

A. General: Regardless of the minimum specifications herein, utilize materials and applications recommended by manufacturer.

- B. Applicator's Qualifications: Use only workers regularly employed in this type of work who can show experience in application of similar materials and specific systems specified.
- C. Single Source Responsibility: Use gypsum board and related joint treatment materials from a single manufacturer for each type used.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver fire-rated materials bearing testing agency label and required fire classification numbers.
- B. Storage:
 - 1. Store materials inside, under cover, stacked flat, off floor.
 - 2. Stack gypsum board so that long lengths are not over short lengths.
 - 3. Avoid overloading floor system of storage area.
 - 4. Store adhesives and finishing compounds in dry areas; protect against freezing at all times.

1.06 ENVIRONMENTAL CONDITIONS

- A. Temperature: In areas receiving gypsum board installation, maintain minimum temperature of 40 degrees F for 48 hours before, during, and after gypsum board application. Maintain minimum temperature of 50 degrees F for 48 hours before, during, and after application of adhesive methods of attachment and finishing compounds until drying is complete.
- B. Ventilation:
 - 1. Provide ventilation during and following adhesives and joint treatment applications.
 - 2. Use temporary air circulators in enclosed areas lacking natural ventilation.
 - 3. Under slow drying conditions, allow additional drying time between coats of joint treatment.
 - 4. Protect installed materials from drafts of ambient air during hot, dry weather.
 - 5. Protect materials from drying too rapidly during hot and dry weather.

PART 2 PRODUCTS

2.01 GYPSUM BOARD

A. Regular Board (GWB): ASTM C1396/C1396M, 5/8-inch thick with tapered edges.

- B. Abuse Resistant Board (ARWB): ASTM C1396/C1396M, Type X, 5/8-inch thick as manufactured by:
 - 1. National Gypsum Company; Gold Bond Hi-Abuse Wallboard.
 - 2. United States Gypsum Co.; SHEETROCK Brand Abuse-Resistant Gypsum Panels.

2.02 TILE BACKING PANELS

- A. Cementitious Backer Board (CBB):
 - 1. Aggregated portland cement panel reinforced with vinyl-coated, woven fiberglass mesh embedded in both surfaces meeting ANSI A118.9.
 - 2. Thickness: 1/2-inch.
 - 3. Manufacturers and Products:
 - a. Custom Building Products; Wonderboard.
 - b. United States Gypsum; Durock.

2.03 FASTENERS

- A. Gypsum Board:
 - 1. Annular Ring Nail: ASTM C514, GWB-54, 1-1/4 inches long for 1/2-inch gypsum board, and 1-3/8 inches long for 5/8-inch gypsum board.
 - 2. Smooth Shank Nail: ASTM C514, 1-3/8 inches long for 1/2-inch gypsum board, and 1-1/2 inches long for 5/8-inch gypsum board.
 - 3. Screws: ASTM C1002, self-drilling, self-tapping, bugle head, for use with power-driven tool.
 - a. Type S, 1-inch long for gypsum board to sheet metal.
 - b. Type W, 1-1/4 inches long for gypsum board to wood.
- B. Glass Mesh Mortar Units/Cementitious Backer Board:
 - 1. Screws: ASTM C1002, self-drilling, self-tapping, bugle head, for use with power-driven tool.
 - a. Type S, 1-1/4-inch, Hi-Lo for wood or 22-gauge to 25-gauge steel framing.
 - b. Type S-12, 1-1/4-inch, for 14-gauge to 20-gauge steel framing; 1-15/16 inch.
 - c. Type S-12, Pilot Point for steel joists.
 - 2. Nails: 1-1/4-inch galvanized roofing nail with 7/16-inch diameter head for wood framing.

2.04 JOINT TREATMENT MATERIALS

- A. Tape:
 - 1. General Interior Applications: ASTM C475/C475M, perforated paper tape.
 - 2. Soffit Board, Glass Mesh Mortar Units, and Cementitious Backer Board: 2-inch wide 10 by 10 open weave glass mesh tape as recommended by manufacturer.
- B. Compound:
 - 1. General Interior Applications: ASTM C475/C475M, all-purpose, ready-mixed compound.
 - 2. Water-Resistant GWB and Soffit Boards: Chemically curing, polyindurate type material as recommended by manufacturer.

2.05 ANCILLARY MATERIALS

- A. Adhesives: As recommended by gypsum board manufacturer for intended use.
- B. Sound Attenuation Blankets: ASTM C665, Type I (no facing), 3 inches thick.
- C. Acoustical Sealant:
 - 1. Nonsetting and nonstaining with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Manufacturers:
 - a. DAP.
 - b. United States Gypsum.
 - c. Tremco.
 - d. Ohio Sealants, Inc.

2.06 TRIM ACCESSORIES

- A. ASTM C1047, Zinc-Coated Metal.
- B. Manufacturers and Products:
 - 1. Corner Bead:
 - a. 1-1/4 inches by 1-1/4 inches:
 - 1) United States Gypsum; Dur-A-Bead.
 - 2) Gold Bond; standard corner beads.
 - 2. Edge Trim:
 - a. United States Gypsum; 200B metal trim.
 - b. Gold Bond; No. 200 casing bead.

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- 3. Metal Control Joint:
 - a. United States Gypsum; No. 093.
 - b. Gold Bond; E-Z strip control joint.

2.07 NONSTRUCTURAL METAL FRAMING MEMBERS

- A. ASTM C645, galvanized C-studs with 1-5/8-inch flanges and C-H studs with J-runners.
- B. Sizes and Gauge: As noted on the Drawings.
- C. Manufacturers:
 - 1. United States Gypsum.
 - 2. Dale/Incor.
 - 3. Gold Bond.
 - 4. Unimast, Inc.

2.08 LIGHT-GAUGE METAL FRAMING ACCESSORIES

- A. Cold-Rolled Carrying Channel: Cold-rolled steel, 16-gauge metal with minimum 1/2-inch wide flange, galvanized 1-1/2 inches deep.
- B. Cold-Rolled Bridging Channel: Cold-rolled steel, 16-gauge metal with minimum 1/2-inch wide flange galvanized 1-1/2 inches deep.
- C. Cold-Rolled Furring Channel: Cold-rolled steel, 25-gauge metal with minimum 1/2-inch wide flange, galvanized 3/4 inches deep.
- D. Z-Furring: Galvanized 25-gauge, 2-1/2 inch(es) deep.
- E. Hat-Shaped Furring Channels: Roll-formed hat shaped section of 25-gauge galvanized steel with a face width of 1-1/4 inches and a depth of 7/8 inch.
- F. Resilient Furring Channels: Roll-formed section of 25-gauge galvanized steel with face width of 1-1/2 inches designed for resilient attachment of gypsum board to framing.
- G. Hanger Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- H. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.625-inch diameter or double strand of 0.0475-inch diameter wire.

2.09 DRY WALL CEILING SUSPENSION SYSTEM

A. Use system of main runners, cross tees, and furring channels.

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- B. Manufacturers:
 - 1. Armstrong World Industries, Inc.; Furring Systems/Drywall.
 - 2. Chicago Metallic Corporation.
 - 3. USG Interiors, Inc.; Drywall Suspension System.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect surfaces to receive gypsum board and related materials before beginning work and report to Engineer any defects in such work which will adversely affect the quality of work specified herein.

3.02 PREPARATION

- A. General: Provide, install, and maintain necessary scaffold, staging, trestles, planking, and temporary heating, lighting, and ventilation as necessary for duration of gypsum board work.
- B. Protection: Protect work of other trades.
- C. Coordination:
 - 1. Coordinate work with that of other trades. Check Specifications and Drawings of other trades to determine parts of work requiring coordination.
 - 2. Cut and repair gypsum board systems for installation of omitted work.
- D. Surface Preparation: Repair defective surfaces prior to starting work. Prepare as specified for application of specific materials.

3.03 ERECTION OF SUSPENDED CEILING

- A. General:
 - 1. Securely brace all ceiling areas against sway as required by code for seismic control.
 - 2. Prevent runner and furring channels from contacting masonry walls.
 - 3. Provide 1-1/2-inch channels around recessed lighting fixture openings to support fixtures.
- B. Hangers:
 - 1. Space not over 4 feet on center (OC) in direction of runners and within 6 inches of ends of runners.

- 2. Securely attach to structure above and provide for full saddle tie to main runner at indicated height.
- 3. Install additional hangers at ends of each suspension member and at light fixtures, 6 inches from vertical surfaces.
- 4. Do not splay wires more than 5 inches in a 4-foot vertical drop.
- 5. Provide four-way wire splays at 45 degrees from main runner to support structure for every 144 square feet of ceiling area to prevent sway.
- 6. Wrap wire minimum three times horizontally, turning ends upward.
- 7. Where hanger wires cannot be hung vertically from structure above because of ducts, pipes, cable trays, or other interferences, provide trapezes of steel channels (minimum 2-inch deep, 16-gauge cold-rolled carrying channels) hung on steel rods or 8-gauge wire from structural members above. Hang ceiling wires from trapezes or similar members supporting ducts or pipes. Do not hang directly from ducts or pipes.
- C. Main Runner Channels:
 - 1. Run main runner channels spaced not more than 4 feet OC, and 6 inches from parallel walls, at right angles to the length of joists.
 - 2. Overlap splices in main runners 12 inches minimum, interlock flanges, and securely tie near each end of splice with double loops of tie wire.
- D. Furring Channels:
 - 1. Attach furring channels to main runners at right angles, space at 16 inches OC.
 - 2. Securely saddle tie furring to the main runners at each crossing or equivalent clips or attachments.
 - 3. Splices in Cross-Furring: Lap 8 inches minimum, interlock flanges, and securely tie near each end of splice with two loops of tie wire.

3.04 ERECTION OF DRY WALL CEILING SUSPENSION SYSTEM

- A. Follow manufacturer's printed instructions.
- B. Hangers:
 - 1. Space not over 4 feet OC in direction of runners and within 6 inches of ends of runners.
 - 2. Securely attach to structure above and provide for full saddle tie to main runner at indicated height.
 - 3. Connections shall develop full strength of hanger wire.
- C. Bracing:
 - 1. Securely brace ceiling areas against sway.

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- 2. Where required by code, install for seismic control.
- 3. Prevent runner and furring channels from contacting masonry walls.
- D. Where ducts interfere with normal spacing of hangers and carrying channels, install additional hangers and channels to properly suspend ceiling.

3.05 ERECTION OF LIGHT-GAUGE NONSTRUCTURAL METAL FRAMING

- A. Layout: Align partitions as shown on the Drawings.
- B. Tracks:
 - 1. Attach metal runner tracks to floor slabs with suitable fasteners located 2 inches from each end and spaced not more than 24 inches OC.
 - 2. Where partitions terminate at suspended or framed ceilings attach top tracks to suspended ceiling with toggle or molly bolts spaced 24 inches OC.
 - 3. Where partitions terminate above suspended ceilings provide diagonal bracing from top of partitions to structure above. Bracing shall be 3-5/8-inch metal studs staggered at 48 inches OC.
 - 4. Where partitions terminate at underside of concrete or metal decking attach deflection channels to substrate with suitable fasteners located 2 inches from each end and spaced not more than 24 inches OC. Locate partition top tracks within deflection channels with a minimum top clearance of 1-inch. Do not attach track to channel.
- C. Studs:
 - 1. ASTM C754.
 - 2. Following manufacturer's printed instructions, position studs vertically, engaging floor and ceiling tracks and spaced as noted on the Drawings.
 - 3. Splice: When necessary, use 8-inch nested lap and one positive attachment per stud flange.
 - 4. Place in direct contact with doorframe jambs, abutting partitions, and partition corners. Provide for anchorage of doorframes to studs.
 - 5. Anchor studs for shelf-walls and those adjacent to window and doorframes, partition intersections, and corners to ceiling and floor runner flanges. Securely anchor studs to jamb and head anchor clips of door or borrowed-light frames by bolt or screw attachment.
 - 6. Over metal door and borrowed-light frames, place horizontally a cut-tolength section of runner, with a web-flanged bend at each end, and secure with one positive attachment per flange. Position a cut-to-length stud (extending to ceiling runner) at vertical panel joints over doorframe header.
 - 7. Locate studs at abutting construction, partition intersections, and partition corners.

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- 8. Spacing: At 16 inches OC, unless otherwise required by manufacturer.
- 9. At Doorframes and Cased Openings:
 - a. Full height double studs, No. 20 gauge minimum, secured to jamb anchors by bolts, screws, or welds.
 - b. Header Track: Secure to frame head anchors and double studs.
 - c. Provide double channel stiffeners through studs above frame and extend at least one stud space beyond each jamb.
- 10. Windows: Similar framing to door openings with stiffeners both above and below.
- 11. Wall Mounting Accessories: Provide channels, horizontal studding, No. 16 gauge sheet 8 inches by 2 inches greater than stud spacing, or other members within walls as required to provide secure and adequate support.
- D. Furring:
 - 1. Space furring channels the same as studs or as shown.
 - 2. Around columns and beams construct furring as shown using metal studs and furring channels securely tied together and anchored in-place.
 - 3. Attach resilient furring channels to wood framing with screws.

3.06 APPLICATION OF GYPSUM BOARD

- A. Inspection and Preparation:
 - 1. Check framing for accurate spacing and alignment.
 - 2. Verify spacing of installed framing does not exceed maximum allowable for thickness of gypsum board to be used.
 - 3. Verify frames are set for thickness of gypsum board to be used.
 - 4. Do not proceed with installation of gypsum board until deficiencies are corrected and surfaces to receive gypsum board are acceptable.
 - 5. Repair protrusions of framing, twisted framing members, or unaligned members before installation of gypsum board is started.
- B. General:
 - 1. Meet requirements of ASTM C840 and GA 216.
 - 2. Joints: Use gypsum board of maximum lengths to minimize end joints. Stagger end joints when they occur. Locate end joints as far as possible from center of wall or ceiling. Abut gypsum board without forcing. Neatly fit ends and edges of gypsum board. Do not place butt ends against tapered edges.
 - 3. Support ends and edges of gypsum board panels on framing or furring members except for face layer of double layer and where ends are back blocked and floated.

- 4. Use metal edge trim where gypsum board abuts another material, at corners, and where shown or noted on the Drawings.
- 5. Use cementitious backer board in toilet, shower, and janitor room walls behind ceramic tile and elsewhere as indicated on the Drawings.
- 6. Follow manufacturer's recommendation of good practice.
- C. Over Framing:
 - 1. Apply gypsum board first to ceiling and then to walls for single layer horizontal application.
 - 2. Use vertical application for fire-rated walls.
 - 3. Fasten gypsum board securely to framing using double nailing, screw, or adhesive method.
- D. Sound-Rated Partitions:
 - 1. Fabricate and erect in accordance with manufacturer's printed instructions for required rating.
 - 2. Install sound-deadening board and attenuation blankets as detailed.
 - 3. Seal with acoustical sealant perimeter edges of gypsum board, joints around penetrations, and other joints as noted.

3.07 INSTALLATION OF CEMENTITIOUS BACKER BOARD (CBB)

- A. Follow manufacturer's printed instructions for erection, cutting, attachments, and joint treatment.
- B. Verify framing is installed at maximum 16 inches OC, and necessary blocking to support fixtures and accessories has been installed. Where backing plates or straps are used, space out from framing to ensure a smooth finish application. Do not proceed until defects are corrected and are acceptable.
- C. Precut boards to required sizes and make necessary cutouts. Fasten with appropriate fasteners. Space fasteners 6 inches OC maximum or as directed by manufacturer. Fit ends closely but not forced together. Maintain 1/4-inch spacing between edge of board and fixture. Caulk all joints and corners that are to receive tiles. Apply 2-inch glass fiber tape over joints and corners embedded with tile setting mortar.

3.08 JOINT SYSTEM FOR GYPSUM WALLBOARD

- A. Interior Gypsum Board: Conform to ASTM C840.
- B. Required: On exposed gypsum board, under ceramic tile and wall covering, and behind casework.

- C. Prefill: Fill V-grooves formed by abutting rounded edges of gypsum board with prefill joint compound. Fill V-joint flush and remove excess compound beyond groove. Leave clear depression to receive tape. Permit prefill joint compound to harden prior to application of tape.
- D. Taping and Finishing Joints:
 - 1. Taping or Embedding Coat: Apply compound in thin, uniform layer to joints and angles to be reinforced. Apply reinforcing tape immediately. Center tape over joint and seat tape into compound. Leave approximately 1/64-inch to 1/32-inch compound under tape to provide bond. Apply skim coat immediately following tape embedment but not to function as fill or second coat. Fold tape and embed in angles to provide true angle. Dry embedding coat prior to application of fill coat.
 - 2. Filling Coat: Apply joint compound over embedding coat. Fill taper flush with surface. Apply fill coat to cover tape. Feather out fill coat beyond tape and previous joint compound line. For joints with no taper, feather out at least 4 inches on either side of tape. Do not apply fill coat on interior angles. Allow fill coat to dry prior to application of finish coat.
 - 3. Finishing Coat: Spread joint compound evenly over and beyond fill coat on joints. Feather to smooth uniform finish. Apply finish coat to taped angles to cover tape and taping compound. Sand final application of compound to provide surface ready for decoration.
 - 4. Filling and Finishing Depressions: Apply joint compound as first coat to fastener depressions. Apply at least two additional coats of compound after first coat is dry. Leave filled and finished depressions level with plane of surface.
- E. Finishing Beads and Trim:
 - 1. First Fill Coat: Apply joint compound to bead and trim. Feather out from ground to plane of the surface. Dry compound prior to application of second fill coat.
 - 2. Second Fill Coat: Apply joint compound in same manner as first fill coat. Extend beyond first coat onto face of gypsum board. Dry compound prior to application of finish coat.
 - 3. Finish Coat: Apply joint compound to bead and trim. Extend beyond second fill coat. Feather finish coat from ground to plane of surface. Sand finish coat to provide flat surface ready for decoration.

3.09 FINAL FINISHES FOR GYPSUM WALLBOARD

A. Levels of Finish: Conform to GA 214.

- B. Level 1:
 - 1. Taping or embedding coat only.
 - 2. Use in concealed areas, and where indicated, unless a higher level is required for fire-resistive or sound-rated assemblies.
- C. Level 2:
 - 1. Taping, filling, and finishing coats.
 - 2. Use on water-resistant gypsum backing board.
- D. Level 3:
 - 1. Taping, filling, and finishing coats.
 - 2. Use on surfaces indicated to have spray texture or ceramic tile.
- E. Level 4:
 - 1. Taping, filling, and finishing coats plus two separate coats applied over joints, angles, fastener heads, and trim accessories.
 - 2. Sand between coats and after last coat.
 - 3. Use on surfaces indicated to receive wall coverings.
- F. Level 5:
 - 1. Same as Level 4, plus a thin, smooth, uniform skim coat of joint compound, or product specially formulated for this purpose, over entire surface.
 - 2. Produce surfaces free of tool marks and ridges, ready for decoration.
 - 3. Use on surfaces not indicated otherwise, those indicated to receive gloss, semi-gloss, and nontextured flat paints, and where indicated.

3.10 SPRAY TEXTURE

- A. Application:
 - 1. Apply on gypsum board wall following manufacturer's printed directions for a medium build peel texture.
 - 2. Before texture application, finish gypsum board as specified for Level 3.
 - 3. When surfaces are prepared and dry, apply sealer and allow to dry. Mix texture finish material as directed by manufacturer.
 - 4. Use spray equipment of a size and type to assure acceptable results.

- 5. Apply by spray only at a coverage rate as recommended by manufacturer and in accordance with directions printed on container. Apply material to blend uniformly and cover fully without starved spots or other evidence of thin application. Provide uniform texture without application patterns.
- 6. After spray application, knockdown and flatten high spots with trowel to produce a Brocade or Travertine marble texture.

3.11 ADJUST AND CLEAN

- A. Clean: Remove droppings or texture overspray from walls, windows, and floor, leaving room clean for following trades.
- B. Nail Pop: Repair nail pop by driving new nail approximately 1-1/2 inches from nail pop and reseat nail. When face paper is punctured, drive new nail or screw approximately 1-1/2 inches from defective fastening and remove defective fastening. Fill damaged surface with compound.
- C. Ridging:
 - 1. Do not repair ridging until condition has fully developed, approximately 6 months after installation or one heating season.
 - a. Sand ridges to reinforcing tape without cutting through tape.
 - b. Fill concave areas on both sides of ridge with topping compound.
 - c. After fill is dry, blend in topping compound over repaired area.
 - 2. Fill cracks with compound and finish smooth and flush.

END OF SECTION

SECTION 09 30 00 TILING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI):
 - a. A108.1A, Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar.
 - b. A108.1B, Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar.
 - c. A108.1C, Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar.
 - d. A108.4, Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive.
 - e. A108.5, Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
 - f. A108.6, Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy.
 - g. A108.8, Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout.
 - h. A108.9, Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout.
 - i. A108.10, Installation of Grout in Tilework.
 - j. A108.11, Interior Installation of Cementitious Backer Units.
 - k. A118.1, Dry-Set Portland Cement Mortar.
 - 1. A118.3, Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy and Water-Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.
 - m. A118.4, Latex-Portland Cement Mortar.
 - n. A118.5, Chemical Resistant Furan Mortars and Grouts for Tile Installation.
 - o. A118.6, Standard Cement Grouts for Tile Installation.
 - p. A118.10, Load Bearing, Bonded, Waterproof Membranes for Thin-set Ceramic Tile and Dimension Stone Installation.
 - q. A136.1, Organic Adhesives for Installation of Ceramic Tile.
 - r. A137.1, Ceramic Tile.

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- 2. ASTM International (ASTM):
 - a. A497/497M, Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete.
 - b. C144, Standard Specification for Aggregate for Masonry Mortar.
 - c. C150, Standard Specification for Portland Cement.
 - d. C206, Standard Specification for Finishing Hydrated Lime.
 - e. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - f. C267, Standard Test Method for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.
 - g. C395, Standard Specification for Chemical-Resistant Resin Mortars.
 - h. C847, Standard Specification for Metal Lath.
 - i. C920, Standard Specification for Elastomeric Joint Sealants.
 - j. D226, Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- 3. South Coast Air Quality Management District: SCAQMD Rule 1168 Adhesive and Sealant Applications.
- 4. Tile Council of North America (TCA): Handbook for Ceramic Tile Installation.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Samples:
 - a. Two for each color, pattern, and type of tile specified.
 - b. Size: Approximately 12 inches square.
 - c. Mark Samples clearly to indicate color or shade, location in which to be used, and manufacturer's name.
- B. Informational Submittals:
 - 1. Certification of Compliance: For tile, mortar, grouts, and adhesives.
 - 2. Manufacturer's Instructions: For storage, mixing, application, cleanup, and use of proposed mortars, grouts, and adhesives.
 - 3. Tile Manufacturer's Maintenance Guidelines: For Owner's use in maintaining ceramic tilework specified herein.

1.03 QUALITY ASSURANCE

A. Perform Work in accordance with TCA Handbook and ANSI A108 Series/A118 Series.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Set and grout tile in portland cement mortar when ambient temperature is at least 50 degrees F and rising. Follow ANSI A108.1A or ANSI A108.1B, as recommended by ANSI A108.1C.
- B. Comply with minimum temperature recommendations of manufacturers for bonding and grouting materials other than portland cement mortar.

1.05 EXTRA MATERIALS

A. Tile: Furnish extra 2 percent of each tile used in clean, marked cartons for Owner's future use.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials and products specified in this section shall be products of:
 - 1. American Olean Tile Co.
 - 2. Dal-Tile Corp.
 - 3. United States Ceramic Tile Co.

2.02 MATERIALS

- A. Unglazed Ceramic Floor Tile (UCFT-1): ANSI A137.1, Section 5.1, porcelain type, smooth cushion edge, nominal face size 12 inches by 12 inches. Furnish slip-resistant tile with 7-1/2 percent abrasive grain content in all areas where floor tile is scheduled or shown on the Drawings.
- B. Unglazed Ceramic Floor Tile (UCFT-2): ANSI A137.1, Section 5.1, porcelain type, smooth cushion edge, nominal face size 2 inches by 2 inches. Furnish slip-resistant tile with 7-1/2 percent abrasive grain content in all areas where floor tile is scheduled or shown on the Drawings.
- C. Glazed Wall Tile (GCWT):
 - 1. ANSI A137.1, Section 6.1.
 - 2. Cushion edges, face finished with colored bright glaze, nominal face size 3 inches by 6 inches.
- D. Coved Base (CERB): Cushion edges, face finished with colored bright glaze, nominal face size 6 inches by 12 inches.
- E. Latex-Portland Cement Mortar: ANSI A118.4.

F. Latex-Portland Cement Grout: Portland cement grout with latex additive, commercial quality, ANSI A118.6.

2.03 ANCILLARY MATERIALS

- A. Expansion Joints:
 - 1. Sealant: Silicone rubber type, meeting ASTM C920, Type S, Grade P, Class 25, Use T, color to match grout, with Shore A hardness of minimum 25 for joints in horizontal surfaces and minimum 35 in traffic areas.
 - 2. Backup Material: Flexible and compressible type, nonstaining and compatible with sealants used.
- B. Edge Strips: Stainless steel, Alloy 316 flat bar, 1/8-inch by depth of tile and mortar.
- C. Tile Cleaner: Neutral tile cleaner solution acceptable to tile manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Examine surfaces to receive ceramic tile, setting beds, or accessories prior to tile installation.
- B. Correct defects or adverse conditions affecting quality and execution of tile installation.
- C. Surfaces to receive tile shall be plumb, level, and true with square corners.
- D. Tolerances for Surfaces to Receive Tile:
 - 1. Portland Cement and Epoxy Mortar Methods:
 - a. Maximum Variation in Subfloor Surface: 1/4-inch in 10 feet.
 - b. Maximum Variation in Vertical and Ceiling Surfaces: 1/4-inch in 8 feet.
- E. Grounds, anchors, plugs, hangers, bucks, electrical and mechanical work, in or behind tile, to be installed prior to proceeding with tilework.
- F. Protection: Protect adjoining work surfaces before tilework begins.
- G. Make substrate firm, dry, clean, and free of oily or waxy films.

3.02 INSTALLATION

- A. Prepare surfaces, fit, set, or bond tile, grout and clean tile in accordance with applicable requirements of ANSI Standards for setting method specified, except as otherwise noted.
- B. Workmanship, Cutting, Fitting, and Grout Joint Size:
 - 1. Center and balance areas of tile.
 - 2. Generally start full size tiles at outside corners and leave cut tiles for inside corners.
 - 3. Tile Cutting:
 - a. Minimize number of cuts.
 - b. No cuts smaller than half size without approval of Engineer.
 - c. Make all cuts on the outer edges of the field.
 - d. Smooth cut edges. Install tile without jagged or flaked edges.
 - e. Do not split tile unless no other alternative is possible.
 - 4. Fit tile closely where edges will be covered by trim, escutcheons, or other similar devices.
 - 5. Maintain heights of tile work in full courses to nearest obtainable dimension where heights are given in feet and inches and are not required to fill vertical spaces exactly.
 - 6. Allowable Lippage: 1/32-inch.
 - 7. Grout Joint Size: 1/8-inch.
 - 8. Install accessories in tile work to be evenly spaced, properly centered with tile joints, and level, plumb, and true to the correct projection. Install accessories at locations and heights shown or designated.
- C. Trim: Provide bases, caps, stops, returns, trimmers, and other shapes to finish installation.
- D. Setting Wall Tile (Thin-Set Application):
 - 1. On Cementitious Backer Board Walls: Meet TCA Method W244C.
 - 2. Use latex-portland cement grout.
- E. Setting Floor Tile (Thin-Set Application):
 - 1. On Concrete: Meet TCA Method F113 with latex-portland cement grout.
- F. Edge Strips:
 - 1. At openings without thresholds and similar discontinuous edges of thinset tile floors.

- 2. Where ceramic tile floors are adjacent to other flooring material at same level.
- 3. Where ceramic tile cove base is combined with other types of flooring.

3.03 CLEANING AND SEALING

- A. Clean tile surfaces thoroughly on completion of grouting.
- B. Remove grout haze, observing tile manufacturer's recommendations as to use of acid and chemical cleaners.
- C. Rinse tilework thoroughly with clean water before and after using chemical cleaners.
- D. Polish surface of glazed tilework with soft cloth.
- E. After grout has cured for 10 days, clean and seal nonglazed tiles following sealer manufacturer's instructions and recommendations.

3.04 PROTECTION

- A. From Construction Dirt:
 - 1. Apply protective coat of neutral cleaner solution, one part cleaner to one part water, to clean completed tile walls and floors.
 - 2. Cover tile floors with heavy-duty, nonstaining construction paper, masked in-place.
 - 3. Just before substantial completion, remove paper and rinse protective coat of neutral cleaner from tile surfaces.
- B. From Traffic:
 - 1. Prohibit foot and wheel traffic from using newly tiled floors for at least 7 days.
 - 2. Place large, flat boards in walkways and wheel ways for 7 days where use of newly tiled floor with cement type grout is unavoidable.

END OF SECTION

SECTION 09 51 13 ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A641/A641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - b. C635/C635M, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - c. C636/C636M, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - d. E1264, Standard Classification for Acoustical Ceiling Products.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Detailed layout of grid indicating hanger spacing, fastening and splicing details, change in level details, and access location.
- B. Informational Submittals: Manufacturer's recommendation for installation of system.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials with manufacturer's labels indicating brand name, pattern, size and thickness.
- B. Store materials in original protective packaging to prevent soiling, physical damage, or wetting.

1.04 ENVIRONMENTAL REQUIREMENTS

- Where acoustical materials are to be installed, maintain humidity of 65 percent to 75 percent in area for 25 hours before, during, and 25 hours after installation.
- B. Maintain uniform temperature of 55 degrees F to 70 degrees F prior to and during installation of materials.

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1.05 EXTRA MATERIAL

A. Provide acoustical units from same production run as installed equal to 1 percent of area.

PART 2 PRODUCTS

2.01 SUSPENSION SYSTEMS

- A. Components, Materials, and Accessories: Product of a single manufacturer.
- B. ASTM C635/C635M, Intermediate Duty:
 - 1. Exposed Aluminum Tee Grid:
 - a. Nonrated, light-duty, spaced to fit lay-in panels.
 - b. Color: White Aluminum.
 - c. Exposed Flange Width: 15/16-inch.
 - d. Edges: Single molding to match grid.
 - e. Manufacturers and Products:
 - 1) Chicago Metallic Corp.; All Aluminum 830 System.
 - 2) Armstrong; AL Prelude Plus system.
 - 2. Edge Molding:
 - a. Minimum 0.020-inch steel, channel- or angle-shaped.
 - b. Flange Width: 15/16-inch minimum.
 - c. Finish to match main members.
 - 3. Hanger Wire: ASTM A641/A641M, minimum 12-gauge, galvanized, soft-annealed, mild steel wire.
 - 4. Wire Ties: ASTM A641/A641M, 18-gauge, galvanized, annealed steel wire.

2.02 ACOUSTICAL UNITS

- A. Recessed Edge Lay-In Panels (ACT-1):
 - 1. Material: Fire-resistive mineral fiber, Class A.
 - 2. In accordance with ASTM E1264, Type III, Form 2.
 - 3. Pattern: Textured, fissured.
 - 4. Noise Reduction Coefficient (NRC): 0.60 to 0.70.
 - 5. Ceiling Attenuation Class (CAC): 30 to 39.
 - 6. Light Reflectance: LR 0.75.
 - 7. Nominal Size: 24 inches by 24 inches by 3/4-inch thick.
 - 8. Edges: Reveal or rabbeted.
 - 9. Finish and Color: Painted white, unless scheduled otherwise.
 - 10. Manufacturers and Products:
 - a. Armstrong; Item 540 Travertone Sanserra.
 - b. Celotex; Item PST-454, Everest.

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- c. U.S.G.; Item 3845, Auratone, Aspen.
- B. Plastic Faced Lay-In Panels (ACT-2):
 - 1. Material: Fiberglass.
 - 2. In accordance with ASTM E1264, Type XII, Form 1.
 - 3. Pattern: Stipple or nubby.
 - 4. Noise Reduction Coefficient (NRC): 0.70 to 0.80.
 - 5. Ceiling Attenuation Class (CAC): 20 minimum.
 - 6. Light Reflectance: LR 0.75 or over.
 - 7. Nominal Size: 24 inches by 24 inches by 5/8-inch thick.
 - 8. Edges: Square.
 - 9. Finish and Color: White vinyl facing.
 - 10. Manufacturers and Products:
 - a. Armstrong; Item 2983, Pebble.
 - b. U.S.G.; Item 7001G, Premier Nubby.

PART 3 EXECUTION

3.01 SEQUENCING

- A. Lay out grid.
- B. Coordinate with mechanical and electrical equipment in framing and cutting material around ceiling penetrations.
- C. Install suspension systems after mechanical work above is complete.
- D. Install acoustical units.

3.02 INSTALLATION OF SUSPENDED GRID SYSTEM

- A. Hang level and in straight alignment directly from structure in accordance with ASTM C636/C636M and manufacturer's printed instructions.
- B. Hanger Wires:
 - 1. Space maximum 4 feet on center each direction and securely attach to structure above.
 - 2. Install additional hangers at ends of each suspension member and at light fixtures, 6 inches from vertical surfaces.
 - 3. Do not splay wires more than 5 inches in a 4-foot vertical drop.
 - 4. Provide four-way wire splays at 45 degrees from main runner to support structure for every 144 square feet of ceiling area.
 - 5. Wrap wire minimum three times horizontally, turning ends upward.
- 6. Where hanger wires cannot be hung vertically from structure above because of ducts, pipes, cable trays, or other interferences, provide steel channel trapezes (minimum 2-inch deep, 16-gauge cold-rolled carrying channels) hung on steel rods or 8-gauge wire from structural members above. Hang ceiling wires from these trapezes or similar members supporting ducts or pipes. Do not hang directly from ducts or pipes.
- C. Edge Molding:
 - 1. Install at intersection of suspended ceiling and vertical surfaces.
 - 2. Miter corners where moldings intersect or install corner caps.
 - 3. Attach to vertical surface with mechanical fasteners.
- D. Provide additional channels, hangers, and trapezes as required to support edges of ceiling around and under mechanical and electrical work.

3.03 INSTALLATION OF ACOUSTICAL UNITS

- A. Upon completion of suspended grid system and other concealed work, install with pattern running in one direction.
- B. Place material to bear all around on suspension members.

3.04 CLEANING

- A. Clean soiled or discolored unit surfaces after installation.
- B. Touch up scratches, abrasions, voids, and other defects in painted surfaces.

3.05 SCHEDULE OF CEILING TYPES

- A. Areas to Receive Acoustical Ceilings: Indicated on Interior Finish Schedule located on the Drawings by type described below.
- B. Acoustical Ceiling Type 1 & 2 (ACT-1 & ACT-2):
 - 1. Suspension System: Exposed aluminum tee grid system, 24 inches by 24 inches.
 - 2. Exposed grid with main runners at 48 inches on center and cross tees at 24 inches on center.
 - 3. Lay out grid to provide symmetrical borders as shown and which are not less than half the size of the lay-in panels.
 - 4. Acoustical Units: As shown on Interior Finish Schedule.

END OF SECTION

ACOUSTICAL PANEL CEILINGS 09 51 13 - 4

SECTION 09 65 01 RESILIENT BASE

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - ASTM International (ASTM):
 a. F1861, Standard Specification for Resilient Wall Base.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Samples: Two 2-1/2-inch wide strips of base material.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 2. Operation and Maintenance Data:
 - a. List of recommended maintenance products, methods, and procedures.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Unless otherwise directed by Engineer, store materials in original containers at not less than 70 degrees F for not less than 24 hours immediately before installation.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature in space to receive flooring between 70 and 90 degrees F for not less than 24 hours before and 48 hours after installation.
- B. Maintain minimum temperature of 55 degrees F after flooring is installed, except as specified above.

1.05 EXTRA MATERIALS

A. Furnish additional rubber base from same production run as installed material.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flooring products of the following manufacturers meeting these Specifications may be used on this Project:
 - 1. Base Basis of Design: Roppe Rubber Company.
 - a. Other manufacturers:
 - 1) R. C. Musson Rubber Co.
 - 2) Johnsonite, Division of Duramax, Inc.

2.02 FLOOR COVERING MATERIALS

- A. Rubber Base: ASTM F1861, Type TP, Group 2, 0.125-inch thick, straight or coved style, 4 inches high.
 - 1. 4-inch Straight Base (RUB).
 - 2. Manufacturer: Roppe Rubber Base "Or-equal," approved.
- B. Adhesive: Type and brands of adhesive as recommended by manufacturer of covering material for conditions of installation.
- C. Primer and Crack Filler: Type and brand recommended by floor covering manufacturer.
- D. Wax: Furnish wax, cleaner, or other finishing material as recommended by floor covering manufacturer for the particular type of flooring material.
- E. Floor Filler: Asphalt mastic as manufactured by Armstrong, Lancaster, PA, or National Floor Products Co., Florence, AL.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate for excessive moisture content and unevenness preventing execution and quality of resilient flooring as specified.
- B. Correct defects before installation of resilient flooring.

3.02 PREPARATION

A. Remove dirt, oil, grease, or other foreign matter from surfaces to receive floor covering materials.

- B. Fill cracks less than 1/16-inch wide and depression less than 1/8-inch deep with floor filler.
- C. Prime surfaces other than wood if recommended by floor covering manufacturer.

3.03 INSTALLATION OF BASE

- A. Remove defects in wall and floor that would prevent level and true installation of base material.
- B. Install base around perimeter of room or space, where shown, and at toe spaces of casework and cabinets.
- C. Unroll base material and cut into accurate lengths as desired or as required for minimum number of joints.
- D. Match edges of seams or double cut adjoining lengths to give continuous appearance.
- E. Install with tight butt joints with no joint widths greater than 1/64-inch.
- F. Apply adhesive and firmly adhere to wall surfaces.
- G. Press down so bottom cove edge follows floor profile.
- H. Ensure top and bottom edges of base are in firm contact with walls and floors.
- I. Form internal and external corners by using premolded corners. Other methods, acceptable to Engineer, may be used if premolded corners are not available.
- J. Scribe base accurately to abutting materials.

3.04 CLEANING AND PROTECTION

- A. Upon completion of the installation of floor covering and adjacent work, and after materials have set, clean surfaces with a neutral cleaner as recommended by manufacturer for type of floor covering material installed.
- B. Repair adjacent surfaces damaged by flooring installation.
- C. Protect completed work from traffic and damage until Substantial Completion by covering with plastic sheet, kraft paper, or plywood panels.

ROGER SCOTT POOL FACILITIES

3.05 INSTALLATION SCHEDULE

A. Areas to receive rubber base are indicated in Interior Finish Schedule on the Drawings.

END OF SECTION

SECTION 09 90 05 ARCHITECTURAL PAINTING

PART 1 GENERAL

1.01 DEFINITIONS

- A. Terms used in this section:
 - 1. Coverage: Total minimum dry film thickness in mils, or square feet per gallon.
 - 2. FRP: Fiberglass Reinforced Plastic.
 - 3. HCl: Hydrochloric Acid.
 - 4. MDFT: Minimum Dry Film Thickness.
 - 5. MDFTPC: Minimum Dry Film Thickness Per Coat.
 - 6. mil: Thousandth of an inch.
 - 7. Military Specification-Paint.
 - 8. PSDS: Paint System Data Sheet.
 - 9. SFPG: Square Feet Per Gallon.
 - 10. SFPGPC: Square Feet Per Gallon Per Coat.
 - 11. SP: Surface Preparation.
 - 12. Existing: Those coated surfaces that are cut into, connected to, or otherwise changed or affected by the work of this contract.
- B. Paint Terms: Conform to ASTM D16.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Manufacturer's descriptive literature for coating materials and coating application accessories.
 - a. For each paint system used, furnish a Paint System Data Sheet (PSDS) and technical data sheet for each product used in the paint system. PSDS form is appended to the end of this section.
 - b. Submit required information on a system by system basis.
 - c. Provide copies of paint system submittals to applicator.
 - 2. Verification Samples: Two samples, minimum size 6 inches (152 mm) square, representing actual color and finish of each finish coating type, color, and finish to be applied.
- B. Informational Submittals:
 - 1. List of references substantiating applicator's experience.

2. Manufacturer's printed application instructions for each product, including product storage requirements and surface preparation requirements.

1.03 QUALITY ASSURANCE

A. Applicator's Experience: Minimum 5 years' practical experience in application of specified products and approved by the paint manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products of this section in manufacturer's unopened packaging until installation.
- B. Establish and maintain storage area conditions for products of this section in accordance with manufacturer's instructions until installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction over project.

1.05 PROJECT CONDITIONS

- A. Do not apply coatings to exterior surfaces except under environmental conditions recommended by coating manufacturer.
- B. Establish and maintain environmental conditions recommended by coating manufacturer before, during, and after application of coatings to interior surfaces.
- C. During application of coating materials, post "WET PAINT" signs.
- D. During application of solvent-based materials, post "NO SMOKING" signs.

1.06 SEQUENCING

A. Do not allow application of finish coats in an area until moisture-producing construction activities, dust-producing construction activities, and other construction activities which could impair performance or appearance of finish coatings, have been completed in that area.

1.07 EXTRA MATERIALS

A. Supply for each finish coating material, color, and finish specified 2 gallons (7.75L) of paint material, in sealed 1-gallon (3.875L) containers, marked with color and finish identification.

B. Custom Colors: Provide details of color formulae and product availability.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Products of the following manufacturers, meeting these specifications, may be used on this project:
 - 1. Sherwin Williams, Cleveland, OH.
 - 2. Duron, Inc., Beltsville, MD.
 - 3. PPG Industries.
 - 4. TNEMEC.
- B. Unless otherwise specified for an individual product or material, supply products specified in this section from the same manufacturer.

2.02 MATERIALS

- A. General:
 - 1. Unless otherwise indicated, furnish factory-mixed paints. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not dilute or thin paints, except as instructed.
 - 2. Do not add additives, except as instructed or recommended by paint manufacturer.
 - 3. Furnish each coating material in quantity required for this section from a single production run.
 - 4. Colors: To be selected by Architect from manufacturer's full range of available colors.
- B. Paint Application Accessories: As specified in this section or as recommended by paint manufacturer's application instructions, including but not limited to thinners, sealers, primers, cleaning agents, etching agents, cleaning cloths, sanding materials, and clean-up materials.
- C. Acrylic Latex, Flat: Sherwin-Williams; ProMar 200 Flat B31W200.
- D. Acrylic Texture Coating: Sherwin-Williams; Conflex, UltraCrete, Medium coarse.
- E. Latex Primer Sealer: Sherwin-Williams; PrepRite High-Build B28W600.
- F. Block Filler: Sherwin-Williams; ProMar Interior/Exterior Block Filler B25.

G. Concrete Primer: Sherwin-Williams; Loxon Concrete and Masonry Primer-Sealer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Immediately prior to coating application, ensure that surfaces to receive coatings are dry.
- B. Ensure that moisture-retaining substrates to receive coatings have moisture content within tolerances allowed by coating manufacturer, using moisture measurement techniques recommended by coating manufacturer.
- C. Immediately prior to coating application, examine surfaces to receive coatings for surface imperfections and for contaminants which could impair performance or appearance of coatings, including but not limited to, loose primer, rust, scale, oil, grease, mildew, algae, or fungus, stains or marks, cracks, indentations, or abrasions.
- D. Correct the above conditions and other conditions that could impair performance or appearance of coatings in accordance with specified surface preparation procedures before proceeding with coating application.

3.02 PREPARATION

- A. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.
- B. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; cover stains and marks which cannot be completely removed with isolating primer or sealer recommended by coating manufacturer to prevent bleed-through.
- C. Mildew, Algae, and Fungus: Remove, using materials and methods recommended by coating manufacturer.
- D. Remove dust and loose particulate matter from surfaces to receive coatings immediately prior to coating application.
- E. Remove or protect hardware, electrical plates, mechanical grilles and louvers, lighting fixture trim, and other items not indicated to receive coatings that are adjacent to surfaces to receive coatings.

- F. Existing Painted Surfaces: Remove loose and peeling paint. Degloss surface if recommended by manufacturer. Sand smooth. Clean entire surface prior to painting.
- G. Aluminum Surfaces: Remove surface contamination by steam or high pressure water. Remove oxidation by phosphoric acid-water solution etching and solvent washing. Apply specified primer as soon as cleaned surfaces are dry.
- H. Concrete and Concrete Masonry: Clean surfaces free of loose particles, sand, efflorescence, laitance, form oil, curing compounds, and other substances which could impair coating performance or appearance.
- I. Concrete Floors: Remove contaminants which could impair coating performance or appearance, acid-etch, flush with clean water; verify alkaline-acid balance recommended by coating manufacturer; mechanically abrade surface, if required, to achieve medium-sandpaper texture.
- J. Galvanized Surfaces: Remove surface contamination and oils by solvent cleaning (SSPC-SP1) and allow to dry. Apply Galvanized Metal Primer in accordance with manufacturer instructions.
- K. Wood:
 - 1. Seal knots, pitch streaks, and sap areas with sealer recommended by coating manufacturer; fill nail recesses and cracks with filler recommended by coating manufacturer; sand surfaces smooth.
 - 2. Apply primer coat to back of wood trim and paneling.
- L. Gypsum Board: Repair cracks, holes, indentations, and other surface defects using joint compound to produce surface flush with adjacent undamaged surface; sand to produce uniform flat surface when dry.
- M. Gypsum Plaster: Cut out cracks, holes, indentations, and other surface defects to extent required for bonding adhesion; apply patching plaster or joint compound to produce surface flush with adjacent undamaged surface; sand to produce uniform flat surface when dry; allow to cure 30 days before coating application.
- N. Wood and Metal Doors: Seal top and bottom edges with specified primer.
- O. Uncoated Steel and Iron Surfaces: Remove grease, rust, scale, and dust from steel and iron surfaces in accordance with Solvent Cleaning SSPC-SP1. Where heavy coatings of scale or contaminants are evident, clean in accordance with Hand Tool Cleaning SSPC-SP2 or other approved SSPC-SP method as needed.

P. Shop Primed Steel Surfaces: Remove loose primer and dust. Sand and feather edges to smooth surface. Clean areas with solvent and spot prime bare metal surfaces with appropriate primer recommended by manufacturer.

3.03 APPLICATION

- A. Apply paint where indicated in Interior Finish Schedule.
- B. Apply each coat to uniform coating thickness following manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
- C. For opaque finishes, tint each coat, including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
- D. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
- E. Inspect each coat before applying next coat; touch-up surface imperfections with coating material, feathering, and sanding if required; touch-up areas to achieve flat, uniform surface without surface defects visible from 5 feet (1.5 m).
- F. Do not apply succeeding coat until previous coat has been approved by Engineer; only Engineer-approved coats will be considered in determining number of coats applied.
- G. Remove dust and other foreign materials from substrate immediately prior to applying each coat.
- H. Where coating application abuts other materials or other coating color, terminate coating, making clean sharp termination line without coating overlap.
- I. Where color changes occur between adjoining spaces, through framed openings that are of same color as adjoining surfaces, change color at outside stop corner nearest to face of closed door.
- J. Re-prepare and recoat unsatisfactory finishes; refinish entire area to corners or other natural terminations.

3.04 ITEMS NOT TO BE PAINTED

- A. Do not paint the following:
 - 1. Items specified or provided with factory finish.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Brick, precast concrete, integrally colored plaster.
 - 5. Concrete masonry in utility, mechanical, and electrical spaces.
 - 6. Stainless steel, anodized aluminum, bronze, terne, or lead.
 - 7. Equipment nameplates, fire rating labels, and operating parts of equipment.
 - 8. Acoustical materials.
 - 9. Concealed piping, ductwork, and conduit.
- B. Materials and products having factory-applied primer are not considered factory finished.

3.05 PAINT SYSTEMS

A. System No. 113 Concrete, Eggshell:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance Concrete Surface Preparation as recommended by Manufacturer	Concrete Acrylic Coating Primer-Sealer	1 coat, as recommended by Manufacturer
	Acrylic Textured Coating	2 coats, 240 SFPGPC

B. System No. 115 Gypsum Board and Plaster, Flat:

Surface Prep.	Paint Material	Min. Coats, Cover
Gypsum Board or Plaster	Latex Primer/Sealer	1 coat, 350 SFPG
	Acrylic Latex (Flat)	2 coats, 240 SFPGPC

END OF SECTION

SECTION 10 14 00 SIGNAGE

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
 - 2. ASTM International (ASTM):
 - a. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - b. D709, Standard Specification for Laminated Thermosetting Materials.
 - 3. National Fire Protection Association (NFPA):
 - a. 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
 - b. HAZ-01, Fire Protection Guide to Hazardous Materials.
 - 4. Occupational Safety and Health Act (OSHA).

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Drawings showing layouts, actual letter sizes and styles, and Project-specific mounting details.
 - b. Manufacturer's literature showing letter sizes and styles, sign materials, and standard mounting details.
 - 2. Samples: One full size for each type of nameplate, sign, and label specified.
 - 3. One letter sample of the Channel letters proposed for the Entrance Sign. May be one of the actual letters to be installed.
- B. Informational Submittals: Manufacturer's installation instructions.

ROGER SCOTT POOL FACILITIES

PART 2 PRODUCTS

2.01 GENERAL

- A. 5.5 inches by 5.5 inches minimum size with square corners. Minimum 2-layer acrylic, 1/8-inch thick.
 - 1. All space identification signs throughout the campus shall be matching in style and color and font size and style.
 - 2. Signs A must be all from the same sign product system.
 - 3. Color background shall be in contrast selected by Owner to contrast with block Helvetica lettering. Manufacturer to recommend font size for signs sized as stated above.
- B. ADA Compliant. Tactile characters/symbols both in reading words and Grade 2 Braille shall be raised 1/32 inch from the sign plate face. Florida ADA code compliant. Use symbols of accessibility in compliance with the Fifth Edition of the Florida Accessibility Code.
- C. Basis of Design: Window Sign with Room Name or Number and matching Braille Signage manufactured by the Office Sign Company.

2.02 ACRYLIC ADA SPACE NAME PLAQUES (TYPE A INTERIOR)

A. Specific scheduled spaces shall have sign mounted in compliance with Florida Accessibility Code. Toilet Rooms, Stairs, Elevator and common facilities will have Braille lettering as well. All Space identification signs shall be ADA Compliant. Spaces shall include room names, space names, and signs for toilet facilities, shower facilities, locker rooms, and safety messages throughout the buildings. See sign schedule.

2.03 FIBERGLASS SIGN (EXTERIOR) TYPE F

- A. Material: Three-ply laminated fiberglass, minimum 1/8-inch thick, with contrasting color core message layer between two clear weather-resistant surface layers.
- B. Manufacturers:
 - 1. Best Manufacturing Co.
 - 2. Brady Signmark.

2.04 BUILDING SIGN (EXTERIOR) TYPE G

1. Contractor shall submit drawings for approval.

2. See sign schedule and Architectural drawings for sign location and letter dimensions.

2.05 ANCILLARY MATERIALS

- A. Fasteners: Stainless steel screws or bolts of appropriate sizes.
- B. Wood Posts: Preservative treated 4 by 4 wood as specified in Section 06 10 00, Rough Carpentry.
- C. Pipe Posts: 2-1/2-inch galvanized steel pipe meeting ASTM A53/A53M, Type S, Grade B.
- D. Chain: Type 304 stainless steel, No. 16 single jack chain or No. 2 double loop coil chain.
- E. Manufacturer's standard brackets for wall mounting of two-sided exit signs.

PART 3 EXECUTION

- 3.01 INSTALLATION—GENERAL
 - A. In accordance with manufacturer's recommendations.
 - B. Mount securely, plumb, and level.

3.02 DOOR NAMEPLATES AND PICTORIAL SYMBOLS

- A. Attach to doors with self-sticking permanent adhesive. See Door and Hardware Schedule for locations and messages.
- B. Mount with bottom of nameplate at 5 feet 6 inches above floor.

3.03 SIGNS

- A. General:
 - 1. Fasten to walls or posts, or hang as scheduled.
 - 2. Anchor in place for easy removal and reinstallation with ordinary hand tools.
- B. Information, Exit, and Safety Signs: Install facing traffic. Locate for high visibility with minimum restriction of working area around walkways and equipment.

3.04 SUPPLEMENTS

- A. The supplement listed below, following "End of Section," is a part of this specification.
 - 1. Sign Schedule: Tabulation of characteristics and mounting information for warning, informational and unlighted exit signs on Project. Provide items as scheduled. Meet requirements of Occupational Safety and Health Act (OSHA).

END OF SECTION

ROGER SCOTT POOL FACILITIES

	SIGN						MOUNTING			L	ETTERING	3		OTHER REQUIRE		
LOCATION	QT Y	MARK	TYPE	FORMAT	MAX	. SIZE	COLOR	LOCATION	METHOD	HEIGHT TO CENTERLIN	HEIGHT	STYLE	COLOR	MESSAGE	FACES	WENTS
					WIDTH	HEIGHT				E						
TICKETING BUILDING	1	S1	F	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	TICKETING BUILDING	1	ADA Compliant. Tactile characters/ symbols
TICKETING BUILDING	1	S2	A	By approved submittal	5.5"	5.5"	TBD	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	RESTROO M (UNISEX GRAPHIC SYMBOL W/ WORD RESTROO M)	1	
TICKETING BUILDING	1	S3	A	By approved submittal	5.5"	5.5"	TBD	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	TICKETS	1	
TICKETING BUILDING	1	S4	F	By approved submittal	5.5"	5.5"	TBD	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	MECH/ELE C	1	
RESTROOM BUILDING	1	S5	F	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	MECH/ELE C	1	ADA Compliant. Tactile characters/ symbols
RESTROOM BUILDING	1	S6	F	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	WOMEN RESTROO M (W/ GRAPHIC SYMBOL)	1	ADA Compliant. Tactile characters/ symbols

ROGER SCOTT POOL FACILITIES

	SIGN			SIGN MOUNTING LETTERING						OTHER REQUIRE						
LOCATION	QT Y	MARK	TYPE	FORMAT	MAX	. SIZE	COLOR	LOCATION	METHOD	HEIGHT TO CENTERLIN	HEIGHT	STYLE	COLOR	MESSAGE	FACES	MENTS
					WIDTH	HEIGHT				E						
RESTROOM BUILDING	1	S7	F	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	MEN RESTROO M (W/ GRAPHIC SYMBOL)	1	ADA Compliant. Tactile characters/ symbols
RESTROOM BUILDING	1	S8	A	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVETIC A	BLACK	JANITOR	1	
TICKETING BUILDING	1	S9	G	See Archite	ectural Draw	rings.	•	See Architectural Drawings	BOLTS/S CREWS	As directed	By approved submittal	To match adjacent Community Center sign	TBS	ROGER SCOTT POOL TICKETING	1	

SIGNAGE 10 14 00 SUPPLEMENT 1 - 2

SECTION 10 21 00 COMPARTMENTS AND CUBICLES

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes solid polymer units as follows:
 - 1. Urinal Screens: Wall hung.
 - 2. Toilet Enclosures: Overhead braced and floor anchored.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI):
 - a. A117.1, Accessible and Usable Buildings and Facilities.
 - b. Z124.2, Plastic Shower Receptors and Shower Stalls.
 - 2. Americans with Disabilities Act (ADA).
 - 3. ASTM International (ASTM):
 - a. A276, Specification for Stainless Steel Bars and Shapes.
 - b. A591/A591M, Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight (Mass) Applications.
 - c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - d. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - e. B221/B221M, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - f. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - g. F594, Specification for Stainless Steel Nuts.
 - 4. Code of Federal Regulations (CFR): 40 CFR 59, National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.
 - 5. Federal Specifications, Standards and Commercial Item Descriptions, (FS): A-A-60003, Partitions, Toilet, Complete.

ROGER SCOTT POOL FACILITIES

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Include plans, sections, elevations, material descriptions, dimensions, and attachments to other work.
 - a. Show locations of cutouts for compartment-mounted grab bars.
 - b. Show locations of reinforcements and attachments for compartment-mounted toilet accessories.
 - c. Product Data: Manufacturer's detailed technical data for toilet compartments and urinal screens specified. Include details of anchors, hardware, and fastenings.
 - 2. Samples for Initial Selection: For each type of unit indicated.
 - 3. Samples for Verification:
 - a. Of each type of color and finish required for units, prepared on a 6-inch by 6-inch square sample of same thickness and material indicated for the Work.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Experienced installer who has 5 years' experience with projects completed in phenolic-core compartment installations similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to this Project with a minimum of 5 years' experience in similar sized projects.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project Site in undamaged condition.
- B. Store and handle phenolic-core and related materials to prevent deterioration or damage as a result of moisture, temperature changes, contaminants, corrosion, breakage, chipping, or warping.
- C. Stack or brace phenolic-core on edge on leveled and adequate A-frames in a manner that prevents undue stresses causing chipping, cracking, and breaking.

PART 2 PRODUCTS

2.01 SOLID POLYMER UNITS

- A. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1-inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Color and Pattern: One color and pattern in each room as selected by Engineer from manufacturer's full range of colors and patterns.
- B. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; polymer or stainless steel.
- C. Polymer Color and Pattern: Matching pilaster.
- D. Brackets Fittings: Stirrup Type: Ear or U-brackets, chrome-plated, nonferrous, cast zinc alloy (zamac) or clear anodized aluminum.
- E. Full-Height (Continuous) Type: Manufacturer's standard design; polymer or extruded aluminum.
 - 1. Polymer Color and Pattern: Matching pilaster.
- F. Manufacturers:
 - 1. Bradley Corporation; Mills Partitions.
 - 2. Capitol Partitions, Inc.
 - 3. Comtec Industries.
 - 4. General Partitions Mfg. Corp.
 - 5. Santana Products, Inc.

2.02 ACCESSORIES

- A. Dowels: Provide 1/4-inch (6.4-mm) diameter dowels fabricated from Type 304 stainless steel, ASTM A276.
- B. Fittings: Cast stainless steel, angle type fittings, with 1-3/4-inch by 1-3/4-inch (44.5-mm by 44.5-mm) legs, 1-1/4 inches (32 mm) long, and capable of supporting compartment components in configuration indicated.
- C. Exposed Anchors and Fasteners: #4 Brushed Stainless Steel fasteners with theft-resistant-type heads. Provide sex-type through bolts with theft-resistant spanner heads and threaded brass rods for attachments to stone.

D. Bolts, Nuts, and Washers: Provide Type 304 stainless steel bolts complying with ASTM F593, nuts complying with ASTM F594, and washers and lock washers for connection to overhead support as indicated.

2.03 FABRICATION

- A. General:
 - 1. Provide standard doors, panels, screens, and pilasters fabricated for compartment system.
 - 2. Provide units with cutouts and drilled holes to receive compartmentmounted hardware, accessories, and grab bars, as indicated.
 - 3. Provide internal reinforcement in metal units for compartment-mounted hardware, accessories, and grab bars, as indicated.
- B. Wall-Hung Screens: Provide units in sizes indicated of same construction and finish as compartment panels, unless otherwise indicated.
- C. Doors: Unless otherwise indicated, provide 24-inch (610-mm) wide inswinging doors for standard toilet compartments and 36-inch (914-mm) wide out-swinging doors with a minimum 32-inch (813-mm) wide clear opening for compartments indicated to be handicapped accessible.
 - 1. Hinges: Manufacturer's self-closing piano type that can be adjusted to hold door open at any angle up to 90 degrees.
 - 2. Latch and Keeper: Recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. At compartments indicated to be handicapped accessible, provide units that comply with accessibility requirements of authorities having jurisdiction.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubbertipped bumper; sized to prevent door from hitting compartmentmounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumpers at outswinging doors or entrance screen doors.
 - 5. Door Pull: At out-swinging doors, manufacturer's standard unit that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be handicapped accessible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Coordinate layout and installation of supports, inserts, and anchors built into other units of work for toilet compartment anchorage.
- D. Coordinate toilet stall required reinforcing, openings for toilet accessories and grab bars.

3.02 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written installation instructions.
 - 2. Install units rigid, straight, level, and plumb.
 - 3. Secure units in position with manufacturer's recommended anchoring devices.
 - 4. Maximum Clearances:
 - a. Pilasters and Panels: 1/2-inch (13 mm).
 - b. Panels and Walls: 1-inch (25 mm).
 - 5. Stirrup Brackets: Secure panels to walls and to pilasters with not less than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holds for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Floor-Anchored Units:
 - 1. Set pilasters with anchors penetrating not less than 2 inches (50 mm) into structural floor, unless otherwise indicated in manufacturer's written instructions.
 - 2. Level, plumb, and tighten pilasters.
 - 3. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

ROGER SCOTT POOL FACILITIES

- C. Wall-Hung Urinal Screens:
 - 1. Attach with anchoring devices to suit supporting structure.
 - 2. Set units level and plumb and to resist lateral impact.

3.03 ADJUSTING AND CLEANING

- A. Adjust and lubricate hardware for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return to fully closed position.
- B. Clean exposed surfaces of partition systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

END OF SECTION

SECTION 10 28 00 TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Fire Protection Association (NFPA): 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.02 DESIGN REQUIREMENTS

A. Design grab bars, shower seats, dressing room bench seats and attachments to resist minimum 250-pound concentrated load applied at any point in any direction.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Manufacturer's literature clearly indicating:
 - 1) Architect's identification mark, size, and description of components.
 - 2) Base material with surface finish inside and out.
 - 3) Hardware and locks and attachment devices.
 - 4) Description of rough-in framing.
 - 5) Manufacturer's cut sheets.
 - 6) Details of blocking and anchorage required.
- B. Informational Submittals:
 - 1. Distributor's List: List of local distributors for supplies required for accessories installed.
 - 2. Cleaning instructions.

1.04 QUALITY ASSURANCE

- A. Flame Resistant Fabric: Passes when tested in accordance with NFPA 701, Test 1 or Test 2.
- B. Recycled Content Materials: Furnish materials with recycled content.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials and products specified in this section shall be products of:
 - 1. Bobrick Washroom Equipment, Inc.
 - 2. Bradley Corp.
 - 3. Accessory Specialties, Inc.
 - 4. Watrous, Inc.
 - 5. Koala Kare
 - 6. American Specialties, Inc.

2.02 TOILET AND BATH ACCESSORIES

A. Furnish accessory items listed where indicated by mark or note on the Drawings.

Item	Mark	Koala Kare	Bobrick	Bradley
Surf. Mounted Dual Roll Toilet Paper Dispenser	TPD-1		No. B-2740	No. 5241-50
Wall Mounted Liquid Soap Dispenser	SD-2		No. B-4112	No. 6542
Mirror, Size on Dwgs	MIR		No. B-290	No. 780
Surf. Mounted Paper Towel Dispenser and Receptacle	PTD-1		No. B-359039	
Surf. Mounted Napkin Disposal	ND		No. B-270	No. 4781-15
Mop and Broom Holder (24")	M&BH		No. B-223 x 24	No. 9953
Grab Bars (straight) (36")	GB-1		No. B-6806-36	No. 812-001-36
Grab Bars (straight) (42")	GB-2		No. B-6806-42	No. 812-001-42
Grab Bars (shower, corner type)	GB-6		No. B-6861	No. 812-036/03 7 Modified (15"x30")
Horizontal Surface-Mounted Baby Changing Station	CS	KB300-00		

B. Baby Changing Station:

- 1. Minimum weight capacity: 50 pound.
- 2. User-friendly child safety strap.
- 3. Complies with ASTM F2285 static load performance requirements.

TOILET AND BATH ACCESSORIES 10 28 00 - 2

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- 4. Antimicrobial surface.
- 5. Built-in dual liner dispenser.
- 6. Color: Selected by Owner.
- 7. Installation: wall mounted.
- C. Finish:
 - 1. Satin stainless steel.
 - 2. Manufacturer's or brand name on face of units is not acceptable.
- D. Anchors: Furnish anchors, fasteners, or other devices necessary for a complete, secure installation.
 - 1. Fasteners: Tamper-proof screws or bolts.
- E. Supplies: Furnish fill supplies, such as paper goods, soap, and napkins, as recommended by accessory manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate support framing and backing as necessary for proper installation of accessories.
- B. Coordinate the Work with placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

3.02 INSTALLATION

- A. Mounting Heights and Locations: Locate where mark is shown on the Drawings at height required by accessibility regulations.
- B. Follow manufacturer's instruction and recommendations.
- C. Install and securely anchor accessories in their proper locations, plumb and level, and without distortion.
- D. Remove protective masking and clean surfaces, leaving them free of soil and imperfections.
- E. Fill units with necessary supplies within 10 days before Substantial Completion.
- F. Deliver to Owner keys and devices required to fill and service units.

3.03 CLEANING

A. Clean and repair existing toilet accessories which remain or are to be reinstalled.

END OF SECTION

TOILET AND BATH ACCESSORIES 10 28 00 - 4

SECTION 10 44 00 FIRE PROTECTION SPECIALTIES AND SAFETY EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Factory Mutual (FM).
 - 2. Mine Safety and Health Administration (MSHA).
 - 3. National Fire Protection Association (NFPA):
 - a. 10, Standard for Portable Fire Extinguishers.
 - b. 30, Flammable and Combustible Liquids Code.
 - 4. National Institute for Occupational Safety and Health (NIOSH).
 - 5. Occupational Safety and Health Administration (OSHA).
 - 6. UL: Fire Protection Equipment Directory.

1.02 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10.
- B. Provide extinguishers classified and labeled by UL for purpose specified and indicated.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Fire Extinguishers: Manufacturer's product data for each item, including sizes, ratings, UL listings, or other certifications, and mounting information.
 - b. Product Data: Extinguisher operational features, color and finish, and anchorage details.
- B. Informational Submittals:
 - 1. Manufacturer's Installation Instructions:
 - a. Special criteria and wall opening coordination requirements.
 - b. Manufacturer's installation details.
 - c. Extinguisher location plan.
 - 2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

3. Operation and Maintenance Data: Submit test, refill or recharge schedules and recertification requirements.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 61 00, Common Product Requirements: Environmental conditions affecting products onsite.
- B. Do not install extinguishers when ambient temperatures are capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.01 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. Basis of Design: JL Industries, Cosmopolitan model.
 - 2. Other Manufacturers:
 - a. Larsen's Manufacturing Co.
 - b. Nystrom Products Co.
 - c. Potter Roemer.
- B. General:
 - 1. Conform to NFPA 10 for fire extinguishers.
 - 2. Furnish fire extinguishers and cabinets from one manufacturer.
 - 3. UL listed, charged and ready for service.
- C. Multipurpose Hand Extinguisher (F. Ext-1):
 - 1. Tri-class dry chemical extinguishing agent.
 - 2. Pressurized, red enameled steel shell cylinder.
 - 3. Activated by top squeeze handle.
 - 4. Agent propelled through hose or opening at top of unit.
 - 5. For use on A, B, and C class fires.
 - 6. Minimum UL Rating: 4A-60B:C, 10-pound capacity.

2.02 ACCESSORIES

- A. Extinguisher Brackets: For hand extinguishers not located in cabinets, furnish heavy-duty brackets with clip-together strap for wall mounting formed steel, enamel finish.
- B. Graphic Identification: Provide graphic identification marking for each fire extinguisher type. OSHA approved pictorial markings to indicate the extinguisher uses and nonuses on a single label.

- C. Fasteners: Furnish necessary screws, bolts, brackets, and other fastenings of suitable type and size to secure items of fire and safety equipment in position.
 - 1. Metal expansion shields for machine screws at concrete and masonry.
 - 2. Interior: Rust-resistant.
 - 3. Exterior: Stainless steel.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Install where indicated or directed and in accordance with manufacturer's recommendations.
 - B. Secure brackets rigidly to structure.
 - C. Provide adequate backing for mounting surfaces.
 - D. Position signage as required by authorities having jurisdiction.

3.02 PORTABLE FIRE EXTINGUISHERS AND CABINETS

- A. Provide at locations shown or as directed by Engineer.
- B. Mount hangers securely in position, following manufacturer's recommendations.
- C. Top of Extinguisher: No more than 54 inches above floor.
- D. Install wall brackets, maximum 48 inches from finished floor to top of extinguisher handle.

END OF SECTION

SECTION 12 20 00 WINDOW TREATMENTS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Details of installation indicating size, attachments, and clearances of operating hardware with other construction.
- B. Product Data: Manufacturer's data sheets shall be submitted for each product specified, including:
 - 1. Preparation instructions and recommendations.
 - 2. Finishes, material descriptions, dimensions of individual components.
 - 3. Construction and installation instructions.
 - 4. Manufacturers recommendations for maintenance and cleaning.
- C. Sample: Contractor shall supply one sample shade of each type specified in for approval. Supplied units shall be furnished complete with all required components, mounting and associated hardware, instructions and warranty.

1.02 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experienced and regularly engaged in the installation of window treatments.
 - 2. Use proper facilities and methods for production of the Work.
 - 3. Acceptable to the Engineer.
- B. Mockups: Provide one mock-up shade for each roller shade type/assembly specified. Approved mockup will be used as control Sample for workmanship and fabrication.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Handle in accordance with manufacturer's instructions.
- B. Storage and Protection: Store window covering and accessories in unopened packages in manner to prevent damage from environmental and construction operations.

1.04 SPECIAL GUARANTEE

A. Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of Work specified in this Specification section found defective during a period of 3 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Heavy Duty Manual Roller Shade:
 - 1. Fabric: Inherently anti-static, flame retardant, fade and stain resistant, light filtering fabrics providing 0 percent to 20 percent openness, containing fiberglass, PVC, polyester, acrylic, vinyl laminates, cotton, and vinyl coatings (based upon fabric choice).
 - a. Finish to be selected by architect from manufacturer's available contract colors.
 - 2. Control System:
 - a. Clutch Operated: Chain-driven operator capable of lifting up to 20 pounds of weight with a maximum allowable pull force of 10 pounds. Utilization of adjustment-free continuous qualified Type 304 stainless ball or fiberglass nylon chain. Components must be maintenance-free from adjustments or lubrication for trouble-free lifetime operation.
 - b. Chain anchor device to be compliant with WCMA safety standard A100.1.1-2010 and must prevent the clutch system from moving the roller shade through lowering and raising if not properly installed as specified in ANSI Standard Section 6.5.2.
 - c. Roller Tube: Circular-shaped aluminum tube extruded from alloy and temper 6063 T-6. Extruded tube to have a .063-inch wall thickness (2.5-inch outside diameter to have a 0.79-inch wall thickness). Heavily reinforced with internal ribs and flutes providing additional tensile strength and allows for secure placement of clutch and end plug.
 - d. Spring-loaded idle end: Reinforced idler assembly containing spring loaded end plug with positive locking wheel allowing for up to 7/8-inch adjustment and provides for a secure installation and removal of shade. Locking tube bearing plug contains minimum 6 ribs and flutes and inserted a minimum of 2-3/8-inch into roller tube on heavy duty systems.

WINDOW TREATMENTS 12 20 00 - 2

- e. Bottom Bar: Industry standard sealed hem bar with weight sewn into pocket providing for tracking adjustments and uniform look of the hanging fabric panel.
- f. Mounting Hardware: Manufacturer's heavy duty bracket constructed of hardened steel to support full weight of shade with bracket and screw hole covers to provide uniform look. Locking mechanism on bracket adapter provides for a secure installation and removal of the shade. Corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and site conditions.
- g. Fascia: L-shaped removable aluminum extrusion valance that attaches to brackets and conceals roller shade. Fascia at the bottom enclosure must allow a maximum of 1-inch gap to allow fabric to come through. Exposure underneath greater than 1-inch is not to be accepted.
- 3. Manufacturers:
 - a. Hunter Douglas.
 - b. Lutron.
 - c. SWFcontract.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements of openings to receive blinds, and provide systems in coordination with work of other trades. Delay installation until all other finish Work in spaces is complete.

3.02 ROLLER SHADE INSTALLATION

A. Install the hardware to manufacturer's recommendations as approved for conditions of the installation. Install in accurate locations, make plumb, true to line, complete with accessories required for satisfactory operations, attach to building construction using approved type of fasteners so as to be rigid and secure, taking care to prevent cracking, marring, or other damage to adjacent finished surfaces.

3.03 ADJUSTING

A. After installation, test and adjust each unit.

3.04 CLEANING

A. Leave installation in a clean and dust-free condition.
3.05 INSTALLATION SCHEDULE

A. Install blinds at all windows indicated in Window Schedule.

END OF SECTION

WINDOW TREATMENTS 12 20 00 - 4

SECTION 22 07 00 PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society of Heating, Refrigerating & Air-Conditioning Engineers Inc. (ASHRAE): 90.1, Energy-Efficient Design of New Buildings except Low-Rise Residential Buildings.
 - 2. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - c. C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - d. C547, Standard Specification for Mineral Fiber Pipe Insulation.
 - 3. National Fire Protection Association (NFPA): 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.02 SUBMITTALS

- A. Action Submittals: Product description, include list of materials, thickness for each service scheduled, and locations.
- B. Informational Submittals:
 - 1. Proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.
 - 2. Manufacturer's installation instructions.

1.03 QUALITY ASSURANCE

- A. Provide standard, cataloged products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.
- B. Provide materials by firms engaged in the manufacture of insulation products of the types and characteristics specified herein, whose products have been in use for not less than 5 years.

C. UL Listing or satisfactory certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Stamp or Label:
 - 1. Deliver insulation, jackets, cements, adhesives and coatings with a manufacturer's stamp or label attached, giving name of manufacturer, brand, and description of material.
 - 2. Insulation Packages and Containers: Mark "asbestos-free."

PART 2 PRODUCTS

2.01 GENERAL

- A. Insulation Exterior: Cleanable, grease-resistant, nonflaking, and nonpeeling.
- B. Conform to referenced publications and specified temperature ranges and densities in pounds per cubic foot.
- C. Insulation for Fittings, Flanges, and Valves: Premolded, precut, or jobfabricated insulation of same thickness and conductivity as used on adjacent piping.
- D. Fire Resistance:
 - 1. Provide noncombustible insulation, adhesives, vapor barrier materials and other accessories, except as specified herein.
 - 2. Use no fugitive or corrosive treatments to impart flame resistance.
 - 3. Flame proofing treatments subject to deterioration as a result of effects of moisture or high humidity are not acceptable.
 - 4. Fire Hazard Rating for Materials including Facings, Mastics, and Adhesives: Not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke, developed as per tests conducted in accordance with NFPA 255 methods.
 - 5. Materials exempt from fire-resistant rating:
 - a. Nylon anchors.
 - b. Treated wood inserts.
 - 6. Materials exempt from fire-resistant rating when installed in outside locations, buried, or encased in concrete:
 - a. Polyurethane insulation.
 - b. PVC casing.
 - c. Fiberglass-reinforced plastic casing.

PLUMBING PIPING INSULATION 22 07 00 - 2

2.02 PIPE INSULATION

- A. Type P3—Elastomeric (ASTM C534, Minus 40 Degrees F to 220 Degrees F):
 - 1. Flexible, closed cell elastomeric.
 - 2. Nominal 6 pcf density, K factor 0.27 maximum at 75 degrees F mean.
 - 3. Water Vapor Transmission: 0.1 perm-inch, or less.
 - 4. Manufacturers and Products:
 - a. Armacell; AP Armaflex.
 - b. Nomaco; K-Flex LS.

2.03 INSULATION FINISH SYSTEMS

- A. Type F1—PVC:
 - 1. Polyvinyl chloride (PVC) jacketing, white, for straight run piping and fitting locations, temperatures to 150 degrees F.
 - 2. Manufacturers and Products:
 - a. Johns Manville; Zeston.
 - b. Ceel-Co; 550.
- B. Type F2—Paint:
 - 1. Acrylic latex paint, white, and suitable for outdoor use.
 - 2. Manufacturer and Product: Armstrong; WB Armaflex finish.

PART 3 EXECUTION

3.01 INSTALLATION OF INSULATION

- A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.
- B. Apply insulation over clean, finish painted, and dry surfaces.
- C. Install insulation after piping system has been pressure tested and leaks corrected.
- D. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
- E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces of scraps abutting each other.
- F. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

- G. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Seal open ends of insulation with mastic. Sectionally seal butt ends of chilled water and condensate drain piping insulation at fittings with white vapor barrier coating.
- H. Cover valves, flanges, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job-fabricated units. Finish cold pipe fittings with white vapor barrier coating and hot piping with white vinyl acrylic mastic, both reinforced with glass cloth.
- I. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.
- J. Install protective metal shields and foamglass inserts where pipe hangers bear on outside of insulation.
- K. Insulation on piping that is to be heat traced shall be installed after installation of heat tape.
- L. Insulate valve bodies, flanges, and pipe couplings.
- M. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
- N. Do not insulate flexible pipe couplings and expansion joints.
- O. Do not allow insulation to cover nameplates or code inspection stamps.
- P. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
- Q. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.
- R. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.
- S. Placement:
 - 1. Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.
 - 2. Insulate valves and fittings with sleeved or cut pieces of same material.
 - 3. Seal and tape joints.
- T. Insulation at Hangers and Supports: Install under piping, centered at each hanger or support.

PLUMBING PIPING INSULATION 22 07 00 - 4

- U. Vapor Barrier:
 - 1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
 - 2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
 - 3. Do not use staples and screws to secure vapor sealed system components.

3.02 INSTALLATION OF INSULATION FINISH SYSTEMS

- A. Use a continuous friction type joint to hold jacket in-place, providing positive weatherproof seal over entire length of jacket.
- B. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
- C. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
- D. Do not use screws or rivets to fasten the fitting covers.
- E. Install removable prefabricated aluminum covers on exterior flanges and unions.
- F. Caulk and seal exterior joints to make watertight.

3.03 INSULATION APPLICATIONS

- A. Potable Cold Water:
 - 1. Type P3, elastomeric.
 - 2. 1-inch thickness for all pipe sizes.
- B. Potable Hot Water:
 - 1. Type P3, elastomeric.
 - 2. 1-inch thickness for all pipe sizes.
- C. Pipe Hangers:
 - 1. Type P3, Elastomeric: Rigid insulation section with 9-inch-long, 16-gauge galvanized steel saddle.

3.04 INSULATION FINISH APPLICATIONS

A. Piping Insulation (Concealed Areas): Factory finish.

- B. Piping Insulation (Exposed to View, Indoors): Factory finish.
- C. Piping Insulation (Outdoors): Factory finish.
- D. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

3.05 FIELD QUALITY CONTROL

A. Test factory-applied materials assembled. Field-applied materials may be tested individually.

END OF SECTION

SECTION 22 10 01 PLUMBING PIPING AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Gas Association (AGA):
 - a. B109.1, Diaphragm Type Gas Displacement Meters (under 500 Cubic Feet Per Hour Capacity).
 - b. B109.2, Diaphragm Type Gas Displacement Meters (500 Cubic Feet Per Hour Capacity and Over).
 - 2. American National Standards Institute (ANSI).
 - 3. American Public Works Association (APWA): Uniform Color Code.
 - 4. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - b. B31.9, Building Services Piping.
 - 5. American Society of Sanitary Engineering (ASSE):
 - a. 1010, Performance Requirements for Water Hammer Arresters.
 - b. 1050, Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage Systems.
 - c. 1051, Performance Requirements for Individual and Branch Type Air Admittance Valves for Sanitary Drainage Systems.
 - d. 1070, Performance Requirements for Water Temperature Limiting Devices.
 - e. 1071, Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment.
 - 6. ASTM International (ASTM):
 - a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
 - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
 - d. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
 - e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - f. A179/A179M, Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes.
 - g. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

- h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
- i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
- j. A197/A197M, Standard Specification for Cupola Malleable Iron.
- k. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- 1. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- m. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
- n. A518/A518M, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
- o. A536, Standard Specification for Ductile Iron Castings.
- p. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- q. A861, Standard Specification for High-Silicon Iron Pipe and Fittings.
- r. A888, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- s. B32, Standard Specification for Solder Metal.
- t. B61, Standard Specification for Steam or Valve Bronze Castings.
- u. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- v. B75/B75M, Standard Specification for Seamless Copper Tube.
- w. B88, Standard Specification for Seamless Copper Water Tube.
- x. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
- y. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
- z. B139/B139M, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
- aa. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
- bb. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
- cc. B306, Standard Specification for Copper Drainage Tube (DWV).
- dd. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- ee. C1173 Standard Specification for Flexible Transition Couplings for Underground Piping Systems.

- ff. C1277, Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- gg. C1460, Standard Specification for Shielded Transition Couplings for use with Dissimilar DWV Pipe and Fittings Above Ground.
- hh. C1540, Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- jj. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- kk. D2000, Standard Classification System for Rubber Products in Automotive Applications.
- D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- mm. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- nn. D2513, Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
- oo. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- pp. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- qq. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- rr. D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- ss. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
- tt. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- uu. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- vv. E438, Standard Specification for Glasses in Laboratory Apparatus.
- ww. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- xx. F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- yy. F876, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

- zz. F877, Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems.
- aaa. F1412, Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.
- bbb. F1924, Standard Specification for Plastic Mechanical Fittings for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing.
- ccc. F1973, Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems.
- ddd. F2023, Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Pipe, Tubing and Systems to Hot Chlorinated Water.
- eee. F2080, Standard Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (PE-RT) Pipe.
- 7. American Water Works Association (AWWA):
 - a. C104/A21.4, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
 - c. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - d. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - e. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - f. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot-Applied.
 - g. C207, Steel Pipe Flanges for Waterworks Service Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
 - h. C505, Resilient-Seated Gate Valves for Water Supply Service.
 - i. C550, Protective Interior Coatings for Valves and Hydrants.
 - j. C606, Grooved and Shouldered Joints.
 - k. C651, Disinfecting Water Mains.
 - 1. C904, Crosslinked Polyethylene (PEX) Pressure Pipe, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
- 8. Canadian Gas Association CGA 3.11, Lever-Operated Pressure-Lubricated Plug-Type Gas Shut-Off Valves.
- 9. Cast Iron Soil Pipe Institute (CISPI):
 - a. 301, Standard Specification for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

- b. 310, Specification for Couplings for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Strom Drain, Waste, and Vent Piping Applications.
- 10. CSA Group.
- 11. FM Global (FM).
- 12. International Association of Plumbing and Mechanical Officials (IAPMO).
- 13. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - a. SP-58, Pipe Hangers and Supports Materials, Design, Manufacture, Selection, Application, and Installation.
 - b. SP-69, Pipe Hangers And Supports Selection And Application.
 - c. SP-80, Bronze Gate, Globe, Angle, and Check Valves.
 - d. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- 14. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components Lead Content.
- 15. Plumbing and Drainage Institute (PDI): WH 201, Water Hammer Arresters Standard.
- 16. UL.
- United States Department of Transportation (USDOT), 49 CFR Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards.

1.02 DESIGN REQUIREMENTS

- A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
 - 1. Building Service Piping: ASME B31.9, as applicable.
 - 2. ICC International Plumbing Code.
 - 3. Local plumbing code.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product data sheets.
 - 2. Shop Drawings:
 - a. Show Contractor recommended changes in location of fixtures or equipment.

- 3. Isometric riser diagrams.
- B. Informational Submittals:
 - 1. Changes in location of equipment or piping that affect connecting or adjacent work, before proceeding with the Work.
 - 2. Complete list of products proposed for installation.
 - 3. Test records produced during testing.
 - 4. For Polyethylene (PE) Pipe:
 - a. Certificates of qualification for persons to be fusing PE pipe.
 - b. Experience and training record of persons to be fusing PE pipe.
 - c. Testing Plan:
 - 1) Submit at least 15 days prior to testing; include following as a minimum:
 - a) Testing dates.
 - b) Piping systems and section(s) to be tested.
 - c) Method of isolation.
 - d) Method of conveying water from source to system being tested.
 - d. Certifications of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
 - e. Test report documentation.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPING

- A. Piping Schedule: Refer to:
 - 1. The Drawings.
 - 2. Article Supplements.

B. Piping Material: Refer to Piping Data Sheet(s), Article Supplements

2.03 PIPE HANGERS AND SUPPORTS

- A. Hangers:
 - 1. Clevis Type: MSS SP-58 and MSS SP-69, Type 1 or Type 6.
 - a. Anvil; Figure 104 or 260, sizes 1/2-inch through 30 inches.
 - b. B-Line; Figure B3198H or B3100, sizes 3/8-inch through 30 inches.
 - 2. Hinged Split-Ring Pipe Clamp: MSS SP-58 and MSS SP-69, Type 6 or Type 12.
 - a. Anvil; Figure 104, sizes 3/4-inch through 8 inches.
 - b. B-Line; Figure B3198H, sizes 3/8-inch through 3 inches.
 - 3. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP-58.
 - 4. Attachments:
 - a. I-Beam Clamp: Concentric loading type, MSS SP-58 and MSS SP-69, Type 21, Type 28, Type 29, or Type 30, which engage both sides of flange.
 - b. Concrete Insert: MSS SP-58 and MSS SP-69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
- B. Saddle Supports:
 - 1. Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
 - a. Nonadjustable Saddle: MSS SP-58 and MSS SP-69, Type 37 with U-bolt.
 - 1) Anvil; Figure 259, sizes 4 inches through 36 inches.
 - 2) B-Line; Figure B3090, sizes 2-1/2 inches through 36 inches.
 - b. Adjustable Saddle: MSS SP-58 and MSS SP-69, Type 38 without clamp.
 - 1) Anvil; Figure 264, sizes 2-1/2 inches through 36 inches.
 - 2) B-Line; Figure B3093, sizes 2-1/2 inches through 36 inches.
- C. Wall Brackets:
 - 1. Welded Steel Bracket: MSS SP-58 and MSS SP-69, Type 33 (heavyduty).
 - a. Anvil; Figure 199, 3,000-pound rating.
 - b. B-Line; Figure B3067, 3,000-pound rating.
 - 2. One-Hole Clamp: Anvil; Figure 126, sizes 3/8-inch through 4 inches.
 - 3. Channel Type:
 - a. Unistrut.

- b. Anvil; Power-Strut.
- c. B-Line; Strut System.
- d. Aickinstrut (FRP).

D. Pipe Clamps:

- 1. Riser Clamp: MSS SP-58 and MSS SP-69, Type 8.
 - a. Anvil; Figure 261, sizes 3/4-inch through 24 inches.
 - b. B-Line; Figure B3373, sizes 1/2-inch through 30 inches.
- E. Channel Type Support Systems:
 - 1. Channel Size: 12-gauge, 1-5/8-inch-wide minimum steel, 1-1/2-inch-wide minimum FRP.
 - 2. Members and Connections: Design for all loads with safety factor of 5.
 - 3. Manufacturers and Products:
 - a. B-Line; Strut System.
 - b. Unistrut.
 - c. Anvil; Power-Strut.
 - d. Aickinstrut (FRP System).
- F. Accessories:
 - 1. Insulation Shields:
 - a. Type: Galvanized steel or stainless steel, MSS SP-58 and MSS SP-69, Type 40.
 - b. Manufacturers and Products:
 - 1) Anvil; Figure 167, sizes 1/2-inch through 24 inches.
 - 2) B-Line; Figure B3151, sizes 1/2-inch through 24 inches.
 - 2. Welding Insulation Saddles:
 - a. Type: MSS SP-58 and MSS SP-69, Type 39.
 - b. Manufacturers and Products:
 - c. Anvil; Figure Series 160, sizes 1-inch through 36 inches.
 - d. B-Line; Figure Series B3160, sizes 1/2-inch through 24 inches.
- G. Galvanize hangers, rods, clamps, protective shields, and hanger accessories.
- H. Trapeze Hangers:
 - 1. Assembly consisting of structure attachments with rod size dependent upon total weight supported, and spacing of assemblies determined by minimum pipe size included in group supported.
 - 2. Trapeze Horizontal: Structural angle or channel section of sufficient size to prevent measurable sag between rods.
 - 3. Manufacturers and Products: a. Unistrut.

- b. B-Line; Strut System.
- c. Anvil; Power-Strut.
- d. Aickinstrut (FRP System).

2.04 INSULATION

- A. As specified in Section 22 07 00, Plumbing Piping Insulation.
- B. As specified in Section 23 07 00, HVAC Insulation.

2.05 VALVES

- A. General:
 - 1. Furnish complete with necessary operating hand wheels, chain wheels, extension stems, floor stands, worm and gear operators, operating nuts, chains, and wrenches.
 - 2. Renewable Parts Including Discs, Packing, and Seats: Types as recommended by valve manufacturer for intended service.
 - 3. Units shall have name of manufacturer and size of valve cast on body or bonnet or shown on a permanently attached plate in raised letters.
- B. Design Features:
 - 1. Brass and bronze components, including appurtenances in contact with water.
 - 2. Alloys containing less than 16 percent zinc and 2 percent aluminum.
 - 3. Alloys are of the following ASTM designations:
 - a. B61, B62, B98/B98M (Alloy A, B, or D), B127, B139 (Alloy A), B164, and B194.
 - b. Stainless steel Alloy 18-8 may be substituted for bronze as an option with approval of Engineer.
 - 4. Gland Bolts on Iron Body Valves: Bronze, fitted with brass nuts.
- C. Valve Operators:
 - 1. Open by turning counterclockwise.
 - 2. Worm and Gear Operators On Manually Operated Valves: Totally enclosed design, proportioned as to permit operation of valve under full operating head with maximum pull of 40 pounds on handwheel or crank.
 - 3. Self-locking type to prevent the disc or plug from creeping.
 - 4. Self-Locking Worm Gears:
 - a. One-piece design of gear bronze material, accurately machine cut.
 - b. Worm: Hardened alloy steel, with thread ground and polished.
 - c. Reduction gearing shall run in a proper lubricant.

- 5. Galvanize handwheels.
- D. Globe Valves:
 - 1. Type V235 Angle Type Hose Valve 3/4-inch:
 - a. 3/4-inch NPT female inlet, 3/4-inch male hose thread outlet, heavy rough brass body rated 125 psi, lockshield bonnet, removable handle, atmospheric vacuum breaker conforming to ASSE 1011 and IAPMO code.
 - b. Manufacturers and Products:
 - 1) Acorn; 8126, surface pipe mount valve, bent nose without flange.
 - 2) Acorn; 8121, surface mount through wall valve, bent nose with flange.
 - 3) Acorn; 8131, pipe and pedestal mounted valve located above 6 inches, straightnose.
 - 4) Acorn; 8136, pedestal mounted valve located lower than 6 inches, inverted nose.
- E. Ball Valves:
 - 1. Type V300 Ball Valve 3 inches and Smaller for General Water and Air Service:
 - a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound CWP, 150-pound SWP, complies with MSS SP-110.
 - b. Manufacturers and Products:
 - 1) Threaded:
 - a) Conbraco Apollo; 70-100.
 - b) Nibco; T-580-70.
 - 2) Soldered:
 - a) Conbraco Apollo; 70-200.
 - b) Nibco; S-580-70.
 - 2. Type V301 Ball Valve 2 inches and Smaller for General Water and Air Service:
 - a. Two-piece, full port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.

- b. Manufacturers and Products:
 - 1) Threaded:
 - a) Conbraco Apollo; 77-100.
 - b) Nibco; T-585-70.
 - 2) Soldered:
 - a) Conbraco Apollo; 77-200.
 - b) Nibco; S-585-70.
- 3. Type V304 Ball Valve 2 inches and Smaller for General Water and Air Service:
 - a. Three-piece body type, bronze body and end pieces, hard-chrome plated bronze or brass ball, full bore port, RTFE seats and packing, blowout-proof stem, zinc-plated steel hand lever operator with vinyl grip.
 - b. Rated 6-pound WOG, 150-psi SWP.
 - c. Manufacturers and Products:
 - 1) Threaded Ends:
 - a) Milwaukee; BA-300.
 - b) Nibco; T-595-Y.
 - c) Conbraco Apollo; 82-100.
 - 2) Soldered Ends:
 - a) Milwaukee; BA-350.
 - b) Nibco; S-595-Y.
 - c) Conbraco Apollo; 82-200.
- 4. Type V311 Ball Valve 2 inches and Smaller for Natural Gas and Propane Service:
 - a. UL Listed for gas to 125 psig and flammable liquids to 250 psig:
 - b. Two-piece body type, bronze or forged brass body and end pieces, hard-chrome plated bronze or brass ball, full bore port, RTFE seats and packing, blowout-proof stem, zinc-plated steel hand lever operator with vinyl grip.
 - c. Full port through 1-inch. Standard port 1-1/4 inches to 2 inches.
 - d. Rated 250-pound WOG.
 - e. Approvals:
 - 1) CSA certified.
 - 2) UL 842 Listed for flammable liquids and gases.
 - 3) MSS SP-110 compliant.
 - f. Manufacturers and Products:
 - 1) Threaded Ends:
 - a) Conbraco Apollo; 80-100.
 - b) Norgas; S95 Series.
 - c) Watts; FBV-3C.
 - d) Nibco; T-585-70-UL (1/4-inch to 1-inch),
 - T-580-70-UL (1-1/4-inch to 2 inches).

- 5. Type V330, Thermoplastic Ball Valves 2 inches and Smaller for Water Service:
 - a. Rated 150 psi at 105 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride (PVC) body, ball, and stem.
 - b. End entry, double union design, with replaceable Teflon seats and Viton or Teflon O-ring stem seals.
 - c. Furnish with hand lever operator.
 - d. Single union ball valves with flanged ends drilled to 150-pound ANSI Standard are acceptable.
 - e. Manufacturers:
 - 1) Asahi/America.
 - 2) R&G Sloane Manufacturing Co., Inc.
- F. Plug Valve:
 - 1. Type V409 Lubricated Tapered Plug Valve 1/2-inch to 6 inches for Natural Gas Service:
 - a. Lubricated type with grey iron or semi-steel body and plug, rated 200 CWP working pressure, with bubble-tight gas shutoff.
 - b. Plug lubrication with side mount sealant injection fitting.
 - c. Plug mechanically balanced with spring for predictable operating torque.
 - d. Flanged ends 2-1/2 inches and larger, threaded ends for smaller valves.
 - e. Actuator rated with actuator mounting pads where required.
 - f. Round or rectangular port of no less than 80 percent of connecting pipe area.
 - g. Buna-N O-ring, stainless spring and stem, TFE stem seal.
 - h. Standards Conformance:
 - 1) Canadian Gas Association CGA 3.11, Lever-Operated Pressure-Lubricated Plug-Type Gas Shut-Off Valves.
 - United States Department of Transportation (DOT),
 49 CFR Part 192, Pipeline Safety Regulations.
 - i. Operators:
 - 1) 3-inch and 4-inch Valves: Wrench lever manual.
 - 2) 6-inch Valves: Totally enclosed, geared, manual operator, with handwheel, 2-inch nut, or chain wheel.
 - j. Manufacturers and Products:
 - 1) Flowserve Nordstrom; Figure 114 (1/2-inch to 2 inches), Figure 115 (2-1/2 inches to 4 inches).
 - 2) Homestead; Figure 601 (1/2-inch to 2 inches), Figure 602 (2-1/2 inches to 6 inches).
 - 3) Milliken; Series 200M (1/2-inch to 2 inches), Series 201M (2-1/2 inches to 6 inches).

- G. Check Valves:
 - 1. Type V600, Check Valves 3 inches and Smaller:
 - a. Bronze body, wye pattern, threaded ends and cap, regrinding seat, and swing type disc.
 - b. Rated 125-pound SWP, 200-pound WOG.
 - c. Manufacturers and Products:
 - 1) Crane; No. 37.
 - 2) Walworth Co.; Figure 406.
 - 2. Type V602 Check Valve 2 inches and Smaller:
 - a. All bronze, threaded cap, threaded ends, swing type replaceable Teflon disc and bronze disc holder, rated 150-pound SWP, 300-pound WOG.
 - b. Manufacturers and Products:
 - 1) Walworth; Figure 3412.
 - 2) Milwaukee; Figure 510.
 - 3. Backwater Check Valve 2 inches to 8 inches:
 - a. Coated cast iron backwater check valve, integral offset type swing-check assembly, gasketed bolted access cover or threaded, ferrule, and cover.
 - b. Manufacturers and Products:
 - 1) J. R. Smith; Figure 7012.
 - 2) Josam; Series 67500.
 - 3) Zurn; Model Z-1095.
- H. Water Pressure Reducing Valves 1/2-inch Through 2-1/2 inches: See the Drawing.
- I. Pressure Reducing Valve, Natural Gas and Propane, High Pressure:
 - 1. Direct diaphragm, spring controlled cast-iron body, spring aluminum diaphragm and spring case, nitrile disc/diaphragm/O-rings, internal relief, NPT thread ends, 125-psig rated.
 - 2. Valve Body Size: 1/2-inch to 2 inches, as indicated.
 - 3. Inlet pressure of 5 psig to 125 psig, as indicated.
 - 4. Outlet Pressure: Set at 2 psig to 10 psig, as indicated.
 - 5. Valve Orifice Size: 1/4-inch to 1-3/16 inches, as indicated.
 - 6. Manufacturer and Product: Fisher; S201H.

2.06 MISCELLANEOUS PIPING SPECIALTIES

- A. Strainers for Water Service:
 - 1. Iron body, Y-pattern, 125-pound rated, with screwed bronze or bolted iron cap.
 - 2. Screen: Heavy-gauge stainless steel or monel, 30 mesh.

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- 3. Manufacturers and Products:
 - a. Crane; No. 988-1/2.
 - b. Mueller; No. 758.
- B. Flexible Connectors for Stainless Steel Gas Lines:
 - 1. Corrugated, Type 316 stainless steel hose, with 10-inch live length and Type 316 stainless steel male NPT pipe connectors at each end.
 - 2. Manufacturers and Product:
 - a. Flexonics; Braided Rex-Weld.
 - b. Kin-Line.
- C. Vacuum Breakers 2 inches and Smaller:
 - 1. Angle type, as required.
 - 2. Manufacturers:
 - a. Febco.
 - b. Watts.
- D. Water Hammer Arresters:
 - 1. Materials: ASSE 1010 certified, Type L copper tube, HHPP piston with two lubricated EPDM O-rings, FDA approved lubricant, rolled piston stop, wrought copper male thread adapter.
 - 2. Manufacturers and Products:
 - a. Sioux Chief Mfg. Co., Inc.; Series 650 and Series 660.
 - b. Precision Plumbing Products, Inc.
- E. Sleeves:
 - 1. Manufacturers and Products:
 - a. J. R. Smith; Figure 1720.
 - b. Josam; No. 26400.
- F. Flashing Sleeves for Roof Penetrations:
 - 1. Built-Up Bituminous Roofing: Fabricate of lead as specified in Section 07 62 00, Sheet Metal Flashing and Trim.
 - 2. Single-Ply Membrane Roofing: Pipe seals as specified in Section 07 70 01, Roof Specialties and Accessories.
- G. Insulating Dielectric Unions and Flanges:
 - 1. Galvanically compatible with piping to which attached and pressure ratings suitable for system working pressures.
 - 2. Unions 2 inches and Smaller: Screwed or solder-joint type.

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- 3. Unions 2-1/2 inches and Larger: Flanged type, complete with bolt insulators, dielectric gasket, bolts, and nuts.
- 4. Manufacturers:
 - a. Epco Sales, Inc., Cleveland, OH.
 - b. Capitol Insulation Unions.
- H. Joint Solder: 95-5 wire solder, ASTM B32, Grade 95 TA. Lead free, NSF certified. Do not use cored solder.
- I. Pipe Joint Sealer: Compound insoluble in water or Teflon tape; approved by NFS for use in potable water.
- J. Rubber Gaskets: ASTM C564.

2.07 MEASURING DEVICES

- A. Thermometer:
 - 1. Adjustable angle, organic spirit type, blue in color, with 9-inch case and scale range in degrees F, as shown.
 - 2. Furnish with 3-1/2-inch stem length and separable NPT lead-free brass thermowell.
 - 3. For locations above 6 feet off floor or grade.
 - 4. Manufacturers and Product:
 - a. Trerice Co.; Model BX9140304.
 - b. Weksler.
- B. Thermometer Dial Type:
 - 1. Compact dial type, 2-1/2-inch diameter, adjustable angle, zinc plated steel case with center back entry.
 - 2. Scale range in degrees F, as shown.
 - 3. Bimetal spiral spring sensing elements.
 - 4. Furnish with separable NPT lead-free brass thermowell.
 - 5. Provide at each water heater and tempering valve outlet, and at the return on each recirculating hot or tempered water system.
 - 6. Manufacturers and Product:
 - a. Watts, Bimetal Model LFTB-2-1/2.
 - b. Trerice Co.
 - c. Weksler.
- C. Pressure Gauges:
 - 1. Construction: 3-1/2-inch gauge size, 0 kPa to 690 kPa, 0 psi to 160 psi range, steel case, glass crystal, brass movement, and 1/4-inch NPT lower connection.

- 2. Furnish with 1/4-inch brass gauge cock.
- 3. Manufacturers and Products:
 - a. Ashcroft; Type 1008.
 - b. Marsh; J80.
 - c. Marshalltown.

PART 3 EXECUTION

3.01 GENERAL

- A. Refer to the Area Classification and Materials Selection Table in the General Section on the Drawings for installation material requirements.
- B. Install plumbing systems to meet applicable plumbing code.
- C. Field Obstructions:
 - 1. Drawings do not attempt to show exact details of piping. Provide offsets around obstructions.
 - 2. Do not modify structural components, unless approved by Engineer.
- D. Sleeves:
 - 1. Pipe sizes shown are nominal sizes, unless shown or specified otherwise.
 - 2. Provide piping passing through walls, floors, or ceilings with standard-weight pipe sleeves.
 - 3. Provide pipes passing through finished walls with chrome-plated canopy flanges.
 - 4. Dry pack sleeves in existing work in-place and provide finished appearance.
 - 5. Pack holes left by removal of existing piping with grout and finish to match adjacent surface.
- E. Provide unions in piping systems at connections to equipment.
- F. Provide shielded transition couplings, insulating dielectric unions and flanges between ferrous and nonferrous piping and where otherwise required for electrically insulated connection.
- G. Pipe air release valves, water-lubricated bearings, and other appurtenances having water effluent with copper tubing to nearest drain.
- H. Provide isolation valves and strainers at pressure regulators.

3.02 INSTALLATION

- A. Steel Pipe (Above Ground Only):
 - 1. Ream, clean, and remove burrs and mill scale from piping before making up.
 - 2. Seal joints with pipe joint sealer or Teflon tape.
 - 3. Steel pipe used for natural gas shall gas rated per Fuel Gas Code.
- B. Copper Tubing:
 - 1. Cut tubing square and remove burrs.
 - 2. Clean both inside of fittings and outside of tubing with steel wool and hydrochloric acid before soldering.
 - 3. Prevent annealing of fittings and hard-drawn tubing when making connections.
 - 4. Do not use mitered joints for elbows or notching of straight runs of pipe for tees.
 - 5. Underground shall be pit wrapped.
- C. PEX-A Polyethylene Piping:
 - 1. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings.
 - 2. Install in compliance with the PEX Piping Systems Design and Installation Manual, and Systems Installation Guide.
 - 3. PEX piping shall be installed per ASTM E84 requirements for plenum applications.
 - 4. Support and provide all required hangers and supporting strapping as required by manufacturer to provide a code compliant installation.
 - 5. Install in straight runs free of sags and kinks and provide bend supports at all 1/2-inch and 3/4-inch drops.
 - 6. All penetrations through wall plates shall be protected or shielded as required to prevent damage to piping.
 - 7. Tubing passing through metal studs shall use grommets or sleeves at the penetration.
 - 8. Provide supports, fixed anchor points, and hangers in compliance with the Piping Systems Design and Installation Manual and Piping Systems Installation Guide, current edition, to minimize expansion and contraction.
 - 9. Install piping at each fixture with out of the wall support bracket to secure piping and prevent excess movement when water stops or shut valves are operated.
 - 10. Where manifolds are used, install centered in access panels to permit servicing.

D. Rigid PVC or CPVC:

- 1. Cut, make up, and install in accordance with pipe manufacturer's recommendations.
- 2. Ream, clean, and remove burrs from cut ends before joining pipe.
- 3. Lay in trench by snaking pipe from one side to other.
- 4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and final use.
- 5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
- 6. Shield ends to be joined from direct sunlight prior to and during laying operation.
- 7. Use strap wrenches only for tightening threaded plastic joints. Do not over tighten fittings.
- E. Polyethylene Piping for Natural Gas (Below Ground):
 - 1. Join pipes, fittings, and flange connections by means of thermal buttfusion.
 - 2. Perform butt-fusion in accordance with pipe manufacturer's recommendations as to equipment and technique.
 - 3. Lay pipe snaking from one side of trench to other.
 - 4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
 - 5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
 - 6. Shield ends to be joined from direct sunlight prior to and during laying operation.
 - 7. Joint Fusion:
 - a. Measure and log each joint fusion by an electronic monitoring device (data logger) affixed to fusion machine capable of being retrieved electronically. Data to be logged shall include the following:
 - 1) Pipe size and dimensions.
 - 2) Machine model and size.
 - 3) Operator identification.
 - 4) Job identification number.
 - 5) Weld number.
 - 6) Fusion, heating, and drag pressure settings.
 - 7) Heater plate temperature.
 - 8) Time stamp showing when weld was performed.
 - 9) Heating and curing time of weld.
 - 10) Curing temperature readings and time stamps of readings.
 - 11) Error messages and warnings for out-of-range temperature or pressure settings.

- b. In addition to logged items above, the following shall be logged or annotated on report:
 - Location of fused joint by pipeline station or by reference to pipe Shop Drawing.
 - 2) Ambient temperature and humidity.
 - 3) If internal bead was removed.
- F. Water System Balancing: Provide a qualified registered engineer or firm specializing in testing and balancing to adjust domestic water system. Balance system for required water flows at each plumbing fixture, terminal device, and recirculating hot water loop.
- G. Water Hammer Arresters:
 - 1. Install in piping systems where shown on the Drawings and adjacent to pieces of equipment where quick closing valves are installed.
 - 2. Install at all emergency safety showers and eyewashes.
 - 3. Size and install in accordance with PDI-WH201.
 - 4. Shock arresters to have access panels or to be otherwise accessible.
- H. Valves: Install in accordance with manufacturer's recommendations.
- I. Miscellaneous Piping Specialties: Install in accordance with manufacturer's recommendations.
- J. Measuring Devices: Install in accordance with manufacturer's recommendations.

3.03 SANITARY AND WASTE DRAINS AND VENTS PIPING

- A. Installation:
 - 1. Set piping above floor slab true and plumb.
 - 2. Set exposed risers as close to walls as possible.
 - 3. Slope drain lines at minimum 1 percent slope, unless otherwise noted. Vent lines shall be installed level or sloped, with no low spots.
 - 4. Where vent stacks pass through roof slab, fit with flashing sleeve secured to roof.
 - 5. Extend vents minimum 1-foot above roof.
 - 6. Provide cleanouts where shown and where required by code.

3.04 HVAC CONDENSATE PIPING

- A. Set piping true and plumb.
- B. Slope piping 1/8-inch per foot minimum.

3.05 WATER SUPPLY PIPING

- A. Water supply piping includes potable and nonpotable systems as indicated.
- B. Flush water piping systems clean of internal debris, clean faucet aerators, and adjust plumbing fixture valves for manufacturer's recommended flow.
- C. Do not run water piping through electrical rooms, stairwells, or immediately over or within a 3-foot horizontal clearance of electrical panels, motor starters, or environmental control panels.
- D. Provide exterior water piping with minimum 1-foot of cover or install below frost line, whichever is greater.
- E. Hose Valves and Hydrants: Attach handle with setscrew and provide manufacturer's recommended gravel fill around drain hole of post hydrants.
- F. Provide valve operators with position indicators, where indicated, to show position of valve disc or plug.
- G. Provide bypass with globe valve for emergency throttling around each reducing valve.
- H. Protect buried copper and steel pipe and fittings with a single wrap of coal-tar saturated felt in accordance with AWWA C203.
- I. Vacuum Breakers 2 inches and Smaller: Install minimum 6 inches above flood line of equipment they serve.
- J. Provide manual air vents at high points in domestic hot water system.

3.06 NATURAL GAS AND PROPANE PIPING

- A. Install in compliance with applicable local gas code.
- B. If gas is wet, slope piping 1/4-inch per foot downward in direction of flow. Provide drip traps at low spots.
- C. If gas is wet, install drip traps at end of runs, where pipe changes elevation.
- D. Provide dirt leg, ground union joint, and isolation valve adjacent to each flexible connector hose at each appliance connection.
- E. Label "NATURAL GAS, X PSIG", or "PROPANE, X PSIG" at intervals not to exceed 5 feet, indicating fuel type and pressure.

3.07 INSULATION

A. As specified in Sections 22 07 00, Plumbing Piping Insulation and 23 07 00, HVAC Insulation.

3.08 PIPE HANGERS AND SUPPORTS

- A. Install pre-engineered support equipment in accordance with manufacturer's recommendations.
- B. Hanger Rod Sizing and Spacing for:
 - 1. Steel Pipe:

Pipe Size	Max. Hanger Spacing (feet)	Min. Rod Size (inches)
1-inch and smaller	6	1/4
1-1/4 through 2-1/2 inches	8	1/4
3 and 4 inches	10	3/8
6 inches	12	3/8
8 inches	12	1/2

- 2. Copper Pipe:
 - a. Rod Size: Same as for steel pipe.
 - b. Spacing: 2 feet less per size than for steel pipe, except pipe 1-1/4 inches and smaller shall be supported every 6 feet.
- 3. Cast Iron Pipe:
 - a. Rod Size: Same as for steel pipe.
 - b. Spacing: Locate hanger rods at each pipe joint and change of direction, 10-foot maximum spacing.
- 4. Plastic Pipe:
 - a. Rod Size: Same as for steel pipe.
 - b. Spacing: As recommended by manufacturer and required by applicable plumbing code for flow and temperature in pipe.
 - c. No metal portion of hanger shall contact pipe directly.
- C. Attach Support Rods For Horizontal Piping:
 - 1. To steel beams with I-clamps.
 - 2. To concrete with inserts or with flanges fastened with flush shells.
 - 3. To wood with thickness of 2-1/2 inches or more with bolts or angle clips.

- D. Trapeze Hangers:
 - 1. Trapeze hangers may be used in lieu of individual hangers where horizontal piping is arranged with two or more parallel lines.
 - 2. Attach lines to horizontal with U-bolts or one-hole clamps.

E. Vertical Piping:

- 1. Support by channel type support system and pipe clamps on 10-foot maximum centers.
- 2. Copper and Plastic Piping: Isolate from channels and pipe clamps with pipe isolators.
- F. Insulated Piping: Furnish galvanized protection shield and oversized hangers under insulated piping.

3.09 INSTALLATION—CONCRETE ENCASED

- A. Where horizontal piping is encased in concrete such as a floor or equipment slab, rigidly mount pipe to rebar and subbase to prevent lateral movement, sagging, and uplifting during concrete installation and finishing. Provide at least two temporary strut supports wired to rebar and supported from the engineered fill or subbase below for each section of pipe.
- B. To account for building settling where construction joints occur, or where piping leaves concrete encasements at buildings, utility trenches, vaults, slabs and other structures, provide elastomeric foam insulation wrap around the pipe at the transition point.
 - 1. Minimum Wrap: five pipe diameters of 1/2-inch-thick
- C. Provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

3.10 INTERIM CLEANING

- A. Prevent accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping during fabrication and assembly.
- B. Examine piping to assure removal of foreign objects prior to assembly.
- C. Conventional commercial cleaning methods of cleaning are acceptable if method and cleaning material does not corrode, deform, swell, or otherwise alter physical properties of material being cleaned.

3.11 TESTING

- A. General:
 - 1. Conduct pressure and leakage tests on newly installed pipelines.
 - 2. Provide necessary equipment and material, and make taps in pipe, as required.
 - 3. Engineer will monitor tests. Provide 24-hour advance notice of start of testing.
 - 4. Test Pressures: As specified herein and in Piping Schedule.
 - 5. Test Records:
 - a. Make records of each piping system installation during test to document the following:
 - 1) Date of test.
 - 2) Description and identification of piping tested.
 - 3) Test fluid.
 - 4) Test pressure.
 - 5) Remarks, including:
 - a) Leaks (type, location).
 - b) Repairs made on leaks.
 - 6) Certification by Contractor and signed acknowledgment by Engineer that tests have been satisfactorily completed.
- B. Testing New Pipe Connected to Existing Pipe: Isolate new pipe with grooved end pipe caps, spectacle blinds, or blind flanges.
- C. Preparation and Execution:
 - 1. Buried Pressure Piping:
 - a. An initial service leak test may be conducted with a partially backfilled trench and the joints left open for inspection, if field conditions permit, as determined by Engineer.
 - b. Expose joints for the acceptance test on buried pressure piping to be pneumatically tested or subjected to an initial service leak test.
 - c. Conduct final hydrostatic acceptance tests after trench has been completely backfilled.
 - 2. Exposed Piping: Conduct tests after piping has been completely installed including supports, hangers, and anchors, but prior to insulation.

- D. Hydrostatic Leak Tests:
 - 1. Equipment:
 - a. Provide the following:

Amount	Description	
2	Graduated containers	
2	Pressure gauges	
1	Hydraulic force pump	
	Suitable hose and suction pipe as required	

- 2. Procedure:
 - a. Use water as the hydrostatic test fluid.
 - b. Provide clean test water of such quality as to minimize corrosion of the materials in the piping system.
 - c. Open vents at high points of the piping system to purge air pockets while the piping system is filling.
 - d. Venting during filling of system may also be provided by loosening flanges with a minimum of four bolts or by the use of equipment vents.
 - e. Test piping systems at test pressure specified in Piping Schedule.
 - f. Maintain hydrostatic test pressure continuously for 30 minutes minimum and for such additional time as necessary to conduct examinations for leakage.
 - g. Examine joints and connections for leakage.
 - h. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking.
 - Correct visible leakage and retest to satisfaction of Engineer.
- 3. Buried Water Lines:

i.

- a. A limited amount of leakage is permissible according to formula specified.
- b. Conduct hydrostatic testing as follows:
 - 1) Pipe with Concrete Thrust Blocking: Do not make pressure test until a minimum of 5 days after thrust blocking is installed.
 - 2) If high-early strength cement is used for thrust blocking, time may be reduced to 2 days.
- c. Cement-Lined Piping: Slowly fill test section with water and allow to stand for 24 hours under slight pressure to allow cement lining to absorb water.
- d. Expel air from piping system prior to testing.

- e. Apply and maintain specified test pressure with hydraulic force pump.
- f. Valve off the piping system when test pressure is reached.
- g. Conduct pressure test for 2 hours, reopening isolation valve only as necessary to restore test pressure.
- h. Accurately measure amount of water required to maintain test pressure by placing pump suction in a barrel or similar device, or by metering.
- i. Measurement represents leakage, defined as the quantity of water necessary to maintain the specified test pressure for the duration of the test period.
- j. Determine maximum allowable leakage in gallons per hour from the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

where:

- L = Allowable leakage, in gallons per hour
- N = N Number of joints in the length of pipe tested
- D = Nominal diameter of pipe, in inches
- P = Test pressure during the leakage test, in pounds per square inch
- k. Correct leakage greater than the allowable determined under this formula, and retest to satisfaction of Engineer.
- 4. Test Pressure for Water: 1-1/2 times system pressure.
- 5. Gravity Sewers and Drains:
 - a. Test by water or air exfiltration tests as prescribed by local or state plumbing codes and visually examine for leaks.
 - b. Repair leaks and retest system until no further leakage is evident.
- E. Pneumatic Leak Tests:
 - 1. Perform on compressed air, natural gas, and vacuum piping.
 - 2. Equipment:
 - a. Provide the following:

Amount	Description
1	Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105 percent of the required primary test pressure
1	Calibrated test gauge

- 3. Procedure:
 - a. Perform pneumatic testing using accurately calibrated instruments and oil-free, dry air.
 - b. Perform tests only on exposed piping, after piping has been completely installed, including supports, hangers and anchors, and inspected for proper installation.
 - c. Test piping system at test pressure specified in Piping Schedule.
 - d. Protect test personnel and Owner's operating personnel from hazards associated with air testing.
 - e. Secure piping to be tested to prevent damage to adjacent piping and equipment in event of a joint failure.
 - f. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by test.
 - g. Apply maximum 25 psig preliminary pneumatic test to piping system prior to final leak testing, to locate major leaks.
 - h. Examine joints and connections for leakage with soap bubbles.
 - i. Correct visible leaks and retest.
 - j. Gradually increase pressure in system to not more than one-half of test pressure.
 - k. Thereafter increase pressure in steps of approximately 1/10 of maximum test pressure until required test pressure is reached.
 - 1. Maintain pneumatic test pressure continuously for minimum 10 minutes and for such additional time as necessary to conduct a soap bubble examination for leakage.
 - m. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leakage.
 - n. Correct visible leakage and retest to satisfaction of Engineer.
 - o. Following pneumatic testing, thoroughly purge lines that are to carry flammable gases with nitrogen to assure no explosive mixtures will be present in system during filling process.

3.12 CLEANING AND DISINFECTION

- A. Prior to final acceptance, following assembly and testing, flush pipelines with water, except for plant process air lines and instrument air lines, and remove accumulated construction debris and other foreign matter.
- B. Minimum Flushing Velocity: 2.5 feet per second.
- C. Insert cone strainers in the connections to attached equipment and leave until cleaning has been accomplished.
- D. Remove accumulated debris through drains 2 inches and larger or by dropping spools and valves.

- E. Immediately after draining flushed lines, dry piping with compressed air.
- F. Use compressed air to remove loose debris from plant process air and instrument air piping.
- G. Disinfect potable water pipelines before placing in service:
 - 1. Meet the requirements of AWWA C651, unless otherwise specified.
 - 2. Disinfecting Mixture:
 - a. A chlorine-water solution having a free chlorine residual of 40 ppm to 50 ppm.
 - b. Prepare by injecting one of the following:
 - 1) Liquid chlorine gas-water mixture.
 - 2) Dry chlorine gas.
 - 3) Calcium or sodium hypochlorite and water mixture.
 - c. Inject mixture into pipeline at a measured rate while freshwater is allowed to flow through the pipeline at a measured rate so the combined mixture of freshwater and chlorine solution or gas is of the specified strength.
 - d. Apply liquid chlorine gas-water mixture by means of a chlorinating device.
 - e. Feed dry chlorine gas through proper devices for regulating the rate of flow and providing effective diffusion of gas into water within pipe being treated.
 - f. Chlorinating devices for feeding solutions of chlorine gas or gas itself must prevent backflow of water into chlorine cylinder.
 - g. Calcium Hypochlorite: If this procedure is used, first mix dry powder with water to make a thick paste, then thin to approximately a 1 percent solution (10,000 ppm chlorine).
 - h. Sodium Hypochlorite: If this procedure is used, dilute liquid with water to obtain a 1 percent solution.
 - i. The following proportions of hypochlorite to water will be required:

Product	Quantity	Water		
Calcium Hypochlorite ¹ (65 - 70 percent C1)	1 lb	7.5 gal		
Sodium Hypochlorite ² (5.25 percent C1)	1 gal	4.25 gal		
¹ Comparable to commercial products known as HTH, Perchloron, and Pittchlor. ² Known as liquid laundry bleach, Clorox, and Purex.				

- H. Point of Application:
 - 1. Inject chlorine mixture into pipeline to be treated at the beginning of the line through a corporation stop or suitable tap in the top of pipeline.
 - 2. Control clean water from existing system or another source so it flows slowly into newly installed piping during chlorine application.
 - 3. Manipulate valves so the strong chlorine solution in the line being treated will not flow back into line supplying the water. Use check valves, if necessary.
- I. Retention Period:
 - 1. Retain treated water in pipeline for a minimum of 24 hours or long enough to destroy nonspore-forming bacteria.
 - 2. At the end of the retention period, the disinfecting mixture shall have strength of at least 10 ppm of chlorine.
 - 3. Operate valves, hydrants, and other appurtenances during disinfection to assure disinfecting mixture is dispersed into all parts of the pipeline including dead ends, new services, and similar areas that otherwise may not receive the disinfecting solution.
 - 4. Do not place concentrated quantities of commercial disinfectants in pipeline before filling with water.
 - 5. After chlorination, flush water from permanent source of supply until water through pipeline is equal chemically and bacteriologically to permanent source of supply.
- J. Disposal of Disinfecting Water:
 - 1. Dispose of disinfecting water in accordance with permits and regulations. Protect the public and receiving waters from harmful or toxic concentrations of chlorine.
 - 2. Do not allow disinfecting water to flow into a waterway without adequate dilution or other satisfactory method of reducing chlorine concentrations to a safe level.

3.13 PROTECTION OF INSTALLED WORK

- A. Protective Covers:
 - 1. Provide over floor and shower drains during construction, to prevent damage to drain strainers and keep foreign material from entering drainage system.
 - 2. Cover roof drains and emergency overflow drains during roofing process so roofing material and gravel do not enter drain piping.
 - 3. Remove at time of Substantial Completion.

END OF SECTION

SECTION 22 30 00 PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Gas Association (AGA).
 - 2. American Society of Heating, Refrigerating & Air-Conditioning Engineers, Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. American Society of Mechanical Engineer's (ASME).
 - 4. American Society of Sanitary Engineering (ASSE):
 - a. 1013, Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Backflow Preventers.
 - b. 1015, Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Backflow Fire Protection Assemblies.
 - 5. American Water Works Association (AWWA):
 - a. C510, Double Check Valve Backflow Prevention Assembly.
 - b. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
 - c. C550, Protective Interior Coatings for Valves and Hydrants.
 - 6. ASTM International (ASTM):
 - a. A48/A48M, Standard Specification for Gray Iron Castings.
 - b. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
 - 7. Canadian Standards Association (CSA):
 - a. B64.4, Backflow Preventers, Reduced Pressure Principle Type (RP).
 - b. B64.5, Backflow Preventers, Double Check Valve Type (DCVA).
 - 8. FM Global (FM).
 - 9. Food and Drug Administration (FDA).
 - 10. Foundation for Cross-Connection Control and Hydraulic Research at University of Southern California (FCCHR): Manual of Cross-Connection Control.
 - 11. International Code Council (ICC): International Plumbing Code (IPC).
 - 12. National Electrical Code (NEC).
 - 13. National Electrical Manufacturers Association, (NEMA): MG 1, Motors and Generators.
- 14. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components Lead Content.
- 15. UL.

1.02 SUBMITTALS

A. Action Submittals: Manufacturer's product data.

1.03 SPECIAL GUARANTEE

A. Where note below, provide manufacturer's extended guarantee in writing with Owner named as beneficiary. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of products found defective during the stated period after date of Substantial Completion.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER HEATERS

- A. Electric Water Heater (Residential):
 - 1. See the Drawing and supplement sheet.
- B. Instantaneous Tankless Gas Water Heating System (Commercial):
 - 1. See the Drawing and supplement sheet.

2.03 GAS VENT STACK

- A. For Gas-Fired Water Heaters:
 - 1. UL listed, Type B double wall, insulated gas vent pipe with rain cap.
 - 2. Galvanized steel outer jacket, aluminum inner sleeve.
 - 3. Insulating thimble.
 - 4. Pier section with cleanout where stack is offset.
 - 5. Manufacturer's standard fittings as required.

2.04 BACKFLOW PREVENTERS

- A. Reduced-Pressure Backflow Preventers (3/4-inch Through 2 inches):
 - 1. Description:
 - a. Regulatory Compliance: AWWA C511, CSA B64.4, FCCHR of USC Section 10, ASSE 1013, ICC (IPC).
 - b. Valve Body: Bronze.
 - c. End Connections: Threaded, NPT.
 - d. Maximum Working Pressure: 175 psi (350 psi test).
 - e. Temperature Range: 32 degrees F to 140 degrees F.
 - f. Shutoff Valve: Full port, resilient seated, bronze ball valve with bronze ball valve test cock.
 - g. Inlet Strainer: Bronze wye strainer, 40-mesh perforated, Type 304 stainless steel.
 - h. Accessories: Drainline air gap fitting.
 - 2. Sizes: See the Drawing.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Install, arrange, and connect equipment as shown on the Drawings and in accordance with manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

- A. Startup:
 - 1. In accordance with Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
 - 2. Piping Systems: Verify that flushing, cleaning, and testing has been completed prior to startup.

3.03 SUPPLEMENTS

- A. Supplements listed below, following "End of Section," are a part of this Specification.
 - 1. Data Sheet: Electric Water heater (Residential).
 - 2. Data Sheet: Instantaneous Gas Water Heater (Commercial).
 - 3. Data Sheet: Backflow Preventers.

END OF SECTION



Commercial Electric Water Heaters

DURA-POWER[™]

Designed for use as a recovery heater having its own storage tank. Available in upright standard models (DEN) and lowboy models (DEL).

GLASSLINED TANK

• Thirteen sizes; 6 thru 119 gallon capacity. Tank interior is coated with glass specially designed by A. O. Smith for water heater use.

ELEMENTS

• Zinc plated copper sheaths for longer life. Medium watt density means lower surface temperature to minimize scale build-up and more surface to heat water. Element sizes from 1.5 to 6.1 KW. Maximum input KW (see chart).

STANDARD VOLTAGES

 120, 277 single phase and 208, 240 and 480V unbalanced three-phase delta; easily converted to single-phase at terminal block with limited exceptions.
Single element heaters, single-phase only.

TERMINAL BLOCK

 Factory-installed. Just bring the service to heater and connect to block. Terminal block not supplied on 120V & 277 volt models. (No junction box on DEL6-20)

CONTROLS

 Temperature control (adjustable through a range of 110° to 170°F on single element and 120° to 181°F on dual element) and manual reset high temperature cutoff per element CSA CERTIFIED AND ASME RATED T&P RELIEF VALVE

SIMPLIFIED CIRCUITRY, COLOR CODED FOR EASE OF SERVICE

ANODE ROD FOR MAXIMUM CORROSION PROTECTION

CABINET HAS BONDERIZED UNDERCOAT WITH BAKED ENAMEL FINISH

TOP INLET AND OUTLET OPENINGS

DRAIN VALVE (EXCLUDES DEL 6-20)

UL APPROVED FIELD CONVERSION PROGRAM

COMPLIANCE

 Meets the standby loss Requirements of the U.S. Department of Energy and current edition of ASHRAE/IES 90.1

LIMITED WARRANTY OUTLINE

 If the tank should leak any time during the first three years, under the terms of the warranty, A. O. Smith will furnish a replacement heater; installation, labor, handling and local delivery extra. THIS OUTLINE IS NOT A WARRANTY. For complete information consult the written warranty or A. O. Smith Water Products Company.



DEL-30







Commercial Electric Water Heaters







ANODE





0



ROUGH-IN DIMENSIONS

Madela		No. of	Nominal	Rated	ļ	1	E	3	(2	D)	Shipping	g Weight
wodels	UEF	Elements	Capacity	Volume	Inches	mm	Inches	mm	Inches	mm	Inches	mm	lbs.	Kg.
DEL-6	N/A	1	6	6	15-1/2	394	14-1/4	362	11	279	N/A	N/A	35	15.9
DEL-10	N/A	1	10	10	18-1/4	464	18	457	12-1/2	318	N/A	N/A	54	24.5
DEL-15	N/A	1	15	15	26	660	18	457	20-1/2	521	N/A	N/A	58	26.3
DEL-20	N/A	1	20	19	22-1/4	565	21-3/4	552	15-3/8	391	N/A	N/A	73	33.1
DEL-30	0.92	2	36	33	32	813	24	610	24	610	8	203	118	53.5
DEL-40**	0.92	2	38	35	32	813	23	584	24	610	8	203	118	53.5
DEL-50	0.92	2	51	48	36	914	26-1/2	673	25	635	8	203	172	78
DEN-30	0.92	2	40	37	49-3/4	1264	20-1/2	521	53-1/4	1353	8	203	118	53.5
DEN-40	0.92	2	50	46	59	1499	20-1/2	521	51-1/4	1302	8	203	125	56.7
DEN-52	0.92	2	55	55	56-1/2	1435	24	610	48-1/2	1232	8	203	145	65.8
DEN-66	N/A	2	66	60	60-3/4	1543	21-3/4	552	N/A	N/A	8	203	176	79.8
DEN-80	N/A	2	80	76	59-3/8	1508	24	610	N/A	N/A	8	203	211	95.7
DEN-120	N/A	2	120	108	62-7/16	1586	29-3/8	746	N/A	N/A	8	203	326	147.9

	U.S Gallons/HR and Litres/HR at Temperature Rise Indicated													
Element Wattage (Upper/Lower)	Input KW	F°	36 F°	40 F°	54 F°	60 F°	72 F°	80 F°	90 F°	100 F°	108 F°	120 F°	126 F°	
		C°	20 C°	22.2 C°	30 C°	33.3 C°	40 C°	44.4 C°	50 C°	55.5 C°	60 C°	66.6 C°	70 C°	
C400/C400++	12.2	GPH	138	124	92	82	69	62	55	49	46	41	39	
0100/0100**	12.2	LPH	522	469	348	310	261	235	208	184	174	153	146	

*No side outlet available on DEL-6 Model

**Blanket model

Note: All 66, 80, 120 models can only be ordered 277V, 240V, or 480V



ELEMENT AVAILABILITY CHART (LIGHT-DUTY COMMERCIAL ELECTRIC)

Models & Elements	Voltage	Wiring		kW Input Available								
	120V	-	1.5	2	2.5	3						
	208V	-	1.5	2	2.5	3						
6-Gallon Models Single-Element	240V	-	1.5	2	2.5	3						
	277V	-	1.5	2	2.5	3						
	480V	-		2	2.5	3						
	120V	-	1.5	2	2.5	3						
10-Gallon through	208V	-	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
20-Gallon Models Single-Element	240V	-	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
	277V	-	1.5	2	2.5	3		4	4.5	5		6
	480V	-		2	2.5	3		4	4.5	5	5.5	6

6 gallon model not available above 3kW

6/10/15/20 gallon models all A6 circuit (2 wire) only

Madal			Element	Wattage		
wodei		120V	208V	240V	277V	480V
DEL 20	Min Watts	N/A	4500	4500	4500	4500
DEL-30	Max Watts	N/A	6000 (*)	6000 (*)	6000	6000
DEL-40	Min Watts	N/A	4500	4500	4500	4500
	Max Watts	N/A	6000 (*)	6000 (*)	6000	6000
	Min Watts	N/A	4000	4000	4000	4000
DEL-50	Max Watts	N/A	6000 (*)	6000 (*)	6000	6000
DEN 20	Min Watts	N/A	4500	4500	4500	4500
DEN-30	Max Watts	N/A	6000 (*)	6000 (*)	6000	6000
	Min Watts	3000 (*)	3000	3000	3000	3000
DEN-40	Max Watts	3000 (*)	6000 (*)	6000 (*)	6000	6000
DEN-52	Min Watts	2500	2500	2500	2500	2500
	Max Watts	3000 (*)	6000 (*)	6000 (*)	6000	6000

Additional limitations apply to 120V, 208V, and 240V - Simultaneous Operation are not available (*) for these voltages. 3 phase only on 240 6000 watt for simultaneous operation



RECOVERY CAPACITIES

Element					U. S.	Gallons/Hr a	nd Litres/H	r at Tempera	ature Rise In	dicated			
Wattage (Upper/	Input	F°	36	40	54	60	72	80	90	100	108	120	126
Lower)	kW	C°	20	22.2	30	33.3	40	44.4	50	55.5	60	66.6	70
Non-Simulataneous Operation													
/1500	1 5	GPH	17	15	11	10	8	8	7	6	6	5	5
/1500	1.5	LPH	64	58	43	38	32	29	26	23	21	19	18
/2000		GPH	23	20	15	14	11	10	9	8	8	7	6
/2000	2	LPH	85	77	57	51	43	38	34	31	28	26	24
/2500	2 5	GPH	28	25	19	17	14	13	11	10	9	8	8
/2500	2.5	LPH	107	96	71	64	53	48	43	38	36	32	30
2000/2000	2	GPH	34	30	23	20	17	15	14	12	11	10	10
5000/5000	5	LPH	128	115	85	77	64	58	51	46	43	38	37
4000/4000	4	GPH	45	41	30	27	23	20	18	16	15	14	13
4000/4000	4	LPH	170	153	114	102	85	77	68	61	57	51	49
4500/4500	4 5	GPH	51	46	34	30	25	23	20	18	17	15	14
4500/4500	4.5	LPH	192	173	128	115	96	86	77	69	64	58	55
5000/5000	5	GPH	56	51	38	34	28	25	23	20	19	17	16
3000/3000	J	LPH	213	192	142	128	107	96	85	77	71	64	61
6000/6000	6	GPH	68	61	45	41	34	30	27	24	23	20	19
8000/8000	0	LPH	256	230	170	153	128	115	102	92	85	77	73
Simulataneo	ous Operat	tion		-						0	u		
3000/3000	6	GPH	68	61	45	41	34	30	27	24	23	20	19
3000/3000	0	LPH	256	230	170	153	128	115	102	92	85	77	73
4000/4000	Q	GPH	90	81	60	54	45	41	36	32	30	27	26
4000/4000	0	LPH	341	307	227	205	170	153	136	123	114	102	97
4500/4500	0	GPH	101	91	68	61	51	46	41	36	34	30	29
4300/4300	9	LPH	384	345	256	230	192	173	153	138	128	115	110
5000/5000	10	GPH	113	101	75	68	56	51	45	41	38	34	32
5000/5000	10	LPH	426	384	284	256	213	192	170	153	142	128	122
6000/6000	12	GPH	135	122	90	81	68	61	54	49	45	41	39
0000/0000	12	LPH	511	460	341	307	256	230	205	184	170	153	146

Recovery capacities at 100° F rise equal: for non-simultaneous element operation = 4.1 gal. x kW of one element; for simultaneous element operation = 4.1 gal. x 2/3 kW of both elements. For other rises multiply element kW as previously explained by 410 and divide by temperature rise. Full load current for single phase = total watts/voltage.

SPECIFICATION

The water heaters(s) shall be Dura-Power[™] Model(s) No. _____ as manufactured by A. O. Smith or an approved equal. Heater(s) shall be rated at ____ volts, ______phase, 60 cycle AC, and listed by Underwriters' Laboratories. Models shall meet the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IES 90.1. Tank(s) shall be _____gallon capacity. Heater(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod. All internal surfaces of the heater(s) exposed to water shall be glasslined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range of 1400°F to 1600°F. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. The outer jacket shall be of backed enamel finish and shall enclose the tank with foam insulation. Electrical junction box with heavy duty terminal block shall be provided (except on 120V & 277V (no junction box on DEL-6 thru 20}). The drain valve shall be located in the front for ease of servicing. Heater tank shall have a three year limited warranty as outlined in the written warranty. Fully illustrated instruction manual to be included.

For technical information, call 800-527-1953. A. O. Smith Corporation reserves the right to make product changes or improvements without prior notice.



The new degree of comfort.®

Rheem[®] RTG Series High Efficiency Non-Condensing Tankless Gas Water Heaters

Easy Installation

- Industry Leading! 43' vent run capability
- Enhanced design up to 10% smaller to fit in even more places than before
- Enhanced design up to 22% lighter making one-person installs even easier

Ready for Retrofits

Specifications

- Industry Best! 1/2" side to side clearance allows you to safely work in spaces the competition can't
- 1/2" Gas line compatibility up to 24 ft (subject to local code)
- Universal Venting Compatibility with UBBINK, Metal Fab, and Rainbow venting for easier tankless to tankless replacements
 Kov Fastures

Key Features

- Rheem[®] Exclusive! Hot-start Programming[™] ensures the unit is in a ready state between back-to-back usage, minimizing any cold water bursts
- Built-in EcoNet® Wi-Fi technology for direct control from your device (on select models)
- LeakGuard[®] All-inclusive leak detection and prevention system that detects any leak that comes from the unit (on indoor Wi-Fi models)

			INDOOR			OUTDOOR					
Rheem Mode	el Number	RTG- 70DVLN-3	RTG- 84DVLN-3	RTG- 95DVLN-3	RTG- 70XLN-3	RTG- 84XLN-3	RTG- 95XLN-3				
Built-in Lea Model N	kGuard [™] umber			RTG- 95DVELN-3 (Wi-Fi Model)			RTG- 95XELN-3 (Wi-Fi Model)				
Gas Input	MAX	160,000	180,000	199,900	160,000	180,000	199,900				
Rate (BTU/h)	MIN	11,000	11,000 11,000 11,000 11,000 11								
Uniform Energy	Factor (UEF)			0.8	32						
Hot Water	MAX (35°F)	7.0 8.4 9.5 7.0 8.4					9.5				
Capacity –	45°F Rise	6.0	6.7	7.4	6.0	6.7	7.4				
Minute (GPM)	67°F Rise	4.1	4.5	5.0	4.1	4.5	5.0				
Number of B	athrooms ¹	2-3	3	3-4	2-3	3	3-4				
Temp. R	ange			100°F -	140°F						
Temp. Setting f	rom Factory			120	°F						
High Temp. Availa	Upgrade ble			N	D						
Freeze Pro	otection	-30°F Air Intake ² , -4°F Ambient									
Heat Exchang	er Material	Primary: Copper									
Minimum Acti	vation Flow			0.4 G	ЪРМ						
Minimum Cont	inuous Flow			0.26 (GPM						
Maximum	Altitude			7,80	0 ft.						
Ultra Lov	v NOx	Meets 1	4 ng/J NOx	requirements -	SCAQMD F	Rule 1146.2 (compliant				
Warra	nty	15	oor								
Heig	ht		24.2"		20.75"						
Wid	ih 		13.5"		13.5"						
Dep	th a t		10.27"		9.4"						
Weight	LDS.)	0	40.5		42						
Max Single	1. Allowed	3 0	5 CONCEI	VIRIC		IN/A					
(straight	pipe)		43 ft.			N/A					
Approved Manufac	Venting cturer	Metal Fab, Rainbow, UBBINK									
Manifold C (max. u	Controls nits)			6 Ur	iits ³						
Contr	ols	Buil	t-in digital di	splay	Externa	al Remote (Ir	ncluded)				
Power S	upply	120V 60Hz									
Max. Po Consum	ower	85W (Normal use), 0.7 Amps 132W (Antifreeze), 1.1 Amps 3.5W (Standb∨), 0.03 Amps⁴									
Gas Conr	ection	3/4" NPT									
Hot Water C	onnection			3/4"	NPT						
Cold Water C	Connection			3/4"	NPT						

Indoor DV Outdoor

RTG Series Models

Indoor & Outdoor Models 11,000-199,900 BTU/h Natural Gas and Liquid Propane Models*

*Swap P for N in model number for Liquid Propane model



Clearances								
Top / Bottom	12"							
Front	1/2"5							
Sides	1/2"							
Back / From Vent Pipe	0"							



¹ Based on simultaneous showers using 2.0 GPM flow rate pre-mixed with cold water line. Flow rates vary depending on temperature of incoming cold water and water heater set temperature. Refer to 9 zone ground water temperature map for accurate sizing. ² For indoor application, this is the temperature of outdoor intake air. ³ Manifolds with standard RJ11 communication cables. ⁴ If anti freeze is on and combustion is on, total W will be 217W (85+132). ⁵ Recommended 24* clearance for service.

All models are available in Natural Gas or Propane (LP). For Propane replace the N with P for LP model.





1

U.S. Ground Water Temperature Zone Map



Average Flow Rates (GPM) by Application

Low Flow Faucet	0.5
Bathroom Faucet	1
Kitchen Faucet	1.5
Shower	2
Dishwasher	2
Washing Machine	3

Equivalent Ft. of Elbows

Venting Materials Allowed: 3-in./5-in. (7.6-cm/12.7-cm) UL-approved

Category III Stainless Steel vent materials or water heater manufacturer-approved vent material (MetalFab, UBBINK, and Rainbow)

3"/5"

1.6 ft.

9 in.

Flow rates may vary.

90° Elbow

45° Elbow

Flow Rate Capacity Table by Zone (Gallons Per Minute - GPM)

Use the U.S. Ground Water Temperature Map to locate your zone. Then use the Flow Rate Capacity Table to determine model flow rate by zone. Flow rates calculated for tankless set temperature of 120°F with a mixed shower temperature of 105°F. Ground water temperatures vary seasonally.

MODEL #	Zone 1 37°F	Zone 2 42°F	Zone 3 47°F	Zone 4 52°F	Zone 5 57°F	Zone 6 62°F	Zone 7 67°F	Zone 8 72°F	Zone 9 77°F
RTG-95	4.0	4.3	4.6	4.9	5.3	5.7	6.3	6.9	7.7
RTG-84	3.6	3.8	4.1	4.4	4.8	5.2	5.7	6.3	7.0
RTG-70	3.2	3.4	3.7	3.9	4.2	4.6	5.0	5.6	6.2

Venting

SINGLE UNIT: MAX. EQUIVALENT VENT LENGTHS - STRAIGHT PIPE								
Number of 90 Elbows Max Length 3" / 5" straight pipe								
0	43 ft. (13.1 m)							
1	41.5 ft. (12.6 m)							
2	38.5 ft. (12.2 m)							
3	34 ft. (11.7 m)							
4	28 ft. (11.3 m)							
5	20.5 ft. (10.8 m)							
6	11.5 ft. (10.4 m)							

Min. Vent Length Straight Pipe								
Number of 90° Elbows	Min. Length 3"/5" pipe							
1	1.0 ft (0.3 m)							

Hanging bracket is included with water heater.

Parts & Accessories

Recirculation Pump	Pipe Cover	Horizontal Vent Termination Twin Pipe System	Concentric Vent Termination Twin Pipe System	AllClear [®] Water Treatment System	Isolation Valve Kit	Manifold Cables
AP17920	RTG20330AJ	RTG20231-2	RTG20211	RTG20251	RTG20326	RCPN-AMP03- 0013111101-0003 (48")

In keeping with its policy of continuous progress and product improvement, Rheem reserves the right to make changes without notice.

Rheem Water Heating • 1115 Northmeadow Parkway, Suite 100 Roswell, Georgia 30076 • www.rheem.com

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Rheem Canada Ltd./Ltée • 125 Edgeware Road, Unit 1 Brampton, Ontario L6Y 0P5 • www.rheem.ca









Engineering Specification

Job Name	Contractor
Job Location ————	Approval
Engineer	Contractor's P.O. No
Approval	Representative



Series LF909 Small Reduced Pressure Zone Assemblies LF909

¾**"-1**"

LF909M1

1¼"-2"

Series LF909 Reduced Pressure Zone assemblies provide superior cross-connection control protection of the potable water supply in accordance with national plumbing codes and containment control for water authority requirements. This series can be utilized in a variety of installations, including health hazard cross-connections in plumbing systems or for containment at the service line entrance. The series features Lead Free* construction to comply with Lead Free* installation requirements. With its exclusive design incorporating the "air-in/water-out" principle, the series provides maximum relief valve discharge during the emergency conditions of combined backsiphonage and backpressure with both checks fouled. Standardly furnished with full port, resilient-seated, and Lead Free* cast copper silicon alloy ball valve shutoffs. Sizes ¾" and 1" shutoffs have tee handles.

This series includes a flood sensor to detect excessive water discharges from the relief valve. The sensor is installed on the assembly exterior and does not alter assembly functions or certifications. The sensor relays a signal that triggers notification to facility personnel, helping to avoid the possibility of ruinous flooding and costly damage.

NOTICE

An add-on connection kit is required to activate the flood sensor. Without the connection kit, the flood sensor is a passive component that does not communicate with any other device. (For more information, download RP-IS-LF909S.)

Features

- Modular, compact design easing installation
- Replaceable seats
- Horizontal or vertical (up or down) installation on limited sizes only
- No special tools required for servicing
- Sensor on the relief valve for flood detection
- Flood alerts feature activated with add-on sensor connection kit, compatible with BMS and cellular communication



How It Operates

The unique relief valve construction incorporates two channels: one for air, the other for water. When the relief valve opens the right channel admits air to the top of the reduced pressure zone, relieving the zone vacuum. The left channel then drains the zone to atmosphere. (See diagram to the right.) Therefore, if both check valves foul, and simultaneous negative supply and positive backpressure develop, the relief valve uses the air-in/water-out principle to stop potential backflow.



NOTICE

Use of the flood sensor does not replicate the need to comply with all required instructions, codes, and regulations related to installation, operation, and maintenance of this product, including the need to provide proper drainage in the event of a discharge. Watts is not responsible for the failure of alerts due to connectivity or power issues.

NOTICE

The information contained herein is not intended to replace the full product installation and safety information available or the experience of a trained product installer. You are required to thoroughly read all installation instructions and product safety information before beginning the installation of this product.

Inquire with governing authorities for local installation requirements.

Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.



^{*}The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.

Specification

A Reduced Pressure Zone assembly shall be installed at each cross-connection to prevent backsiphonage and backpressure of hazardous materials into the potable water supply. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves. Backsiphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel, or directly into the supply pipe via a separate vent. The assembly shall be constructed using Lead Free* cast copper silicon materials. The Lead Free* reduced pressure zone assembly shall comply with state codes and standards, where applicable, requiring reduced lead content. The assembly shall include two tightly closing shutoff valves before and after the assembly, test cocks and a protective strainer upstream of the No. 1 shutoff valve. The assembly (specify Model LF909 for temperatures up to 140°F (60°C) or Model LF909HW for temperatures up to 210°F (99°C)) shall meet the requirements of ASSE Standard 1013; AWWA Standard C-511-92 CSA B64.4; FCCCHR of USC Manual Section 10. Listed by IAPMO (UPC). SBCCI (Standard Plumbing code). The assembly shall be a Watts LF909QT, and shall include strainer (-S) and sensor on the relief valve for flood detection (-FS).

Model/Option

FS	Sensor on relief valve for flood detection
QT	Quarter-turn ball valves
S	Bronze strainer
HW	Stainless steel check modules for hot and harsh water conditions

NOTICE

The installation of a drain line is recommended. When installing a drain line, an air gap is necessary.

Materials

Body: Lead Free* cast copper silicon alloy Check Seats: 909 Celcon® Relief Valve Seats: Stainless Steel 909 Test Cocks: Lead Free* cast copper silicon alloy

Standards

AWWA C-511-92 FCCCHR of USC Manual Section 10 IAPMO (UPC), SBCCI (Standard Plumbing code) Tested and Certified by NSF International

Approvals



Listed by IAPMO

Listed by SBCCI

Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California (QT and S models). Vertical "flow-up" approval only on ¾" and 1" sizes (Model LF909QT).

Pressure - Temperature

Temperature Range: 33°F – 140°F (0.5°C – 60°C) continuous; 180°F (82°C) intermittent

Maximum Working Pressure: 175 psi (12.1 bar)

Series LF909HW:

Temperature Range: 33°F – 210°F (0.5°C – 99°C) Maximum Working Pressure: 175 psi (12.1 bar)

Connections

 $\frac{3}{4}$ " – 1" 909-NPT Female threaded body connection 1 $\frac{1}{4}$ " – 2" 909-M1-NPT Male threaded body connection

Insulated Enclosure

The WattsBox insulated enclosure is available for this series. For more information download ES-WB at watts.com.



Dimensions – Weights

When installing a drain line, use Model 909AG air gaps on Series LF909 Small backflow preventers. Model 909EL elbows are for air gaps on backflow preventers in vertical installations.



Call customer service if you need assistance with technical details. Model 909AG Air Gaps

		909 D	RAIN	00	TLET		DIMENS	WEIGHT			
Iron Body		Siz		Size		A		В			
No.	Desc.	in.	тт	in.	тт	in.	тт	in. mn		lb	kg
909AG-C	Air Gap	³ ⁄4, 1	19,25	1	25	3¼	83	41/8	124	1½	0.7
909EL-C	Elbow	³ ⁄4, 1	19,25	-	-	23/8	60	23/8	60	3/8	0.2
909AG-F	Air Gap	1¼-2	32-50	2	50	43/8	111	6¾	171	3¼	1.5
909EL-F	Elbow	1¼-2	32-50	-	-	31/8	92	31/8	92	2	0.9







LF909, LF909M1

SIZE	DIMENSIONS												WEIGHT									
	A		A As		В		С		D		E		Es		L		Р		QT		QT-S	
	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	lb	kg	lb	kg
3/4"	14%	365	181/16	459	91/8	251	4	102	51/8	149	6¾	171	103/16	259	7 5⁄16	186	31/8	98	14	6.4	15.6	7.1
1"	15%	391	19%	498	91/8	251	4	102	51/8	149	7	178	11	279	7 ⁵ / ₁₆	186	31/8	98	15	6.8	17.5	7.9
1¼"M1	18½	470	237/16	595	12¾	324	51/2	140	7%	194	71/2	191	12 ³ ⁄ ₁₆	310	10%	264	51⁄4	133	40	18.1	42.8	19.4
1½"M1	19	483	24%	619	12¾	324	5½	140	7%	194	71/2	191	125/8	321	10%	264	51⁄4	133	40	18.1	44.0	20.0
2"M1	19½	495	2515/16	659	123/4	324	51/2	140	7%	194	73/4	197	1315/16	354	103/8	264	51/4	133	40	18.1	47.4	21.5

Capacity

As compiled from documented Foundation for Cross-Connection Control and Hydraulic Research of the University of Southern California lab tests.





SECTION 22 40 00 PLUMBING FIXTURES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Americans with Disabilities Act (ADA).
 - 2. American Gas Association (AGA).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. American Society of Sanitary Engineering (ASSE): 1010, Performance Requirements for Water Hammer Arresters.
 - 5. ASTM International (ASTM): D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
 - 6. Food and Drug Administration (FDA).
 - 7. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components Lead Content.
 - 8. Plumbing and Drainage Institute (PDI):
 - a. Code Guide 302 and Glossary of Industry Terms.
 - b. WH-201, Water Hammer Arrester Standard.
 - 9. UL.

1.02 SUBMITTALS

- A. Action Submittals: Catalog information and rough-in dimensions for plumbing fixtures, products, and specialties.
- 1.03 REGULATORY REQUIREMENTS
 - A. Comply with the Americans with Disabilities Act (ADA), and local and state requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MANUFACTURERS

- A. Fixture Trim:
 - 1. Supply Stops and Traps:
 - a. McGuire.
 - b. American Standard.
 - c. Kohler.
 - 2. Flush Valves: Sloan.
 - 3. Water Closet Seats:
 - a. Bemis.
 - b. Church.
 - c. Olsonite.
 - 4. Lavatory Supply, Tailpiece, and Trap Insulation:
 - a. McGuire.
 - b. Trap Wrap.
 - c. Truebro.
- B. Plumbing Fixtures:
 - 1. Water Closets, Lavatories, and Urinals:
 - a. American Standard.
 - b. Kohler.
 - c. Eljer.
 - 2. Service Sinks:
 - a. Kohler.
 - b. Eljer.
 - 3. Faucet Fittings:
 - a. Sinks:
 - 1) Chicago.
 - 2) T&S Brass.

PLUMBING FIXTURES 22 40 00 - 2

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- b. Lavatories:
 - 1) Chicago.
 - 2) Symmons.
- c.
- 4. Stainless Steel Sinks:
 - a. Elkay.
 - b. Just.
- C. Drainage Products:
 - 1. General:
 - a. Smith.
 - b. Wade.
 - c. Zurn.
- D. Plumbing Specialties:
 - 1. Shock Arresters:
 - a. Smith.
 - b. Sioux Chief.
 - c. Precision Plumbing Products.
 - 2. Trap Primers:
 - a. Precision Plumbing Products.
 - b. Smith.
 - c. Wade.
 - 3. Pressure/Temperature Relief Valves:
 - a. Cash-Acme.
 - b. Kunkle Valve.
 - c. Watts.
 - 4. Pressure Gauges:
 - a. Ashcroft.
 - b. Marsh.
 - c. Marshalltown.
 - 5. Thermometers:
 - a. Trerice.
 - b. Weksler.
 - 6. Automatic Washer Supplies:
 - a. Guy Gray.
 - b. Symmons.

2.03 GENERAL

- A. Fixture Trim: Provide plumbing fixture trim where applicable on fixtures.
- B. Plumbing Fixtures: Indicated by fixture number as shown on the Drawings.

- C. Drainage Products: Indicated by fixture number as shown on the Drawings.
- D. Plumbing Specialties: Indicated by fixture number as shown on the Drawings.
- E. Exposed fixture connections and piping shall be polished chrome-plated.

2.04 MATERIALS

- A. Fixture Trim:
 - 1. Supply Stop:
 - a. Flexible supply with heavy cast brass, loose key, 1/2-inch IPS by 3/8-inch outside diameter tubing angle stop to wall with escutcheon plate; chrome-plated finish.
 - b. Provide stop with stuffing box.
 - c. Manufacturer: McGuire Manufacturing Company, Inc.
 - 2. Trap:
 - a. Chrome-plated, 17-gauge, semicast P-trap with compression ring cast brass waste and vent connection and cleanout.
 - b. 1-1/2 inches for lavatories and drinking fountains.
 - c. 1-1/2 inches for sinks.
 - d. Manufacturer: McGuire Manufacturing Company, Inc.
 - 3. Water Closet and Urinal Flush Valves: Sloan Valve Co., Royal Continental, low flush, quiet action with screwdriver stop and vacuum breaker.
- B. Plumbing Fixtures: See the Drawing for fixture schedule.
- C. Drainage Products: See the Drawing for fixture schedule.
- D. Plumbing Specialties:
 - 1. Water Hammer Arresters:
 - a. Materials: ASSE 1010 certified, Type L copper tube, HHPP piston with two lubricated EPDM O-rings, FDA approved lubricant, rolled piston stop, wrought copper male thread adapter.
 - b. Manufacturer and Product: Sioux Chief Mfg. Co., Inc.; Series 650 and 660.
 - 2. ETP-1, Automatic Trap Priming System: See the Drawing.
 - 3. ETP-2, Automatic Trap Priming System: See the Drawing.
- E. Sealant: In accordance with Section 07 92 00, Joint Sealants.

PART 3 EXECUTION

3.01 PREPARATION

A. Drawings do not attempt to show exact details of fixtures. Changes in locations of fixtures, advisable in opinion of Contractor, shall be submitted to Engineer for review before proceeding with the Work.

3.02 INSTALLATION

- A. Fixture Trim: Install fixture trim where applicable on fixtures.
- B. Plumbing Fixtures, Mounting Heights:
 - 1. Standard rough-in catalogued heights, unless shown otherwise on the Drawings.
 - 2. Caulk fixtures in contact with finished walls with waterproof, white, nonhardening sealant which will not crack, shrink, or change color with age. See Section 07 92 00, Joint Sealants.
- C. Exact fixture location and mounting arrangement shall be as indicated on toilet room elevations and details as shown on the Drawings.
- D. Unless noted otherwise and as a minimum, fixtures shall be supported as indicated in PDI Code Guide 302.
- E. Safety Equipment:
 - 1. System Shutoff Valves:
 - a. Shutoff valves shall give visual indication of position (open or closed).
 - b. Shutoff valves shall be lockable valves and locked in open position.
 - 2. Each safety shower, eyewash, combination safety shower/eyewash shall have red safety signoff tag. After completing requirements listed below, Contractor and Owner shall sign red safety signoff tag. Requirements are as follows:
 - a. Visually check safety shower/eyewash piping for leaks.
 - b. Verify that upon operation, stay-open valves remain open.
 - c. Showerheads to be between 82 inches and 96 inches above standing surface.
 - d. Shower spray pattern, when valve is full open, shall be a minimum 20 inches in diameter at 60 inches above standing surface.
 - e. Water arcs from eyewash spray heads must cross. Test with eyewash gauge; Haws Drinking Faucet Co., Model 9015.
 - f. Minimum flow rates for safety showers shall be 20 gpm.

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- g. Minimum flow rates for eyewashes shall be 3 gpm.
- h. Tempered water shall be temperature indicated on the Drawings.
- F. Drainage Products:
 - 1. Floor Drains: Set top flush with floor. Provide membrane clamps where required.
 - 2. Cleanouts: Install where shown or required for purposes intended. Set cover flush with finished floor.
 - 3. Hub Drains: Set top of hub 2 inches above finished floor.
- G. Plumbing Specialties:
 - 1. Shock Arresters:
 - a. Install PDI-certified and rated shock arresters, sized and located in accordance with PDI WH-201 and as shown on the Drawings.
 - b. Install adjacent to equipment wherein quick closing valves are installed.
 - c. Install at each emergency safety shower.
 - d. Shock arresters to have access panels or to be otherwise accessible.
 - 2. Drain P-Trap Priming:
 - a. Pipe: Type K, soft copper.
 - b. Trap and prime floor drains and hub drains, unless shown otherwise on the Drawings. No attempt has been made to show trap primer valve locations or trap primer pipe routing.
 - c. Field route trap primer piping during installation of floor drains and hub drains, and install trap primer valves in mechanical rooms, janitor rooms, or other locations acceptable to Engineer.
 - d. Priming System: Complete with connection to serving **W1** cold water system.
 - 3. Trap Priming Valves:
 - a. Floor drain traps primed with priming valves, 1/2-inch copper to floor drain.
 - b. Two traps maximum primed from one priming valve or as recommended by manufacturer. Locate in mechanical spaces or janitor's rooms and as indicated on the Drawings.
 - c. Provide shutoff valve ahead of priming valves.
 - 4. Thermometers and Pressure Gauges:
 - a. Arrange devices to facilitate use and observation.
 - b. Install in orientation that will allow clear observation from ground level.
 - c. Provide pressure gauges with block valves.
 - d. Install thermometers in thermowells.

- H. Caulk penetrations of exterior walls with weatherproof sealant in accordance with Section 07 92 00, Joint Sealants.
- I. Adjust water flows in domestic water systems for reasonable water flows at each plumbing fixture, terminal device, and recirculation loop. Flush valve fixtures shall be adjusted for proper flush cycle time and water quantity.

3.03 FIELD QUALITY CONTROL

- A. Perform visual inspection for physical damage, blocked access, cleanliness, and missing items.
- B. Notify Owner and Engineer 48 hours prior to shower testing. Owner and Engineer reserve the right to witness all tempered water and safety shower testing.

END OF SECTION

SECTION 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Moving and Conditioning Association, Inc. (AMCA): 203, Field Performance Measurement of Fan Systems.
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): HVAC Applications Handbook.
 - 3. Associated Air Balance Council (AABC): National Standards for Field Management and Instrumentation Total System Balance.
 - 4. National Environmental Balancing Bureau (NEBB):
 - a. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - b. Procedural Standards for Measuring Sound and Vibration.
 - 5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): HVAC Testing, Adjusting, and Balancing Manual.

1.02 SUBMITTALS

- A. Informational Submittals:
 - 1. Documentation of experience record of testing authority.
 - 2. Documentation of current AABC or NEBB certifications for those technicians in responsible charge of the work under this Contract.
 - 3. Submit detailed test and balance procedures, including test conditions for systems to be tested, prior to beginning the Work.
 - 4. Written verification of calibration of testing and balancing equipment.
 - 5. Balancing Log Report following completion of system adjustments including test results, adjustments, and rebalancing procedures.

1.03 QUALITY ASSURANCE

- A. Air Balancing and Test Agency Qualifications:
 - 1. Certification by AABC of NEBB for testing, adjusting and balancing of HVAC systems.
 - 2. Corporately and financially independent organization functioning as an unbiased testing authority.
 - 3. Professionally independent of manufacturers, suppliers, and installers of HVAC equipment being tested.

- 4. Have a proven record of at least five similar projects.
- 5. Employer of engineers and technicians regularly engaged in testing, adjusting and balancing of HVAC equipment and systems.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide materials, tools, test equipment, computers and instrumentation required to complete the work included.
- B. Test Hole Plugs: Plug test holes in ducts with plugs made for that purpose and replace any insulation removed to specified conditions.
- C. Drives for Belt-Driven Fans:
 - 1. Furnish cast iron or flanged steel sheaves.
 - 2. Sheaves and belt combination shall be capable of providing 150 percent of motor horsepower.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Adjust and balance air and water systems in accordance with standard procedures and recognized practices of the AABC or SMACNA.
 - 1. Adjust and balance the following systems: Supply, return and exhaust air systems.

3.02 ADJUSTING AND BALANCING AIR SIDE

- A. Preparation:
 - 1. Prior to beginning the Work, perform the following activities:
 - a. Review Shop Drawings and installed system for adequate and accessible balancing devices and test points.
 - b. Recommend to Engineer dampers that need to be added or replaced in order to obtain proper air control.
 - c. Verify proper startup procedures have been completed on the system
 - d. Verify controls installation is complete and system is in stable operation under automatic control.
 - e. Verify test instruments have been calibrated to a recognized standard and are within manufacturer's recommended calibration interval before beginning the Work.

- B. General:
 - 1. When adjustments are made to a portion of a fan system, reread other portions of that same system to determine effects imposed by adjustments. Readjust as necessary.
 - 2. Lock and mark final positions of balancing dampers with permanent felt pen.
 - 3. Correct fan and airflow measurements for Site elevation.
- C. Equipment Data:
 - 1. Collect the following data and included in final report:
 - a. Type of unit.
 - b. Equipment identification number.
 - c. Equipment nameplate data (including manufacturer, model, size, type, and serial number).
 - d. Motor data (frame, hp, volts, FLA rpm, and service factor).
 - e. Sheave manufacturer, size, and bore.
 - f. Belt size and number.
 - g. Sheave centerline distance and adjustment limits.
 - h. Starter and motor overload protection data.
 - i. Include changes made during course of system balancing.
- D. Fan Systems:
 - 1. Measure fan system performance in accordance with AMCA 203.
 - 2. In each system at least one airpath from fan to final branch duct termination shall have dampers fully open. Achieve final air quantities by adjusting fan speed.
 - 3. Adjust Fan Air Volumes:
 - a. Adjust fan speeds and motor drives for required equipment air volumes, with allowable variation of plus 10 percent minus 0 percent.
 - b. After final adjustments, do not operate motor above nameplate amperage on any phase.
 - c. After final adjustments, do not operate fan above maximum rated speed.
 - d. Perform airflow test readings under simulated or actual conditions of full cooling, full heating, minimum outside air, full outside air and exhaust, and full return air.
 - e. Provide and make drive and belt changes on motors or fans as required to adjust equipment to specified conditions. Drives shall be able to deliver 150 percent of motor horsepower. Provide written notice to air handling unit manufacturer and Owner and Engineer if drive or belt changes were made.

- 4. Adjust outside air dampers, return air dampers, relief air dampers, exhaust air dampers, and motorized louvers for maximum and minimum air requirements.
- 5. Read and record static pressures at unit inlet and discharge, each filter set, coils, dampers, plenums, and mixing dual-duct or adjustable-volume boxes, on every supply, return, and exhaust fan for each test condition.
- 6. Read and record motor amperage on all phases for each test condition.
- E. Air Terminal Devices:
 - 1. Terminal Airflow Calibration: Calibrate and set the flow coefficients in terminal controller units to ensure controller readings are identical to measured values. This shall be a one-point calibration at maximum flow conditions. Record coefficient values.
 - 2. Test each terminal flow device at minimum and maximum flow conditions. Ensure terminal controller is under control at time of each test.
 - 3. If airflow of terminal device is derived from two or more flow streams, the individual air streams shall be measured and recorded independently for each test.
 - 4. In each terminal system at least one airpath from terminal to final duct termination shall have dampers fully open.
 - 5. Adjust air volumes on each terminal to quantity shown, with allowable variation of plus 10 percent minus 5 percent.
- F. Air Outlets and Inlets:
 - 1. In each system at least one air path from fan to final branch duct termination shall have dampers fully open.
 - 2. Adjust air volumes on supply diffusers and grilles, and on return and exhaust grilles, to the quantity shown, with allowable variation of plus or minus 10 percent.
 - 3. Adjust diffusers and grilles for proper deflection, throw, and coverage. Eliminate drafts and noise where possible.
 - 4. After final adjustments are made secure dampers to prevent movement and mark final positions with permanent felt pen.
- G. Building Static Pressure:
 - 1. Measure building static pressure relative to outside in perimeter entrances during normal system conditions that would yield widest range in internal building pressure.
 - 2. Adjust building static pressure control parameters to ensure perimeter entrances are positive to outdoors by 0.05-inch WC with entrance doors closed.

3. For multi-story buildings, test pressure conditions at ground, intermediate, and upper levels.

3.03 FIELD QUALITY CONTROL

- A. Performance Testing:
 - 1. Electric Heating Coil Testing:
 - a. Adjust system as required to achieve full output from coil.
 - b. Read and record amperages and voltages for all phases.
 - 2. Heating or Sensible Cooling Coil Testing:
 - a. Adjust system as required to achieve design flow conditions for both air and water sides of coil.
 - b. Measure and record airflow rate, water flow rate, entering air temperature, entering water temperature, leaving air temperature and leaving water temperature.
 - 3. Cooling or Dehumidification Coil Testing:
 - a. Adjust system as required to achieve design flow conditions for both air and water sides of coil.
 - b. Measure and record airflow rate, water flow rate, entering air dry bulb and wet bulb temperatures, entering water temperature, leaving air dry bulb and wet bulb temperatures and leaving water temperature.
- B. Balancing Log Report Requirements:
 - 1. Include narrative description for each system explaining TAB methodology and assumptions used. Clearly identify test conditions for tests performed. Include control setpoint.
 - 2. Log and record operational information from every test for each system, as necessary to accomplish services described.
 - 3. Include equipment data for units tested.
 - 4. Include reduced set of HVAC Drawings or system schematic diagrams with each element uniquely identified and indexed to balance log.
 - 5. Indicate recorded site values, and velocity and mass correction factors used to provide equivalent standard air quantities.
 - 6. Include separate section in log, if necessary, describing operating difficulties in air or water systems that could not be eliminated by specified procedures. Identify these problems by system and location within building; include outline or summary of condition and its effect on building, and describe corrective actions attempted and recommended.

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- C. Quality Control Verification:
 - 1. After adjustments have been completed and balance logs submitted, balancing and testing agency shall be available to demonstrate the following:
 - a. Air and water balancing procedures, vibration tests, and verification of test results.
 - b. Perform spot tests on a maximum of 20 percent of total diffusers and grilles, on two air handling fan devices per building, and on 10 percent of total water balance fittings, with measuring equipment used in original tests, at random points selected by Engineer.
 - c. Results of these spot tests shall agree with balance logs within plus or minus 10 percent. Where this accuracy cannot be verified, rebalance portions of system as requested by Engineer.
 - d. At completion of rebalance procedures, perform another spot test if required to verify results.

END OF SECTION

SECTION 23 07 00 HVAC INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society of Heating, Refrigerating & Air-Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 2. Association of the Nonwoven Fabric Industry (INDA). IST 80.6, Water Resistance (Hydrostatic Pressure).
 - 3. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C547, Standard Specification for Mineral Fiber Pipe Insulation.
 - c. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - d. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - e. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - g. G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 - h. G22, Standard Practice for Determining Resistance of Plastics to Bacteria.
 - 4. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - b. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - c. 259, Standard Test Method for Potential Heat of Building Materials.
 - 5. UL.

1.02 DEFINITIONS

A. Cold Air Ductwork: Designed to convey mechanically cooled air or return ducts in such systems.

B. Warm Air Ductwork: Designed to convey mechanically heated air or return ducts in such systems.

1.03 SUBMITTALS

- A. Action Submittals: Product description, list of materials and thickness for each service or equipment scheduled, locations, and manufacturer's installation instructions.
- B. Informational Submittals:
 - 1. Proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

1.04 QUALITY ASSURANCE

- A. Materials furnished under this specification shall be standard, cataloged products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.
- B. Provide materials by firms engaged in the manufacture of insulation products of the types and characteristics specified herein, whose products have been in use for not less than 5 years.
- C. UL listing or satisfactory certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Stamp or Label:
 - 1. Every package or standard container of insulation, jackets, cements, adhesives and coatings delivered to Project Site for use must have manufacturer's stamp or label attached, giving name of manufacturer, brand, and description of material.
 - 2. Insulation Packages and Containers: Marked "asbestos-free."

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Insulation Exterior: Cleanable, grease-resistant, nonflaking, and nonpeeling.
 - B. Insulation: Conform to referenced publications and specified temperature ranges and densities in pounds per cubic foot.

- C. Insulation for Fittings, Flanges, and Valves: Premolded, precut, or jobfabricated insulation of same thickness and conductivity as used on adjacent piping.
- D. Fire Resistance:
 - 1. Insulation, Adhesives, Vapor Barrier Materials and Other Accessories, Except as Specified Herein: Noncombustible.
 - 2. Do not use fugitive or corrosive treatments to impart flame resistance.
 - 3. Flame proofing treatments subject to deterioration resulting from the effects of moisture or high humidity are not acceptable.
 - 4. Provide materials including facings, mastics, and adhesives, with fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke, developed as per tests conducted in accordance with ASTM E84 (NFPA 255) methods.
- E. Materials exempt from fire-resistant rating:
 - 1. Nylon anchors.
 - 2. Treated wood inserts.
- F. Materials exempt from fire-resistant rating when installed in outside locations, buried, or encased in concrete:
 - 1. Polyurethane insulation.
 - 2. PVC casing.
 - 3. Fiberglass-reinforced plastic casing.

2.02 PIPE INSULATION

- A. Type P1—Fiberglass (ASTM C547, Type 1
 - 1. Fiberglass, UL-rated, preformed, sectional rigid, minimum 4 pounds per cubic foot (pcf) density, K factor 0.23 maximum at 75 degrees F mean, with factory-applied all-service jacket (ASJ).
 - 2. All-service Jacket:
 - a. Composed of reinforced kraft paper and aluminum foil laminate.
 - b. Provide self-sealing lap to facilitate closing longitudinal and end joints.
 - 3. Manufacturers and Products:
 - a. CertainTeed; Preformed Pipe Insulation.
 - b. Johns Manville; Micro-Lok HP.
 - c. Owens/Corning; Fiberglas Pipe Insulation.
 - d. Knauf; Crown Pipe Insulation.

- B. Type P1A—Fiberglass, ASTM C547, Type 2, 650 Degrees F, Maximum; Class 3, 850 Degrees F, Maximum:
 - 1. Fiberglass, minimum 5 pcf density, K factor 0.34 maximum at 300 degrees F mean, with factory-applied all-weather jacket (AWJ) for temperatures ambient to 850 degrees F.
 - 2. Manufacturers and Products:
 - a. CertainTeed; Preformed Pipe Insulation.
 - b. Johns Manville; Micro Lok.
 - c. Knauf; Rocksil Mattress.
 - d. Owens/Corning; Fiberglas Pipe Insulation.
- C. Type P2—Calcium Silicate (ASTM C533, 1,200 Degrees F, Maximum):
 - 1. Calcium silicate, minimum 12 pcf density, K factor 0.46 maximum at 300 degrees F mean, without factory-applied jacket.
 - 2. Manufacturers and Products:
 - a. Owens/Corning Fiberglass; Kaylo 10.
 - b. Johns Manville; Thermo-12 Gold.
 - c. Calsilite; 1,200-degree thermal insulation.
- D. Type P3—Elastomeric (ASTM C534, Minus 40 Degrees F to 220 Degrees F):
 - 1. Flexible, closed cell elastomeric.
 - 2. Nominal 6 pcf density, K factor 0.27 maximum at 75 degrees F mean.
 - 3. Water vapor transmission 0.1 perm-inch, or less.
 - 4. Manufacturers and Products:
 - a. Armacell; AP Armaflex.
 - b. Nomaco; K-Flex LS.
- E. Type P4—Cellular Glass:
 - 1. Cellular glass, closed cell, rigid, nominal 8 pcf density, maximum K factor 0.33 at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures to 900 degrees F.
 - 2. Manufacturer and Product: Pittsburgh-Corning; Foamglas.

2.03 DUCT INSULATION

- A. Type D1—Blanket (ASTM C553, Type 1, Class B3):
 - 1. Fiberglass, nominal 1 pcf density blanket, K factor 0.31 maximum at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures to 250 degrees F.
 - 2. Manufacturers and Products:
 - a. CertainTeed; Duct Wrap.

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- b. Johns Manville; Microlite.
- c. Owens/Corning Fiberglass; Soft R.
- d. Knauf; Ductwrap.
- B. Type D2—Board:
 - 1. Fiberglass, minimum 2.75 pcf density board, K factor 0.23 maximum at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures from 0 degree F to 450 degrees F.
 - 2. Manufacturers and Products:
 - a. CertainTeed; CertaPro Commercial Board.
 - b. Knauf; Duct Slab.
 - c. Owens/Corning Fiberglass; TIW.
 - d. Johns Manville; 1000 Series Spin-Glass.
- C. Type D3—Liner (ASTM C1071, Type 1):
 - 1. Fiberglass, nominal 1.5 pcf density liner, K factor 0.25 maximum at 75 degrees F mean, black composite coated surface exposed to airstream to prevent erosion of glass fibers, for temperatures to 250 degrees F.
 - 2. Liquid water repellency rating not less than 4 when tested in accordance with INDA IST 80.6.
 - 3. Potential heat value not exceeding 3,500 Btu/lb when tested in accordance with NFPA 259 and meeting the classification of "Limited Combustible" as defined by NFPA 90A.
 - 4. Maximum rated velocity not less than 6,000 fpm when tested in accordance with ASTM C1071.
 - 5. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C1139, ASTM G21, and ASTM G22.
 - 6. Manufacturers and Products:
 - a. CertainTeed; Toughgard.
 - b. Johns Manville; Linacoustic (rectangular), Spinacoustic (Round).
 - c. Knauf; Acoustic Duct Liner.
- D. Type D4—Ceramic Fiber (to 2,300 degrees F):
 - 1. UL-listed, 2-hour fire-rated, 6 pcf density, inorganic foil encapsulated ceramic fiber blanket.
 - 2. Manufacturer and Product: Thermal Ceramics; Firemaster.
- E. Type D5—Flexible Elastomeric (ASTM 534, Type I for tubular materials and Type II for sheet materials):
 - 1. Closed-cell, sponge- or expanded-rubber materials.
 - 2. Manufacturers and Products:
 - a. Aeroflex USA Inc.; Aerocel.

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- b. Armacell LLC; AP Armaflex.
- c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.04 EQUIPMENT INSULATION

- A. Type E1—Elastomeric (ASTM C534):
 - 1. Flexible, closed-cell elastomeric, nominal 6 pcf density, K factor 0.27 maximum at 75 degrees F mean.
 - 2. Manufacturers and Products:
 - a. Armstrong; Armaflex II.
 - b. Nomaco; Therma-Cel.
- B. Type E2—Board:
 - 1. Fiberglass, minimum 2.75 pcf density board, K factor 0.23 maximum at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures from 100 degrees F to 850 degrees F.
 - 2. Manufacturers and Products:
 - a. CertainTeed; CertaPro Commercial Board.
 - b. Knauf; Duct Slab.
 - c. Owens/Corning Fiberglass; TIW.
 - d. Johns Manville; 1000 Series Spin-Glass.

2.05 INSULATION FINISH SYSTEMS

- A. Type F1—PVC:
 - 1. Polyvinyl chloride (PVC) jacketing, white, for straight run piping and fitting locations, temperatures to 150 degrees F.
 - 2. Manufacturers and Products:
 - a. Johns Manville; Zeston.
 - b. Ceel-Co; 550.
- B. Type F2—Paint:
 - 1. Acrylic latex paint, white, and suitable for outdoor use.
 - 2. Manufacturer and Product: Armstrong; WB Armaflex finish.
- C. Type F3—Aluminum:
 - 1. Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100 or 3105 to ASTM B209 with H-14 temper, minimum 0.016-inch thickness, with smooth mill finish.

- 2. Moisture Barrier: Provide factory applied moisture barrier, consisting of 40-pound kraft paper with 1-mil-thick low-density polyethylene film, heat and pressure bonded to inner surface of the aluminum jacketing.
- 3. Fitting Covers: Material as for aluminum roll jacketing, premolded, one or two piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
- 4. Manufacturer and Product:
 - a. RPR Products; INSUL-MATE.
 - b. ITW, Pabco-Childers.

PART 3 EXECUTION

3.01 APPLICATION OF PIPING INSULATION

- A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.
- B. Apply insulation over clean, finish painted, and dry surfaces.
- C. Install insulation after piping system has been pressure tested and leaks corrected.
- D. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
- E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces of scraps abutting each other.
- F. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- G. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Seal open ends of insulation with mastic. Sectionally seal all butt ends of chilled water and condensate drain piping insulation at fittings with white vapor barrier coating.
- H. Cover valves, flanges, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job-fabricated units. Finish cold pipe fittings with white vapor barrier coating and hot piping with white vinyl acrylic mastic, both reinforced with glass cloth.
- I. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

- J. Install protective metal shields and foamglass inserts where pipe hangers bear on outside of insulation.
- K. Insulation on piping that is to be heat traced shall be installed after installation of heat tape.
- L. Insulate valve bodies, flanges, and pipe couplings.
- M. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
- N. Do not insulate flexible pipe couplings and expansion joints.
- O. Do not allow insulation to cover nameplates or code inspection stamps.
- P. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
- Q. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.
- R. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.
- S. Placement:
 - 1. Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.
 - 2. Insulate valves and fittings with sleeved or cut pieces of same material.
 - 3. Seal and tape joints.
- T. Insulation at Hangers and Supports: Install under piping, centered at each hanger or support.
- U. Vapor Barrier:
 - 1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
 - 2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
 - 3. Do not use staples and screws to secure vapor sealed system components.

3.02 INSTALLATION OF DUCTWORK INSULATION

- A. General: Install insulation products in accordance with the manufacturer's written instructions and in accordance with recognized industry practices.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulation. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation and protect it to prevent puncture and other damage. Tape all punctures.
- E. Seal longitudinal and circumferential joints with FSK tape, and finish with fiberglass mesh fabric embedded in vapor barrier mastic.
- F. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated.
- G. Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.
- H. Refer to Section 23 31 13, Metal Ducts and Accessories, for installation of internal duct liner.

3.03 INSTALLATION OF EQUIPMENT INSULATION

- A. Application Requirements: Insulate where external surface temperature of equipment is below ambient temperature in the space, including surfaces that have a recognized possibility for condensation.
- B. Install equipment thermal insulation products in accordance with manufacturer's written instructions and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- C. Install insulation materials with smooth and even surfaces and on clear and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.
- D. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- E. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.
- F. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.
- G. Avoid using scrap pieces of insulation where larger sheets will fit.

3.04 INSTALLATION OF INSULATION FINISH SYSTEMS

- A. Use a continuous friction type joint to hold jacket in-place, providing positive weatherproof seal over entire length of jacket.
- B. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
- C. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
- D. Do not use screws or rivets to fasten the fitting covers.
- E. Install removable prefabricated aluminum covers on exterior flanges and unions.
- F. Caulk and seal all exterior joints to make watertight.

3.05 PIPING INSULATION REQUIREMENTS

- A. Refrigeration Suction:
 - 1. Type P3, elastomeric.
 - 2. 1/2-inch thickness for pipe sizes up to 1-inch.
 - 3. 3/4-inch thickness for pipe sizes over 1-inch.
- B. Refrigeration Hot Gas Reheat:
 - 1. Type P3, elastomeric.
 - 2. 3/4-inch thickness.
- C. Condensate Drain:
 - 1. Type P3, elastomeric.
 - 2. 1/2-inch thickness for pipe sizes up to 2-5/8 inches ID.
 - 3. 3/4-inch thickness for pipe sizes over 2-5/8 inches ID.
- D. Stack:
 - 1. Type P1A.
 - 2. 2-inch thickness for temperatures up to 700 degrees F.
 - 3. 3-inch thickness for temperatures over 700 degrees F.

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- E. Pipe Hangers:
 - 1. Type P1, Fiberglass: UL-rated, preformed rigid pipe insulation inserts of thickness equal to adjoining insulation, 10 inches in length, with factory-applied, vinyl-coated and embossed vapor barrier jacket with self-sealing lap.
 - 2. Type P3, Elastomeric: Rigid insulation section with 9-inch-long, 16-gauge galvanized steel saddle.

3.06 DUCTWORK INSULATION REQUIREMENTS

- A. Mechanically Cooled and Heated Supply and Return Air; (Concealed):
 - 1. Type D1, blanket.
 - 2. 2-inch thickness.
- B. Mechanically Cooled and Heated Supply and Return Air; (Within 30 Feet of Air Handling Unit):
 - 1. Type D3, liner.
 - 2. 1-1/2-inch thickness.
- C. Mechanically Cooled and Heated Supply and Return Air, and Outside Air (run in attic with ceiling insulation): Increase specified insulation thickness by 1/2-inch.
- D. Mechanically Cooled and Heated Supply Air, Return Air, and Outside Air (outdoors):
 - 1. Type D3, liner.
 - 2. 2-inch thickness.
- E. Outside Air Intake:
 - 1. Type D1, blanket.
 - 2. 1-1/2-inch thickness.
- F. Mechanically Cooled and Heated Supply Air (within 10 feet of fan-powered terminal unit discharge):
 - 1. Type D3, liner.
 - 2. 1-1/2-inch thickness.
- G. Unheated Supply Air:
 - 1. Type D3, liner.
 - 2. 1-inch thickness.

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- H. Sheet Metal Plenums:
 - 1. Type D3, liner.
 - 2. 1-1/2-inch thickness.
- I. Air Distribution Devices: Refer to Section 23 37 00, Air Outlets and Inlets, for requirements.

3.07 INSULATION FINISH REQUIREMENTS

- A. Piping, Duct, and Equipment Insulation (Concealed Areas): Factory finish.
- B. Piping Insulation (Exposed to View, Indoors):
 - 1. Type F1, PVC.
 - 2. Type F3, aluminum.
- C. Ductwork Insulation (Exposed to View, Indoors): Factory finish.
- D. Equipment Insulation (Exposed to View, Indoors): Type F2, paint (for use with Type P3, elastomeric).
- E. Piping Insulation (Outdoors):
 - 1. Type F2, paint (for use with Type P3, elastomeric).
 - 2. Type F3, aluminum.
- F. Ductwork Insulation (Outdoors): Type F4, ceramic.
- G. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

3.08 FIELD QUALITY CONTROL

A. Test factory-applied materials assembled. Field-applied materials may be tested individually.

END OF SECTION

SECTION 23 09 00 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI): INCITS 4, Information Systems - Coded Character Sets - 7-Bit American National Standard Code for Information Interchange (7-Bit ASCII).
 - 2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
 - a. Handbook Fundamentals.
 - b. Guideline 3, Reducing Emission of Fully Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems.
 - c. 135, Data Communication Protocol for Building Automation and Control Networks.
 - 3. American Society of Mechanical Engineers (ASME): B19.3, Safety Standard for Compressors for Process Industries.
 - 4. American Water Works Association (AWWA): C704, Propeller-Type Meters for Waterworks Applications.
 - 5. Electronic Industries Alliance (EIA):
 - a. TIA-232-F, Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 - b. 485, Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multi-point Systems.
 - 6. Federal Communications Commission (FCC).
 - International Organization for Standardization (ISO): 8802-3, Information Technology - Telecommunication and Information Exchange Between Systems - Local and Metropolitan Area Networks -Specific Requirements - Carrier Sense Multiple Access with Detection (CSMA/CD) Access Method and Physical Layer Specifications.
 - 8. National Electrical Manufacturers' Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - 9. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code.
 - b. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 10. UL: 916, Standard for Safety Energy Management Equipment.

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1.02 DEFINITIONS

- A. The terms "HVAC Control System," "Automatic Temperature Control System," "Building Automation System," and "Environmental Management and Control System" shall be considered equivalent and used interchangeably for the purposes of this Contract.
- B. Algorithm: A software procedure for solving a recurrent mathematical or logical problem.
- C. Analog: A continuously varying signal or value (temperature, current, velocity, etc.).
- D. Binary: A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level.
- E. Control Wiring:
 - 1. Wiring, high or low voltage other than power wiring required for proper operation of mechanical systems.
 - 2. Includes conduit, wire and wiring devices to install complete control system including motor control circuits, interlocks, thermostats, PE and EP switches and like devices.
 - 3. Includes wiring from DDC cabinet to all sensors and points defined in the Points List summary or specified herein and required to execute sequence of operation.
 - 4. Includes necessary power wiring to HVAC control devices, digital controllers including terminal units and actuators.
- F. Control Process: Software required to complete control loop from input signal to interlock logic and process calculation to final output signal control.
- G. Deadband: Temperature range over which no heating or cooling energy is supplied, such as 72 degrees F to 78 degrees F; as opposed to single point changeover or overlap, or a range from set point over which no control action is taken.
- H. Direct Digital Control (DDC): Consists of microprocessor-based controllers with control logic performed by software. Analog-to-digital (A/D) converters transform analog values into digital signals that microprocessor can use.
- I. Power Wiring: Line voltage wiring to mechanical equipment. Line voltage wiring that also serves as control circuit, such as line voltage thermostat or involves interlocking with damper shall be considered control wiring.

- J. Abbreviations that may be used in this section:
 - 1. AC: Air Conditioning.
 - 2. ATC: Automatic Temperature Control.
 - 3. BAS: Building Automation System.
 - 4. CHWS/R: Chilled/Hot Water Supply/Return.
 - 5. CMOS: Complementary Metal Oxide Semiconductor.
 - 6. DDC: Direct Digital Control.
 - 7. DX: Direct Expansion.
 - 8. EP: Electro-Pneumatic
 - 9. EEPROM: Electronic Erasable Programmable Read Only Memory.
 - 10. EMCS: Environmental Management and Control System.
 - 11. HCP: HVAC Control Panel.
 - 12. HGS/R: Hot Glycol Supply/Return.
 - 13. HMI: Human-Machine Interface.
 - 14. HOA: Hand-Off-Auto (Switch).
 - 15. HVAC: Heating, Ventilation, and Air Conditioning.
 - 16. IP: Current (I) Pressure (P), as in IP transducer.
 - 17. LCD: Liquid Crystal Display.
 - 18. LED: Light Emitting Diode.
 - 19. PE: Pneumatic-Electric
 - 20. PLC: Programmable Logic Controller.
 - 21. RAM: Random Access Memory.
 - 22. RTD: Resistance Temperature Detectors.
 - 23. VAV: Variable Air Volume.
 - 24. W3: Nonpotable Water.

1.03 SYSTEM DESCRIPTION

- A. General Requirements:
 - 1. Provide control wiring, power wiring, conduit, hardware, and electrical work associated with the HVAC control system.
 - 2. Provide control wiring between HVAC control panel contacts and field control devices, such as duct smoke detectors and motor starter control coil contacts.
 - 3. Provide controls necessary for entire system to have fail-safe operation.
 - 4. Control sequences and functions including alarms, monitoring and resetting functions, and operational sequences shall not be limited to point schedules and sequences of operation.
 - 5. Provide sequences and functions as required to deliver a fully functioning HVAC system.

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- B. Control System Types:
 - 1. The following control system types may be used in this Project:
 - a. Electric/Electronic Control System (ELECTRIC):
 - 1) System using simple electric or electronic control devices.
 - 2) User interface at control device.
 - b. Standalone DDC Control System (STANDALONE DDC):
 - 1) Microprocessor-based DDC Control System utilizing standalone DDC controllers.
 - 2) No information sharing between controllers.
 - 3) User interface at DDC controller.
 - 2. Provide control system(s) of architecture defined in Control Type Schedule, below:

Control Type Schedule		
Location	System	Control Type
All	Where operating sequences call for simple thermostatic or interlock control	ELECTRIC
Ticketing Building	All	STANDALONE DDC
Toilet Building	All	STANDALONE DDC

- C. Performance Requirements: Design control system and equipment to perform under the following conditions:
 - 1. Temperature, Ambient:
 - a. Summer maximum 92 DB/77.4 WB degrees F.
 - b. Winter minimum 54.7 DB degrees F.
 - c. Based on ASHRAE Handbook Fundamentals weather data for the City of Pensacola, FL.
 - 2. Temperature, Indoor:
 - a. Air-conditioned Areas: Summer maximum 75 degrees F; Winter minimum 70 degrees F.
- D. Refer to Section 01 61 00, Common Product Requirements, for additional environmental performance requirements.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature that includes make, model, dimensions, weight of equipment, and electrical schematics, for all control system components.
 - 2. Complete system power, interlock, control, and data transmission wiring diagrams no smaller than 11 inches by 17 inches.
 - 3. Complete drawings and schematics of proposed control system, including panel power requirements.
 - 4. System operating sequences to be programmed, in exact English language.
 - 5. Complete points list.
 - 6. Interfaces with HVAC equipment.
 - a. Schematic diagram of each equipment item.
 - b. Indicate location of each control item in equipment.
 - c. Show equipment manufacturer controls where installed.
 - 7. Panel face layout drawings.
 - 8. Damper actuator sizing calculations, in schedule form.
 - 9. Automatic control valve sizing calculations, in schedule form.
- B. Informational Submittals:
 - 1. Table identifying which member of Contractor's team is responsible for furnishing and setting in-place power wiring and control wiring of each item or component of HVAC equipment.
 - 2. Recommended procedures for protection and handling of equipment and materials prior to installation.
 - 3. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 4. Confirmation that control system Supplier has received, and coordinated with all approved HVAC equipment submittals.
 - 5. Experience and qualifications of control system Supplier's proposed representative who will supervise installation, adjustment, and calibration of control systems.
 - 6. Performance test plan and schedule.
 - 7. Test Results:
 - a. Functional and performance test documentation.
 - 8. Operation and Maintenance Data. In addition, include the following detailed information:
 - a. Operation and maintenance instructions for control system as furnished and installed, including control of associated mechanical and electrical equipment.

- b. Record of system adjustments and calibration methods.
- c. Performance test results.

1.05 QUALITY ASSURANCE

- A. Materials, devices, appliances, and equipment used shall be indicated as acceptable by established standards of UL.
- B. Codes and Standards: Meet requirements of applicable standards and codes, except when more detailed or stringent requirements are indicated by Contract Documents, including requirements of this section.
 - 1. UL: Products shall be UL 916-PAZX listed.
 - 2. National Electrical Code NFPA 70.
 - 3. Federal Communications Commission Part J.
- C. Qualifications of HVAC Controls System Supplier:
 - 1. Minimum of 15 years' experience in design, installation, and maintenance of fully electronic building automation systems.
 - 2. Minimum of 10 years' experience in design, installation, and maintenance of computer based, direct digital control, facility automation systems.
 - 3. Minimum of 5 years' experience as manufacturer's authorized representative in design, installation, and maintenance of manufacturer's system and products.
 - 4. Capable of furnishing factory-trained technicians, competent to provide instruction, routine maintenance, and emergency service onsite within 4 hours after receipt of request.
 - 5. Factory trained certified engineering and commissioning staff, and complete offsite training facilities.
 - 6. Necessary facilities to provide Owner with complete maintenance, periodic inspection, and service contract. Refer to Paragraph, Maintenance.
- D. FCC Regulation: Electronic equipment shall conform to requirements of FCC Regulation, Part 15, Section 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.
- E. Compatibility:
 - 1. System shall have documented history of compatibility by design for minimum of 15 years. Future compatibility shall be supported for no less than 10 years.

- 2. Compatibility shall be defined as:
 - a. Ability to upgrade existing field panels to current level of technology, and extend new field panels on previously installed network.
 - b. Ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers, or protocol converters.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 61 00, Common Product Requirements.
- B. Corrosion Protection:
 - 1. Control panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, shall be protected from corrosion through use of corrosion-inhibiting vapor capsules.
 - 2. Prior to shipment, capsules shall be provided within shipping containers and equipment as recommended by capsule manufacturer.
 - 3. During construction period, capsules shall be replaced in accordance with capsule manufacturer's recommendations.

1.07 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials.
 - 1. Spare parts shall be available for at least 5 years after Substantial Completion.
- B. Tools:
 - 1. For each building, furnish one complete set of special tools recommended by manufacturer for maintenance, dismantling, or repair of each separate type of equipment item.
 - 2. Furnish toolbox for storage of special tools. Identify purpose by means of stainless steel or solid plastic nametag attached to box.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified shall be products of the following manufacturers, unless indicated otherwise:
 - 1. Allen Bradley.
 - 2. Siemens Building Technologies.
 - 3. Johnson Controls.
 - 4. The Trane Company.
 - 5. Honeywell.
 - 6. Invensys.
 - 7. Alerton Technologies.
 - 8. Delta Controls.
 - 9. Automated Logic Corporation.
 - 10. Andover.
 - 11. Mitsubishi

2.02 MATERIALS

- A. General:
 - 1. Products used in this installation shall be new, currently under manufacture, and shall have been applied in similar installations for minimum of 2 years.
 - 2. System shall not be used as test Site for new products, unless explicitly approved by Owner's representative, in writing.
- B. Control Components:
 - 1. Control range to obtain specified capacities.
 - 2. Sensitivity to maintain control points close enough to set point for acceptable offset, without cycling equipment more frequently than recommended by manufacturer.
 - 3. Field or computer adjustable to actual set point, ranges. Adjustable to other settings that will provide proper operation of entire control system.
- C. Controls Interfacing:
 - 1. Interface controls properly with factory supplied components of mechanical systems. Coordinate special control interfacing requirements.
 - 2. For equipment that requires special interfacing with control system, provide equipment with integral controls or provide accessory devices required for operation of total mechanical system.

- 3. Coordinate interfaces with electrical work as necessary.
- 4. Provide electric, electronic, and mechanical devices as required to properly interface with prewired control panels furnished with HVAC equipment and with other mechanical and electrical components.

2.03 LABELING

- A. All products, namely electrical materials, devices, appliances, and equipment used, shall be indicated as acceptable by established standards of UL and Factory Mutual (FM).
- B. Valid label affixed to item shall provide indication of product acceptance by required agencies.
- C. HVAC control panels and control components that consist of multiple components shall bear UL listing mark on unit.

2.04 SERVICE CONDITIONS

- A. Refer to Section 01 61 00, Common Product Requirements, Section 26 05 02, Basic Electrical Requirements, and Electrical Drawings for classification of areas as hazardous, corrosive, wet, indoor dry, and dust-tight.
- B. Use materials and methods, and enclose devices in NEMA enclosure types suitable for classification indicated, and as required by NFPA 70.
- C. Exhaust ductwork shall be considered same classification as area served.
- D. Instruments within 3 feet of ducts conveying air from spaces classified as Class I, Division 1 or Division 2 (in accordance with NFPA 70) shall be suitable for same area classification as space exhausted.

2.05 ELECTRICAL COMPONENTS AND ACCESSORIES

- A. Electrical components shall be provided in accordance with requirements of Division 26, Electrical.
- B. Wiring:
 - 1. In accordance with Section 26 05 05, Conductors, and NFPA 70.
 - 2. Insulation shall be rated 600 volts, minimum.

2.06 FIELD COMPONENTS AND INSTRUMENTS

A. Refer to HVAC controls detailed specification, Section 23 09 13, HVAC Controls, Field Components, and Instruments.

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2.07 ACCESSORIES

- A. Corrosion-inhibiting vapor capsules as manufactured by:
 - 1. Northern Instruments; Model Zerust VC.
 - 2. Hoffman; Model A-HCI.
- B. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.
- C. Equipment Identification Plates:
 - 1. Provide 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8 or 1/4-inch high engraved or die-stamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.
 - 2. Provide adjacent to the following control devices, and for equipment whose function is not readily apparent.
 - a. Night low limit thermostats.
 - b. Manual override timers.
 - c. START/STOP switches.
 - d. Humidistats.
 - e. Emergency STOP switches.
 - f. Special purpose devices.
 - g. HVAC control panels.
- D. Anchor Bolts: Type 316 stainless steel sized by equipment manufacturer or 1/2-inch minimum diameter (whichever is larger), and as specified in Section 05 50 00, Metal Fabrications.

2.08 EQUIPMENT FINISH

- A. Provide materials and equipment with manufacturer's standard finish system. Provide manufacturer's standard finish color, except where specific color is indicated.
- B. If manufacturer has no standard color, provide gray finish as approved by Owner.

PART 3 EXECUTION

- 3.01 SEQUENCES OF OPERATION
 - A. Reference the Drawings.

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3.02 INSTALLATION

A. General:

- 1. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings, and equipment details.
- 2. Changes in location or installation of control devices or equipment shall be approved by Engineer before proceeding with the Work.
- 3. Mount devices requiring manual reset and all other user serviceable control devices in readily accessible locations.
- B. Wiring:
 - 1. General:
 - a. Install electric wire, cable, fittings, and conduit associated with systems specified in this section, in accordance with requirements of NFPA 70.
 - b. Install control and interlock wiring separate from power wiring.
 - c. Number code or color code conductors, excluding those used for individual zone controls, appropriately for future identification and servicing of control system.
 - d. Provide wire markers on each conductor in panel and at load connections. Identify circuit with control wire number.
 - e. Restrain wiring in control panels by plastic ties or ducts.
 - f. Hinge wiring shall be secured at each end so that any bending or twisting will be around longitudinal axis of wire and bend area shall be protected with sleeve.
 - g. Arrange wiring neatly, cut to length, and remove surplus wiring. Provide abrasion protection for any wire bundles that pass through holes or across edges of sheet metal.
 - h. Use manufacturer's recommended tool with proper sized anvil for crimp terminations. No more than two wires may be terminated in single crimp lug and no more than two lugs may be installed on single screw terminal.
 - i. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.
 - j. Properly support and run wiring in a neat manner.
 - k. Run wiring parallel or at right angles to building structure.
 - 2. Concealment:
 - a. Generally conceal wiring from view, except in mechanical rooms and areas where other conduit and piping are exposed; install exposed wiring and conduit to be as unobtrusive as possible.
 - b. Install line voltage control wiring, wiring exposed to view, surface-mounted wiring, and wiring concealed within walls in conduit, in accordance with Division 26, Electrical.

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- c. Install exposed and concealed low voltage control wiring systems in conduit.
- d. Wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals.
- e. Conduit shall be sized to suit the number, type, and size of conductors as specified in Section 26 05 05, Conductors.
- C. End-User Accessible Control Components:
 - 1. Do not mark room thermostats.
 - 2. Mount user adjustable control components (room thermostats, humidistats, temperature sensors, humidity sensors, etc.) level and in accordance with applicable accessibility requirements of local Building Code.
- D. Control Dampers:
 - 1. Verify correctness of installation.
 - 2. Verify proper control action.
 - 3. Adjust limit switch settings.
 - 4. Adjust opening and closing speeds, and travel stops.
 - 5. Stroke control dampers by means of associated control output.
- E. DDC Controllers:
 - 1. Verify control wiring for correctness.
 - 2. Verify power wiring.
 - 3. Calibrate and adjust manual and auto control actions of controllers.
 - 4. Tune control loop.
 - 5. Stroke associated final element through controller output.
 - 6. Verify set points and alarm functions.
- F. HVAC Control Panel (HCP) Equipment:
 - 1. Mount HCPs level, plumb, and securely to wall or column. Verify that adequate clearance is provided to allow for full front panel swing.
 - 2. Provide field terminations and conduit knockouts for control/instrumentation wiring.
 - 3. Field termination wiring shall have designated instrument tag.
 - 4. Panel cutouts shall be cut, punched, or drilled and smoothly finished with round edges.
 - 5. Provide separate conduit entry for each power feeder circuit.
 - 6. Signals requiring grounding shall be grounded within panel.
 - 7. Field end of conductor shield/drain wires shall be folded back and placed under heat-shrink tubing without being grounded.

- 8. Panel end of conductor shield/drain wires shall be covered with clear tubing at panel and grounded.
- 9. Calibrate instrumentation provided on control panels.
- 10. Provide labels for internal panel material (such as, terminal blocks, power supplies, relays, PLC racks).

3.03 TRAINING

- A. Provide training of Owner's personnel to enable them to operate HVAC equipment in available modes, to adjust set points, and to interpret alarm signals.
- B. Training sessions shall be prepared in advance, and arranged for clear, effective transfer of information in minimum time.

3.04 ADJUSTING AND CALIBRATING

- A. Control system shall be adjusted and calibrated by qualified manufacturer's representative.
- B. Calibrate control devices at time of installation to ensure measuring and reading accuracy.
- C. Adjustment Record:
 - 1. Prepare complete record of system adjustments for each control system.
 - 2. Indicate deviations from specified temperatures.
 - 3. Include copy of completed record in each copy of Operation and Maintenance Manual.

3.05 CLEANING AND TOUCHUP PAINTING

A. Touchup scratches, scrapes, or chips in exterior surfaces with finish matching type, color, consistency, and type of surface of original finish.

END OF SECTION

SECTION 23 09 00.01 HVAC CONTROLS SEQUENCE OF OPERATION, GENERAL CONTROL TYPES

1.01 GENERAL CONTROL TYPES

- A. Motorized Damper Control:
 - 1. When AC-1 is commanded to start, open MD-1. Close damper on unit shutdown.
 - 2. When AC-4 is commanded to start, open MD-2.Close damper on unit shutdown.
- B. Occupied/Unoccupied Control:
 - 1. Modes shall be determined by 7-day facility operation schedule.
 - 2. Provide momentary contact manual after-hours override switch at room temperature sensor.
 - 3. Initially set after-hours override duration for 1-hour.

END OF SECTION

SECTION 23 09 00.02 HVAC CONTROLS SEQUENCE OF OPERATION, AIR HANDLING UNITS

1.01 AIR HANDLING UNITS

- A. Constant Volume, Direct Expansion, 100 percent Outside Air Unit, AC-1.
 - 1. General: This sequence describes the required operation of a constant volume air handling unit (AHU). The unit is a 100 percent outside air unit with no recirculation of air.
 - 2. Unoccupied: When the facility is unoccupied, AC-1, EF-3, EF-4, and EF-6 will stop in unison.
 - 3. Occupied: When the facility is occupied, AC-1, EF-3, EF-4, and EF-6 shall run continuously in unison.
- B. Variable Refrigerant Volume, Wall mounted, mini split system, AC-2.
 - 1. General: This sequence describes the required operation of AC-2. This unit will run off of a thermostat with 2 modes based on facility occupation.
 - 2. Unoccupied: When the facility is unoccupied, AC-2 will modulate to condition the space at the client's predetermined unoccupied schedule setpoint. AC-2 will be the sole climate control when not occupied.
 - 3. Occupied: When the facility is occupied, AC-2 will modulate to condition the space at the client's predetermined occupied schedule setpoint in tandem with AC-1
- C. Variable Refrigerant Volume, Multi Position Air Handler, AC-3.
 - 1. General: This sequence describes the required operation of AC-3. This unit will run off of a thermostat with 2 modes based on facility occupation.
 - 2. Unoccupied: When the facility is unoccupied, AC-3 will modulate to condition the space at the client's predetermined unoccupied schedule setpoint.
 - 3. Occupied: When the facility is occupied, AC-3 will modulate to condition the space at the client's predetermined occupied schedule setpoint.
- D. Variable Refrigerant Volume, Multi Position Air Handler, AC-4.
 - 1. General: This sequence describes the required operation of AC-4. This unit will run off of a thermostat with 2 modes based on facility occupation.

- 2. Unoccupied: When the facility is unoccupied, AC-4 will modulate to condition the space at the client's predetermined unoccupied schedule setpoint.
- 3. Occupied: When the facility is occupied, AC-4 will modulate to condition the space at the client's predetermined occupied schedule setpoint.
- E. Variable Refrigerant Volume, Multi Position Air Handler, AC-5.
 - 1. General: This sequence describes the required operation of AC-5. This unit will run off of a thermostat with 2 modes based on facility occupation.
 - 2. Unoccupied: When the facility is unoccupied, AC-5 will modulate to condition the space at the client's predetermined unoccupied schedule setpoint.
 - 3. Occupied: When the facility is occupied, AC-5 will modulate to condition the space at the client's predetermined occupied schedule setpoint.

END OF SECTION

SECTION 23 09 13 HVAC CONTROLS, FIELD COMPONENTS, AND INSTRUMENTS

PART 1 GENERAL (NOT USED)

PART 2 PRODCUTS (NOT USED)

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Control Dampers: Install at locations indicated on the Drawings and in accordance with manufacturer's instructions.
 - B. EF-2 and EF-5:
 - 1. Install at locations indicated on the Drawings and in accordance with manufacturer's instructions.
 - 2. Fans to be thermostatically controlled. When mechanical rooms are less than 80F the fans will not be powered. When mechanical rooms are 80F or greater the fans will be energized.

END OF SECTION

SECTION 23 23 00 REFRIGERANT PIPING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 760, Performance Rating of Solenoid Valves for Use with Volatile Refrigerants.
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): 15, Safety Standard for Refrigeration Systems.
 - 3. American Society of Mechanical Engineers (ASME):
 - a. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - b. B31.5, Refrigeration Piping and Heat Transfer Components.
 - 4. American Welding Society (AWS):
 - a. A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding.
 - b. BRH, Brazing Handbook.
 - 5. ASTM International (ASTM): B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 6. National Electrical Manufacturers Association (NEMA).
 - 7. UL.

1.02 DEFINITIONS

- A. ACR: Air conditioning and refrigeration.
- B. NRTL: National Recognized Testing Laboratory.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings in 1/4-inch scale for refrigerant piping showing pipe and tube sizes, flow capacities location, elevations, fittings, accessories, and piping connections.
 - 2. Manufacturer's data on refrigerant piping, piping products, thermostatic expansion valves, solenoid valves, hot-gas bypass valves, filter dryers, strainers, pressure regulating valves and accessories.

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- B. Informational Submittals:
 - 1. Welding certificates.
 - 2. Field quality control; test report.
- C. LEED Submittals:
 - 1. Documentation required indicating compliance with Fundamental Refrigerant Management—EA Prerequisite 3.
 - 2. Documentation required indicating compliance with Enhanced Refrigerant Management—EA Credit 4.
- 1.04 QUALITY ASSURANCE
 - A. Safety Code Compliance: Comply with applicable portions of ASHRAE 15.
 - B. Brazing: Comply with applicable requirements of ASME B31.5 pertaining to brazing of refrigerant piping for shop and Project Site locations.
 - C. Installer: A firm with at least 5 years of successful installation experience on projects with refrigerant piping similar to that required for this Project.
- 1.05 DELIVERY, STORAGE, AND HANDLING
 - A. Refrigerant piping shall be cleaned, dehydrated, and sealed when delivered.
 - B. Store piping in clean and protected area with end caps in place.

PART 2 PRODUCTS

- 2.01 MATERIALS
 - A. Material and dimensional requirements for field assembled refrigerant piping, valves, fittings and accessories shall conform to ASHRAE 15 and ASME B31.5, except as hereinafter specified.
 - B. Piping, 3 inches and Smaller: Copper, Type ACR tube, ASTM B280, copper No. 122, hard-drawn temper. Brazed joints required.
 - C. Fittings for Copper Tube: Wrought-copper/bronze solder-joint fittings in accordance with ASME B16.22.
 - D. Pipe Insulation: Refer to Section 22 07 00, Plumbing Piping Insulation.

2.02 MISCELLANEOUS PIPING PRODUCTS

- A. Brazing Materials:
 - 1. Except as otherwise indicated, provide 15 percent silver alloy brazing material for copper to copper and copper to brass fittings.
 - 2. Comply with AWS A5.8M/A5.8 for brazing filler materials.
- B. Refrigerant Specialties:
 - 1. Refrigerant Suction Line Filter-Dryer:
 - a. Provide steel shell, corrosion-resistant finish filter-dryer, with molded felt core with 10-micron particle retention, in size and working pressure indicated, with copper connectors, and access valve (not applicable for heat pump system).
 - b. Operating Temperature Rating: 240 degrees F.
 - c. Working Pressure: 500 psi.
 - d. Provide size recommended by refrigeration equipment manufacturer.
 - 2. Refrigerant Liquid Line Dryer:
 - a. Provide refrigerant liquid line filter-dryer for all units.
 - b. Operating Temperature Rating: 240 degrees F.
 - c. Working Pressure: 500 psi.
 - d. For heat pumps, provide biflow directional types (not required if included with air-conditioning equipment).
 - e. Provide size recommended by refrigeration equipment manufacturer.
- C. Refrigerant Valves:
 - 1. Globe and Check Valves: Listed and labeled by an NRTL.
 - a. Shutoff Valves:
 - Forged brass, packed, back seating winged seal cap, 300 degrees F (140 degrees C) temperature rating 500 psi working pressure.
 - 2) Maximum Opening Pressure: 0.5 psig.
 - 3) Valve required only if shutoff service valves are not included with package air-conditioning equipment.
 - b. Manufacturers:
 - 1) Henry Technologies.
 - 2) Parker Hannifin Corp.

- 2. Solenoid Valve: Listed and labeled by an NRTL.
 - Two-Way Solenoid Valves: Forged brass, designed to conform to AHRI 760, normally closed, Teflon valve seat, NEMA 1 solenoid enclosure, 24 volts, 60-Hz, UL Listed, 1/2-inch conduit adapter, 250 degrees F (121 degrees C) temperature rating 500 psi working pressure.
 - b. Provide valve only if recommended by air-conditioning equipment manufacturer.
 - c. Manual Operator: Provide optional manual operator to open valve.
 - d. Manufacturers:
 - 1) Alco Controls Div.; Emerson Electric Co.
 - 2) Automatic Switch Co.
 - 3) Parker Hannifin Corp.
- 3. Thermostatic Expansion Valve:
 - a. Body Bonnet and Seal Cap: Forged brass or steel.
 - b. Diaphragm, Piston, Closing Spring and Seat Insert: Stainless steel.
 - c. Capillary and Bulb: Copper tubing filled with refrigerant.
 - d. Suction Temperature: 40 degrees F.
 - e. End Connections: Socket or flare.
 - f. Working Pressure: 700 psig.
 - g. Manufacturers:
 - 1) Henry Technologies.
 - 2) Parker Hannifin Corp.
 - 3) Danfoss Group Global.
- 4. Safety Relief Valve:
 - a. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 - b. Seat Disk: Polytetrafluoroethylene.
 - c. Working Pressure: 500 psig.
 - d. Operating Temperature: 240 degrees F, maximum.
 - e. Manufacturers:
 - 1) Henry Technologies.
 - 2) Parker Hannifin Corp.
 - 3) Danfoss Group Global.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPING SYSTEM

- A. Install piping products in accordance with manufacturer's written instructions, applicable requirements of ASME B31.5, ASHRAE 15, and in accordance with recognized industry practices to ensure products serve intended function.
- B. Install dryers on liquid and suction lines.

- C. Refrigerant Piping:
 - 1. Cut pipe accurately to measurements established at Site and work into place without springing or forcing.
 - 2. Install piping with sufficient flexibility to adequately provide for expansion and contraction as a result of temperature fluctuation inherent in its operation.
 - 3. Where pipe passes through building structure, pipe joints shall not be concealed, but located where they may be readily inspected.
 - 4. Run pipe to be insulated as shown and as required with sufficient clearance to permit application of insulation.
 - 5. Run piping as shown on the Drawings, taking care to avoid interference with other piping, conduit or equipment. Except where specifically indicated otherwise, run piping plumb, and straight and parallel to walls and ceilings.
 - 6. Trapping of lines shall not be permitted, except where indicated.
 - 7. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
 - 8. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
 - 9. Install piping free of sags and bends.
 - 10. Install fittings for changes in direction and branch connections.
 - 11. Install refrigerant piping in protective conduit where installed belowground.
 - 12. Install accumulator in suction line near condensing unit.
 - 13. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
 - 14. Slope refrigerant piping as follows:
 - a. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - b. Install horizontal suction lines with a uniform slope downward to compressor.
 - c. Install traps and double risers to entrain oil in vertical runs.
 - d. Liquid lines may be installed level.
- D. Pipe Sleeves:
 - 1. Provide pipe sleeves of suitable size for pipe and tubing that penetrate building structure.
 - 2. Secure sleeves in position and location before and during construction. Space between pipe and sleeves, or between insulation and pipe sleeves, shall be not less than 1/4-inch between outside of pipe or insulation, and inside wall of sleeves.

- 3. Sleeves for uninsulated pipes shall have ends flush with finished wall surfaces; provide pipe or tubing as above with outside perimeter of pipe caulked to sleeve.
- 4. Extend sleeves for insulated pipes 1/2-inch from wall faces and caulk to sleeve on both sides.
- 5. Seal terminal ends of pipe insulation with mastic.
- 6. Extend sleeves for lines passing through floors 3 inches above finished floor slab and caulk to slab.
- E. Braze cap (seal) ends of piping when not connected to mechanical equipment.

3.02 SOLDER JOINTS

A. Solder joints shall not be used for joining refrigerant piping systems.

3.03 BRAZED JOINTS

- A. Braze copper piping with silver solder complying with AWS A5.8M/A5.8.
- B. Brazed Joints:
 - 1. Construct joints according to AWS *Brazing Handbook* Chapter "Pipe and Tube".
 - 2. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 3. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- C. Inside of tubing and fittings shall be free of flux.
- D. Clean parts to be joined with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled.
- E. Cool joints in air and remove flame marks and traces of flux.
- F. During brazing operation, prevent an oxide film from forming on inside of tubing by slowly flowing dry nitrogen to expel air.
- G. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.

3.04 EQUIPMENT CONNECTIONS

A. Connect refrigerant piping to mechanical equipment in the manner shown, and comply with equipment manufacturer's instructions where not otherwise indicated.

REFRIGERANT PIPING 23 23 00 - 6

3.05 FIELD QUALITY CONTROL

A. General:

- 1. Notify Engineer at least 48 hours before testing is performed.
- 2. Furnish equipment required for tests.
- 3. Group as many systems together as possible when testing in order to consolidate number of test inspections.
- B. Leak Test:
 - 1. Prior to initial operation, clean and test refrigerant piping in accordance with ASME B31.5.
 - 2. Perform initial test with dry nitrogen to 300 psig minimum using soap solution to test joints.
 - 3. Evacuate system after initial test and charge system with refrigerant or dry nitrogen, 20 percent refrigeration mixture to 600 psig minimum.
 - 4. Upon completion of initial system test, test factory, as well as field, refrigerant piping joints with electronic-type leak detector to acquire a leak-tight refrigerant system.
 - a. If leaks are detected, remove entire refrigerant charge for the system, replace defective pipe or fitting, and retest entire system as specified above.
- C. Evacuation, Dehydration, and Charging:
 - 1. After system is found to be without leaks, evacuate system using reliable gauge and vacuum pump capable of pulling a vacuum of at least 1-mm Hg absolute (29.88-inch Hg gage).
 - 2. Evacuate system with vacuum pump until temperature of 35 degrees F (2 degrees C) is indicated on vacuum dehydration indicator.
 - 3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
 - 4. Maintain vacuum on system for minimum of 12 hours after closing valve between vacuum pump and system. If system holds vacuum for 12 hours it is ready for charging.
 - 5. Break vacuum with refrigerant gas or dry nitrogen gas, allowing pressure to build up to 2 psi (15 kPa).
 - 6. Install new filter-dryer core in charging line.
 - 7. Repeat evacuation procedure and complete charging of system; provide full operating charge.

3.06 ADJUSTING

- A. General:
 - 1. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
 - 2. Adjust high-pressure and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
 - 3. Adjust setpoint temperature of air-conditioning or chilled-water controllers to system design temperature.
 - 4. Perform following adjustments according to manufacturer's written instructions before operating refrigeration system:
 - a. Open shutoff valves in condenser water circuit.
 - b. Verify compressor oil level is correct.
 - c. Open compressor suction and discharge valves.
 - d. Open refrigerant valves, except bypass valves that are used for other purposes.
 - e. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- B. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13 METAL DUCTS AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Movement and Control Association (AMCA): 500, Test Methods for Louvers, Dampers and Shutters.
 - 2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook.
 - 3. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
 - 4. Association of the Nonwoven Fabrics Industry (INDA): IST 80.6, Water Resistance (Hydrostatic Pressure).
 - 5. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A90/A90M, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - c. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - d. A176, Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.
 - e. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - f. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - g. A568/A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
 - h. A653/A653M, Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - i. A700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment.
 - j. A924/A924M, Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process.

- k. A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- 1. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- m. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- n. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- o. C916, Standard Specification for Adhesives for Duct Thermal Insulation.
- p. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- q. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.
- r. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- s. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
- 6. National Air Duct Cleaners Association (NADCA): General Specifications for the Cleaning of Commercial Heating, Ventilation and Air Conditioning Systems.
- 7. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - b. 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - c. 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - d. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - e. 259, Standard Test Method for Potential Heat of Building Materials.
 - f. 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- 8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. Duct Construction Standards.
 - b. Guidelines for Seismic Restraints of Mechanical Systems.
 - c. Fibrous Glass Duct Construction Standards.

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- d. Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.
- e. HVAC Air Duct Leakage Test Manual.
- 9. UL:
 - a. 181, Standard for Safety Factory-Made Air Ducts and Connectors.
 - b. 214, Standard for Tests for Flame-Propagation of Fabrics and Films.
 - c. 555, Standard for Safety Fire Dampers.
 - d. 555S, Standard for Safety Smoke Dampers.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. CFM: cubic feet per minute.
 - 2. FPM: feet per minute.
 - 3. PCF: pounds per cubic foot.
 - 4. WC: water column.
- B. Sealing Requirements: For the purpose of duct systems sealing requirements specified in this section, the following definitions apply:
 - 1. Seams: Joining of two longitudinally (in direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on perimeter are deemed to be joints.
 - 2. Joints, duct surface connections including:
 - a. Girth joints.
 - b. Branch and subbranch intersections.
 - c. Duct collar tap-ins.
 - d. Fitting subsections.
 - e. Louver and air terminal connections to ducts.
 - f. Access door, and access panel frames and jambs.
 - g. Duct, plenum, and casing abutments to building structures.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Rectangular, Rigid Round, and Oval Ductwork:
 - 1) Schedules of duct systems, materials, joints, sealing, gage and reinforcement.
 - 2) SMACNA Figure Numbers for each shop fabricated item.
 - 3) Reinforcing details and spacing.
 - 4) Seam and joint construction details.

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- 5) Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- b. Ductwork Accessories:
 - 1) Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, and finishes, including the following items:
 - a) Fittings and volume control damper installation (both manual and automatic) details.
 - b) Duct liner.
 - c) Sealing materials.
 - d) Dampers; include leakage, pressure drop, and maximum back pressure data.
 - e) Duct-mounted access panels and doors.
 - f) Flexible ducts.
 - g) Sheet metal fasteners.
- B. Informational Submittals:
 - 1. Record Drawings: Include duct systems routing, fittings details, and installed accessories and devices.

1.04 QUALITY ASSURANCE

- A. Industry Standards:
 - 1. Unless otherwise indicated or specified, sheet metal ductwork shall be constructed and installed in accordance with SMACNA Duct Construction Standards relevant to ductwork system being provided. These standards are herein referenced as the SMACNA Manual, unless otherwise indicated.
 - 2. Comply with ASHRAE Fundamentals Handbook recommendations, except as otherwise indicated.
 - 3. NFPA Compliance: NFPA 90A and NFPA 90B.
- B. Manufacturers: Firms regularly engaged in manufacture of ductwork products of types, materials, and sizes required, whose products have been satisfactorily used in similar service for not less than 5 years.
- C. Suppliers of duct and fitting components shall provide on request the following information:
 - 1. Laboratory performance data for duct, including leakage rate, bursting strength, collapse strength, seam strength, and pressure loss.

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- 2. Laboratory performance data for fittings, including zero-length dynamic losses.
- D. Installer shall be a firm with at least 3 years' experience of successful installation on ductwork systems similar to that required for this Project.
- E. Changes or alterations to layout or configuration of duct system shall be:
 - 1. Specifically approved in writing by Engineer.
 - 2. Proposed layout shall provide original design results, without increasing system total pressure.

1.05 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:
- B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect ductwork from dirt, water, and debris. During storage on Job Site, keep ends of ductwork covered to prevent foreign objects and water from entering ductwork.
- B. If fabricated sound-lined ductwork ductboard gets wet during installation, remove and dispose of ductwork from the Site.
- C. Deliver sealant materials to Site in original unopened containers labeled with manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- D. Store and handle sealant materials in compliance with manufacturers' recommendations to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- E. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

PART 2 PRODUCTS

2.01 SCHEDULES

A. Ductwork Schedule: Refer to the Drawings.
2.02 GENERAL

- A. Specified components of this ductwork system, including facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.
- B. Internally Lined Ductwork: Duct sizes indicated for internally lined ducts are the clear inside dimensions, and shall be increased in both dimensions by twice the thickness of the liner.
- C. Ductwork Interior Surfaces:
 - 1. Smooth.
 - 2. No sheet metal parts, tabs, angles, or other items may project into air ducts, unless otherwise specified.
 - 3. Seams and joints shall be external.
 - 4. For ductwork that is required to be reinforced, Contractor may use either external or internal reinforcing.

2.03 SHEET METAL MATERIALS

- A. Construct metal duct systems from galvanized steel.
- B. Where no specific ductwork materials are indicated in Specifications or on the Drawings, galvanized steel sheet metal shall be basis of Contract.
- C. Galvanized Steel Ductwork:
 - 1. Comply with ASTM A653/A653M and ASTM A924/924M.
 - 2. Product Name: Steel Sheet, Zinc Coated (Galvanized Steel).
 - 3. Sheet Designation: CS Type B.
 - 4. Applicable Specification: ASTM A653/A653M.
 - 5. (Zinc) Coating Designation: G90.
 - 6. Coating designation in accordance with Test Method A, ASTM A90/A90M. and ASTM A924/A924M.
 - 7. Provide mill-phosphatized finish for ducts exposed to view and for ducts scheduled to be painted.
 - 8. Provide sheet metal packaged and marked as specified in ASTM A700.
- D. Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.04 DUCT SEALING MATERIALS

- A. General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
- B. Adhesives, Cements, Sealant, and Installation Accessories: As recommended by duct manufacturer for application.
- C. Solvent-Based Sealants:
 - 1. Ultraviolet light resistant.
 - 2. Mildew resistant.
 - 3. Flashpoint: Greater than 70 degrees F, SETA CC.
 - 4. Manufacturers and Products:
 - a. Hardcast, Inc.; Versagrip 102.
 - b. Rectorseal; AT-33.
 - c. Childers CP-140.
- D. Water-Based Sealants:
 - 1. Listed by manufacturer as nonflammable in wet and dry state.
 - 2. Manufacturers and Products:
 - a. Foster; Series 32.
 - b. Childers; CP-145A, 146.
 - c. Rectorseal; Airlok 181.

2.05 DUCTWORK FASTENERS

- A. General:
 - 1. Rivets, bolts, or sheet metal screws.
 - 2. Ductwork fasteners shall be same metal as duct being supported, unless otherwise noted.
- B. Self-Drilling Screws:
 - 1. Galvanized Steel Ductwork System: Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated carbon steel with zinc electroplated finish.

2.06 DUCTWORK PRESSURE CLASS

A. Construct duct systems to pressure classifications indicated in the Ductwork Schedule.

B. Where no specific duct pressure designations are indicated in Specifications or on the Drawings, 2-inch WC pressure class shall be basis of Contract.

2.07 RECTANGULAR DUCTWORK

- A. Fabricate rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, and Rectangular Industrial Duct Construction Standards, unless specified otherwise.
- B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20-gauge or less, with more than 10 square feet of unbraced panel area, as indicated in SMACNA Manual, unless they are lined or are externally insulated.

2.08 RECTANGULAR DUCTWORK FITTINGS

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible and Rectangular Industrial Duct Construction Standards.
- B. Elbows:
 - 1. Fit square-turn elbows with vane side rails.
 - 2. Shop fabricate double-blade turning vanes of same material as ductwork.
 - 3. Fabricate with equal inlet and outlet.
 - 4. Rectangular radius elbows with inside radius of 3/4 of duct width in direction of turn.
 - 5. Manufacturers and Products:
 - a. Elgen; All-Tight.
 - b. Duro-Dyne; Type TR.

2.09 RECTANGULAR DUCTWORK BRANCH CONNECTIONS

A. Branch duct connections to rectangular duct mains shall be made using factory fabricated fittings with spot welded tap to main duct connections or with factory fabricated, field installed taps, with spin-in or mechanical fastened tap to main duct connections.

2.10 RECTANGULAR DUCTWORK INSULATION LINER

A. Location: Provide ductwork with internal insulation liner where indicated on the Drawings or in Ductwork Schedule.

B. Material:

- 1. Fiberglass, nominal 1.5 pcf density liner, K factor 0.25 maximum at 75 degrees F mean.
- 2. Black composite coating on surface exposed to airstream to prevent erosion of glass fibers, for temperatures to 250 degrees F.
- 3. Liquid water repellency rating not less than 4.0 when tested in accordance with INDA IST 80.6.
- 4. Potential heat value not exceeding 3,500 Btu per hour per pound when tested in accordance with NFPA 259 and meeting classification of "Limited Combustible" as defined by NFPA 90A.
- 5. Maximum rated velocity not less than 6,000 fpm when tested in accordance with ASTM C1071.
- 6. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C1139.
- 7. Manufacturers and Products:
 - a. CertainTeed; Toughgard.
 - b. JohnsManville; Linacoustic RC.
 - c. Knauf; Duct Liner M.
- C. Thickness: Minimum 1-inch(es) or greater thickness where indicated on the Drawings or Ductwork Schedule.
- D. R-Value: Minimum 4.2 hours foot squared degrees F per Btu or greater, where indicated on the Drawings or Ductwork Schedule.
- E. Liner Adhesive: In accordance with NFPA 90A and ASTM C916.
- F. Mechanical Fasteners:
 - 1. Same material as ductwork, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct.
 - 2. Provide fasteners that do not damage liner when applied as recommended by manufacturer, that do not cause leakage in duct, and will indefinitely sustain 50-pound tensile dead load test perpendicular to duct wall.
 - 3. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8-inch into airstream.
 - 4. Adhesive for Attachment of Mechanical Fasteners: In accordance with Fire Hazard Classification of duct liner system.
- G. Liner Application:
 - 1. Ductwork liner shall be applied at time of ductwork manufacture in an approved sheet metal workshop.

- 2. Adhere single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
- 3. Apply coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
- 4. Butt transverse joints without gaps and coat joint with adhesive.
- 5. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
- 6. Longitudinal Joints:
 - a. Shall not occur except at corners of ducts, unless size of duct and standard liner product dimensions make longitudinal joints necessary.
 - b. Apply adhesive coating on longitudinal seams in ducts exceeding 2,500 fpm air velocity.
- Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter, at 3 inches from transverse joints, and at intervals not exceeding 18 inches longitudinally.
- 8. Secure transversely oriented liner edges facing airstream with metal nosing that are either channel or "Z" profile or are integrally formed from duct wall at the following locations:
 - a. Fan discharge.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts.
- 9. Seal insulation edges.
- 10. Repair abrasions or tears with mastic.

2.11 DOUBLE WALL DUCTWORK

- A. General:
 - 1. Double wall duct system consisting of outer sheet metal pressure shell, internal sheet metal liner, with insulating material in annular space.
 - 2. Location: Provide where indicated on the Drawings or in Ductwork Schedule.
- B. Construction:
 - 1. Outer shell gauge shall be based upon actual outer shell dimensions.
 - 2. Inner liner secured to outer shell with mechanical fasteners that maintain metal liner distance from duct without compressing insulation.
 - 3. Inner liner: Same material as outer pressure shell, unless indicated otherwise.

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C. Insulation:

- 1. Void space between liner and outer pressure shell shall be filled with fiberglass insulation, material and installation in accordance with Article Rectangular Ductwork Insulation Liner.
- 2. Thickness: Minimum 1-inch(es) or greater thickness where indicated on the Drawings or Ductwork Schedule.
- 3. R-Value: Minimum 4.2 hours foot squared degrees F per Btu or greater, where indicated on the Drawings or Ductwork Schedule.
- D. Liner Terminations:
 - 1. Terminate internal liner with duct build-outs (metal hat sections) where double wall ductwork connects to single wall ductwork or to any uninsulated component.
 - 2. Secure build-outs to duct wall with bolts, screws, rivets, or welds.
 - 3. Terminate liner at fire dampers at connection to fire damper sleeve.

2.12 RIGID ROUND DUCTWORK

- A. Construct rigid round ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible and Round Industrial Duct Construction Standards, unless specified otherwise.
- B. Basic Round Diameter: As used in this Article, is inside diameter of size of round duct.
- C. Where space limitations prevent use of round duct or where shown on the Drawings, provide ductwork of flat oval construction hydraulically equivalent to round ductwork.
- D. Fabricate round ducts with spiral seam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams.
- E. Snaplock seams may only be used for duct systems of construction pressure classification less than 2-inch WC.

2.13 RIGID ROUND DUCTWORK FITTINGS

A. Construct rigid round ductwork fittings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible and Round Industrial Duct Construction Standards, unless otherwise specified.

- B. 90-Degree Tees, Laterals, and Conical Tees: Fabricate to conform to SMACNA manual with metal thicknesses specified for longitudinal seam straight duct.
- C. Diverging Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- D. Elbows:
 - 1. Fabricate in stamped (die-formed), pleated, or segmented (gored) construction 1.5 times elbow diameter. Two piece segment elbows are not allowed, except with turning vanes.
 - 2. Segmented Elbows: Fabricate with welded construction.
 - 3. Round Elbows 8 inches and Smaller:
 - a. Stamped elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees configuration.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 3-1/2 inches and 4-1/2 inches) elbows with segmented construction.
 - 4. Round Elbows 9 inches Through 14 inches:
 - a. Segmented or pleated elbows for 30, 45, 60, and 90 degrees.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 9-1/2 inches and 10-1/2 inches) elbows with segmented construction.

2.14 ROUND DUCTWORK BRANCH CONNECTIONS

- A. Branch duct connections (taps) to round duct mains shall be made using factory fabricated fittings.
- B. Field installed taps are not acceptable.

2.15 ROUND DUCTWORK INSULATION LINER

- A. Location: Provide round ductwork with internal insulation liner where indicated on the Drawings or in Ductwork Schedule.
- B. Material:
 - 1. Fiberglass, nominal 4.0-pcf density, K factor 0.23 maximum at 75 degrees F mean.
 - 2. Black composite coating on surface exposed to air stream, to prevent erosion of glass fibers.
 - 3. Suitable for temperatures up to 250 degrees F.
 - 4. Noise Reduction Coefficient: Minimum 0.75 for 1.0-inch thickness, in accordance with ASTM C423.

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- 5. Liquid water repellency rating not less than 4.0 when tested in accordance with INDA IST 80.6.
- 6. Potential heat value not exceeding 3,500 Btu per hour per pound when tested in accordance with NFPA 259 and meeting classification of "Limited Combustible" as defined by NFPA 90A.
- 7. Maximum rated velocity not less than 6,000 fpm when tested in accordance with ASTM C1071.
- 8. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C1139.
- 9. Manufacturers and Products:
 - a. CertainTeed.
 - b. Johns Manville; Spiracoustic Plus.
 - c. Knauf.
- C. Thickness: Minimum 1.0-inch or greater thickness where indicated on the Drawings or Ductwork Schedule.
- D. R-Value: Minimum 4.3 hour foot squared degrees F per Btu, or greater, where indicated on the Drawings or Ductwork Schedule.
- E. Liner Application:
 - 1. Install liner in accordance with manufacturer's instructions.
 - 2. In Straight Duct Sections: Apply at time of ductwork manufacture in an approved sheet metal workshop, or field install.
 - 3. In Duct Fittings: Apply at time of ductwork manufacture in an approved sheet metal workshop only.
 - 4. Install single layer of indicated thickness of duct liner. Multiple layers of insulation to achieve indicated thickness is prohibited.
 - 5. Fastening: Interference fit.
 - 6. Seal insulation edges.
 - 7. Repair abrasions or tears with mastic.

2.16 A: FIBERGLASS DUCTBOARD

- A. Fabricate in accordance with SMACNA Fibrous Glass Duct Construction Standards.
- B. One-inch-thick fiberglass ductboard with exterior vapor barrier.
- C. UL 181 Listed for 5,000 fpm velocity, with a factory applied, thermosetting, biocide treated acrylic polymer coating to airstream side.
- D. K equals 0.23 at 75 degrees F mean, and NRC of 0.80 as tested on Type A mounting.

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- E. Manufacturers and Products:
 - 1. Manville; Micro-Aire or Superduct.
 - 2. Owens-Corning; Type 1400-FR.

2.17 ROUND FIBERGLASS DUCT

- A. Fiberglass Thickness: 1-inch.
- B. One-piece construction with premolded slip joints, 6-foot sections.
- C. Scrim reinforced aluminum jacket on outside and acrylic coating on inside.
- D. K equals 0.23 at 75 degrees F mean and NRC of 0.80 as tested on Type A mounting.
- E. Fittings:
 - 1. Sheet metal wrapped with R-8 with FSK duct wrap, or fabricated as follows:
 - a. Miter and saddle cuts made with bandsaw.
 - b. Reducers cut with alligator notcher designed specifically for that purpose.
 - c. Gores: Glue with Miracle PF-96 or construction adhesive and seal with Therm-Lok closure.
- F. Manufacturer and Product: Manville; Super Round.

2.18 FIBERGLASS DUCTBOARD FITTINGS

- A. Round takeoffs from rectangular fiberglass duct shall be made with Twist-Lok fittings.
- B. Manufacturers:
 - 1. General Environment.
 - 2. Flexmaster.
 - 3. Gensco.

2.19 INSULATED FLEXIBLE DUCT

- A. Fabricate in accordance with:
 - 1. UL 181, Class 1.
 - 2. NFPA 90A and NFPA 90B.

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- B. Construction:
 - 1. Outer Jacket: Fire retardant reinforced metalized vapor barrier jacket with reinforced cross-hatched scrim having a permeance of not greater than 0.1 perm when tested in accordance with ASTM E96/E96M, Procedure A.
 - 2. Inner Liner: Tri-laminate of aluminum foil, fiberglass, and aluminized polyester.
 - 3. Reinforcing: Galvanized steel wire helix, mechanically locked to and encapsulated by inner liner fabric.
 - 4. Insulation:
 - a. Factory insulated with fiberglass insulation.
 - b. R-value: 6.0 minimum at a mean temperature of 75 degrees F.
 - 5. Internal Working Pressure: Rating shall be minimum 4-inch WC positive and 5-inch WC negative, with bursting pressure of at least 2-1/2 times working pressure.
 - 6. Air Velocity Rating: 4,000 fpm, minimum.
- C. Environment: Suitable for continuous operation at temperature range of minus 20 degrees F to plus 200 degrees F.
- D. Manufacturers and Products:
 - 1. Flex-Master; Type 5M.
 - 2. Thermaflex; Type M-KC.
 - 3. Hart & Cooley; Type F216.

2.20 HIGH TEMPERATURE FLEXIBLE DUCTWORK

- A. Metal flexible ductwork for high heat applications.
- B. Fully interlocked, stainless steel, 0.012-inch thickness.
- C. Manufacturer and Product: Flexonics; RT-6.

2.21 DUCTWORK HANGERS AND SUPPORTS

- A. General:
 - 1. Attachments, hangers, and supports for ductwork shall be in accordance with SMACNA Manual referenced for type of duct system being installed.
 - 2. Duct hanging system shall be composed of three elements; upper attachment to building, hanger itself, and lower attachment to duct.
 - 3. Wire hangers are not acceptable.

- 4. Hanger Spacing:
 - a. Ducts Up to 60 inches in Largest Dimension: 10 feet, maximum.
 - b. Ducts Over 61 inches in Largest Dimension: 8 feet, maximum.
- B. Construction Materials: Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:
 - 1. Galvanized Steel Ductwork:
 - a. Indoors: Carbon steel, zinc electroplated.
 - b. Outdoors: Carbon steel, hot-dipped galvanized after fabrication.
- C. Building Attachments:
 - 1. Concrete inserts, powder-actuated fasteners, or structural steel fasteners appropriate for building materials.
 - 2. Do not use powder-actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
 - 3. Upper Attachment (Concrete):
 - a. Drive pin fastener and expansion nail anchor may be used for ducts up to 18-inch maximum dimension.
 - b. Threaded stud fastener may be used for ducts up to 36-inch maximum dimension.
 - c. Concrete attachments shall be made of steel.
- D. Duct Fasteners: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials and conforming to requirements of Article Ductwork Fasteners.
- E. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36/A36M, hot-dipped galvanized after fabrication.

2.22 DUCTWORK FLEXIBLE CONNECTIONS

- A. General:
 - 1. Factory fabricated metal-edged fabric flexible connectors for commercial or industrial applications.
 - 2. Sheet metal permanently secured to fabric with double fabric fold, double metal crimp.
 - 3. Comply with NFPA 90A and NFPA 90B requirements.
 - 4. Airtight and waterproof.

- B. Materials:
 - 1. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
 - 2. Metal Edges: Construct from same material as ductwork, unless otherwise noted.
 - 3. Fabric:
 - a. Comply with NFPA 701 or UL 214 (except teflon coated).
 - b. Woven polyester or nylon for most applications.
 - c. Woven fiberglass for high temperature applications.
 - d. Coating: Vinyl, Neoprene, Hypalon, Silicone, or Teflon.
- C. Construction:
 - 1. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA Manual.
 - 2. Standard Metal Edged Connectors: Strip of fabric 3 inches wide attached to two strips of 3-inch-wide sheet metal.
 - 3. Wide Metal Edged Connectors: Strip of fabric 4 inches wide attached to two strips of 4-inch-wide sheet metal.
 - 4. Extra Wide Metal Edged Connectors: Strip of fabric 6 inches wide attached to two strips of 6-inch-wide sheet metal.
- D. Manufacturers:
 - 1. Ductmate; PROflex, Commercial.
 - 2. Ventfabrics.
 - 3. Duro-Dyne.

2.23 CEILING ACCESS DOORS

- A. Size: 24 inches by 24 inches.
- B. Finish in primer finish suitable for field painting.
- C. Manufacturers:
 - 1. Inryco Milcor.
 - 2. Krueger.

2.24 DUCT INSPECTION DOORS

- A. General:
 - 1. Insulated, gasketed, and at least 15 inches by 15 inches when duct dimensions are large enough.

- 2. On ductwork where largest side dimension is less than 16 inches, furnish inspection doors at least 8 inches by 8 inches.
- 3. Complete with necessary hardware and either Amerlock 10 or Ventlock No. 100 latches, and Ventlock Series No. 100 hinges.
- 4. Fabricated of same material as ductwork
- B. Round Spin-in Type Access Doors:
 - 1. Size: 18-inch and 24-inch diameter will be acceptable in lieu of comparable size square or rectangular access doors specified herein.
 - 2. Complete with insulation, spin-in frame, inner door, attachment cable, gaskets, three latches, and pull ring.
 - 3. Manufacturer and Product: Flexmaster; Inspector Series.
- C. Manufacturers:
 - 1. Ventlok.
 - 2. Duro-Dyne.
 - 3. Flexmaster.

2.25 MANUAL DAMPERS

- A. Butterfly Manual Dampers:
 - 1. Fabricate from two gauges heavier than duct in which installed, of same material as ductwork
 - 2. Align operating handle with damper blade.
 - 3. Provide 2-inch standoff bracket for insulated duct systems.
 - 4. Damper Manufacturers:
 - a. Ruskin.
 - b. American Warming and Ventilating.
 - 5. Operator Manufacturers:
 - a. Accessible Ductwork: Ventlok; Type 620 or 635.
 - b. Accessible Insulated Ductwork: Ventlok; Type 639.
 - c. Concealed Ductwork: Ventlok; Type 677 with extended operating rod and concealed regulator with plain cover.
- B. Manual Opposed-Blade Balancing Dampers:
 - 1. Externally operated gang airfoil, damper blades.
 - 2. Fabricate from same material as ductwork.
 - 3. Stainless steel or nylon sleeve bearings.
 - 4. Construction shall have interlocking edges and maximum 10-inch blade width.

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- 5. Manufacturers and Products:
 - a. Ruskin; CD102.
 - b. American Warming and Ventilating; Model VC-31.

2.26 CONTROL DAMPERS

A. Refer Section 23 09 13, HVAC Controls, Field Components, and Instruments, for requirements.

2.27 EXTERNAL DUCT INSULATION

A. Refer to Section 22 07 00, Plumbing Piping Insulation.

2.28 MISCELLANEOUS ACCESSORIES

- A. Louver and Grille Blank-Off Sections:
 - 1. Fabricate from 20-gauge sheets of same material as louver/grille.
 - 2. Line with sound attenuation/insulating material.
 - 3. Shop-prime and paint outside face of blank-off section with two coats of flat black exterior paint.
- B. Auxiliary Drain Pans:
 - 1. Dimensions: Minimum 6 inches larger in both dimensions than equipment it is serving and 2 inches high, minimum.
 - 2. Construction: 16-gauge stainless steel with welded joints. Pans shall be watertight and have hemmed edges.
 - 3. Drain Connection:
 - a. Minimum 1-inch IPS or as shown on the Drawings.
 - b. Locate at lowest point of drain pan.
 - c. In lieu of drain connection, float switch may be installed. Float switch shall shut down air handling equipment upon sensing water.
- C. Accessories Hardware:
 - 1. Instrument Test Holes:
 - a. Cast metal, material to suit duct material, including screw cap and gasket and flat mounting gasket.
 - b. Size to allow insertion of pitot tube and other testing instruments.
 - c. Provide in length to suit duct insulation thickness.
 - 2. Flexible Duct Clamps:
 - a. Stainless steel band with cadmium-plated hex screw to tighten band with worm-gear action.
 - b. Provide in sizes from 3 inches to 18 inches to suit duct size.

PW\JA\CITY OF PENSACOLA\D3754400 JUNE 10, 2024 ©COPYRIGHT 2024 JACOBS METAL DUCTS AND ACCESSORIES 23 31 13 - 19 3. Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline, and grease.

2.29 DUCTWORK IDENTIFICATION

- A. Painted Identification Materials:
 - 1. Stencils: Standard metal stencils, prepared for required applications with letter sizes generally comply with recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch high letters for ductwork and not less than 3/4-inch-high letters for access door signs and similar operational instructions.
 - 2. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray can form and grade.
 - 3. Identification Paint: Standard identification enamel of colors indicated or in accordance with ASME A13.1 for colors for systems not identified herein.
- B. Plastic Duct Markers
 - 1. General: Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color code:
 - a. Black text on yellow background: Odorous Air.
 - b. For other hazardous exhausts, use colors and designs recommended by ASME A13.1.
- C. Nomenclature: Include the following:
 - 1. Direction of air flow.
 - 2. Duct service (supply, return, exhaust).
- D. Manufacturers:
 - 1. W.H. Brady, Co.
 - 2. Seton Identification Products.
 - 3. Craftmark.
 - 4. Brimar Industries, Inc.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Miscellaneous:
 - 1. Install sheet metal ductwork and flexible ductwork in accordance with SMACNA Manual, NFPA 90A, and NFPA 90B.
 - 2. Install ductwork using manufacturer's recommended adhesives, cement, sealant, and insulation accessories.
 - 3. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth.
 - 4. Interface Between Ductwork and Louvers: At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be installed, sloped, and connected to louver so water entering ductwork system positively drains back to and out of louver.
- B. Ductwork Location:
 - 1. Locate ductwork runs vertically and horizontally, unless otherwise indicated.
 - 2. Avoid diagonal runs wherever possible.
 - 3. As indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment.
 - 4. In general, install as close to bottom of structure as possible.
 - 5. For ductwork concealed above ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.
 - 6. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 - 7. Ductwork that must transition and drop below piping or other ductwork shall be transitioned back to bottom of structure immediately adjacent to obstruction.
- C. Penetrations:
 - 1. Provide duct sleeves or prepared openings for duct mains, duct branches, and ducts passing through roofs, walls and ceilings.
 - 2. Clearances:
 - a. For uninsulated ducts, allow 1-inch clearance between duct and sleeve, except at grilles, registers, and diffusers.
 - b. For insulated ducts, allow 1-inch clearance between insulation and sleeve, except at grilles, registers, and diffusers.
 - 3. Closure Collars:
 - a. Minimum 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed.

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- b. Fit collars snugly around ducts and insulation.
- c. Same gauge and material as duct.
- d. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier.
- e. Use fasteners with maximum 6-inch centers on collars.
- 4. Packing: Mineral fiber in spaces between sleeve or opening and duct or duct insulation.
- D. Concealment:
 - 1. Wherever possible in finished and occupied spaces, conceal ductwork from view by locating in mechanical shafts, hollow wall construction, or above suspended ceiling.
 - 2. Do not encase horizontal runs in solid partitions, except as specifically shown.
 - 3. Limit clearance to 1-inch where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.
- E. Coordination with Other Trades:
 - 1. Coordinate duct installation with installation of accessories, dampers, coil frames, equipment, controls, and other associated work of ductwork system.
 - 2. Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on the Drawings.
 - 3. Coordinate ductwork layout with suspended ceiling, lighting and sprinkler head layouts and similar finished work.
 - 4. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.
- F. Shower Room and Toilet Room Exhaust Ductwork:
 - 1. Joints and Seams: Seal watertight.
 - 2. Slope branch ducts downward to grille.
- G. Fume Hood, Laboratory, and Chlorine Room Exhaust Ductwork:
 - 1. Seal joints and seams with chemical-resistant mastic.
 - 2. Rivet butt joints with minimum of eight pop rivets.

3.02 RECTANGULAR DUCTWORK

- A. General:
 - 1. Where possible, install ductwork so seams and joints will not be cut for installation of grilles, registers, or ceiling outlets.

- 2. If cutting of seams or joints is unavoidable, reinforce cut portion to original strength.
- B. Low Pressure Taps:
 - 1. Use bell mouth or conical fittings with integral locking quadrant damper. Spin-in fitting shall be sealed at duct tap with a gasket or sealed with sealant as specified for medium pressure ductwork.
 - 2. Determine location of spin-in after outlet location is determined.
 - 3. Fitting shall be securely attached to shaft to prevent damper from rotating around shaft.
- C. Fittings:
 - 1. Use bell-mouth or conical tee fittings for round duct takeoffs from rectangular mains.
 - 2. Use 45-degree entry fittings conforming to SMACNA requirements for rectangular takeoffs from rectangular or round mains.
 - 3. Make offsets with maximum angle of 45 degrees.
 - 4. Use fabricated fittings for changes in directions, changes in size and shape, and connections.
- D. Rectangular Ductwork Transverse Joints:
 - 1. Install each run with a minimum of joints.
 - 2. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
 - 3. Mechanical Joint Option:
 - a. Construct transverse joints with Ductmate 25/35 duct connector systems, Ductmate W.D.C.I. Heavy/Lite duct connector systems, or Ductlok J/E duct connector system. Slip-on duct flange connectors shall have integral sealant pocket with permanently flexible sealant.
 - b. When using Ductmate W.D.C.I. Heavy/Lite system, construct ductwork in accordance to the Ductmate W.D.C.I. Heavy J and Light H Assembly Manual and Duct Construction Standards.
 - c. When using Ductlok J/E duct connector system, construct ductwork in accordance with Ductlok's Rectangular Duct Construction Manual for Low, Medium, and High Pressure.
 - d. For longitudinal seams, use Pittsburgh lock seam sealed internally with permanently elastic sealer such as Ductmate 5511M mastic.
 - e. Conform to SMACNA Class A sealing requirements.

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3.03 RIGID ROUND OR OVAL DUCTWORK

- A. General: Except where interrupted by fittings, install round ducts in lengths as long as possible to minimize joints.
- B. Rigid Round or Oval Ductwork Joints:
 - 1. Rigid round ductwork joints shall be in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible or Round Industrial Duct Construction Standards, unless otherwise specified.
 - 2. Single and Double Wall Supply and Return System Joints:
 - a. Less than 36 inches: Slip coupling.
 - b. 36 Inches and Larger: Flanged connector, Van Stone, or welded companion flange type.
 - 3. Single and Double Wall Exhaust and Return System Joints:
 - a. Spiral Seam Duct: Welded flanged connector.
 - b. Longitudinal Seam Duct: Van Stone flange connector.

3.04 FIBERGLASS DUCTBOARD

- A. Grooves shall be modified ship-lap.
- B. Closure to be Therm-Lok or fiberglass fabric mesh and mastic.

3.05 INSULATED FLEXIBLE DUCT

- A. Installation:
 - 1. Where shown, between branch duct and ceiling diffusers and grilles.
 - 2. Without sags, kinks, sharp offsets, or elbows.
 - 3. As straight and taut as possible.
- B. Connection: Connect flexible ductwork to round collars, air distribution devices, and terminal units in accordance with flexible duct manufacturer's recommendations.
- C. Length: Maximum length of low-pressure flexible duct (construction pressure class up to 2-inch WC) to be 8 feet.
- D. Flexible ductwork shall not pass through wall, floor, or fire resistant rated assembly.

3.06 DUCTWORK HANGERS AND SUPPORTS

A. Install ductwork with support systems in accordance with SMACNA Manual, unless otherwise noted.

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- B. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape and to prevent buckling.
- C. Install additional bracing on ductwork as required, to prevent ballooning or breathing.
- D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- E. Support vertical ducts at maximum interval of 16 feet and at each floor.
- F. Upper attachments to structures shall have allowable load not exceeding 1/4 of failure (proof test) load, but are not limited to specific methods indicated.
- G. In new construction, install concrete insert prior to placing concrete.

3.07 FLEXIBLE CONNECTIONS

- A. Flexible Collars and Connections:
 - 1. Use between fans and ducts.
 - 2. For round ducts, securely fasten flexible connections by zinc-coated steel clinch-type draw bands.
 - 3. For rectangular ducts, lock flexible connections to metal collars.

3.08 DAMPERS

- A. General:
 - 1. Inspection:
 - a. Inspect areas to receive dampers.
 - b. Notify Engineer of conditions that would adversely affect installation or subsequent utilization of dampers.
 - c. Do not proceed with installation until unsatisfactory conditions are corrected.
 - 2. Install dampers at locations indicated on the Drawings and in accordance with manufacturer's installation instructions.
 - 3. Install square and level.
 - 4. Handle damper using sleeve or frame. Do not lift damper using blades or jack-shaft.
 - 5. Damper blades and hardware shall operate freely without obstruction.
 - 6. Damper blades and hardware that bind within frame or obstructed by adjacent construction will not be acceptable.
 - 7. When installed, damper frames shall be gasketed or caulked to eliminate leakage between duct and damper frames.
 - 8. Head and sill shall have stops.

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- 9. Suitable for installation in mounting arrangement shown.
- 10. Do not compress or stretch damper frame into duct or opening.

B. Manual Dampers:

- 1. Provide balancing dampers for grilles and diffusers as indicated on the Drawings in branch duct as near main as possible.
- 2. Add or remove balancing dampers as requested by air balancing firm for necessary control of air.
- C. Back Draft Dampers:
 - 1. Install dampers square and free from racking with blades running horizontally.
 - 2. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.
- D. Fire Dampers:
 - 1. At ceiling grille and diffuser fire dampers, provide thermal blankets where required by local authorities.
 - 2. Install 1-1/2-hour rated, unless otherwise indicated, at locations shown and in accordance with SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.

3.09 ACCESS DOORS

- A. Ductwork: Install access doors in ductwork, in accordance with manufacturer's instructions, at each:
 - 1. Volume damper.
 - 2. Automatic damper.
 - 3. Coil, on both upstream and downstream side.

3.10 EXTERNAL DUCT INSULATION

A. Refer to Section 22 07 00, Plumbing Piping Insulation.

3.11 MISCELLANEOUS ACCESSORIES

- A. Auxiliary Drain Pans:
 - 1. Under equipment for which pan is shown on the Drawings and under all horizontal air handling units located above ceilings and piping located in ceiling space directly above computer facility areas; furnish and install auxiliary drain pans.

- 2. Route drain lines to nearest floor or hub drain independent of any other drain.
- 3. Slope drain pans toward drain connection to promote drainage.
- B. Louver and Grille Blank-Off Sections: Attach airtight to louver or grille and install to allow for easy removal.
- C. Inspection Plates and Test Holes:
 - 1. Where required in ductwork for balance measurements.
 - 2. Test holes shall be airtight and noncorrosive with screw cap and gasket.
 - 3. Extend cap through insulation.

3.12 DUCT SEALING

- A. Seal duct seams and joints as follows:
 - 1. In accordance with SMACNA requirements as indicated on Ductwork Schedule.
 - 2. In accordance with the following:
 - a. Pressure Classification Less than 2-Inch WC: Transverse joints only.
- B. If no specific duct sealing requirements are specified, requirements of SMACNA manual shall govern.
- C. Seal externally insulated ducts prior to insulation installation.
- D. Provide additional duct sealing as required to comply with Article Ductwork Leakage Testing.
- E. Seal all audible leaks.

3.13 DUCTWORK LEAKAGE TESTING

- A. General:
 - 1. Tests shall be conducted on completed ductwork systems.
 - 2. Testing of partial installations or limited sections of ductwork will not be acceptable.
 - 3. All ductwork leakage test procedures and results shall be submitted to Engineer for review.
 - 4. Engineer shall retain the right to witness some or all ductwork leakage testing procedures.
 - 5. Contractor shall notify Engineer in writing at least 5 working days prior to ductwork testing.

- B. Leakage Criteria:
 - 1. Assemble and install ductwork with maximum leakage limited as follows:
 - 2. Constant Volume Systems:
 - a. Supply Ductwork:
 - 1) Operating Pressure: 0- to 2-inch WC.
 - a) Allowable Leakage: 2 percent of design airflow.
 - b. Return Ductwork:
 - 1) Operating Pressure: All.
 - 2) Allowable Leakage: 2 percent of design airflow.
- C. Leakage Testing Method:
 - 1. Contractor shall be responsible for providing all necessary test fans and calibrated measuring devices to accomplish ductwork leakage test and to demonstrate that ductwork systems leakage rate is less than maximum rate specified.
 - 2. Pressure testing shall be accomplished using a pressure blower with a calibrated orifice and manometer.
 - 3. Blower shall maintain system design static pressure during test.
 - 4. Perform testing in accordance with procedures given in SMACNA HVAC Air Duct Leakage Test Manual.

3.14 BALANCING OF AIR SYSTEMS

A. Perform air balancing in accordance with requirements of Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.15 PROTECTION OF INSTALLED WORK

- A. Open ends of installed ductwork systems shall be covered to prevent dust, foreign objects and water from entering ductwork.
- B. Ductwork systems shall not be used for air conveyance until adequate air filtration devices are installed in air handling equipment, to prevent ingress of construction dust.

3.16 CLEANING

- A. Ductwork shall be cleaned of rust, dust, and debris, both internally and externally, before placing in operation.
- B. Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.

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C. If duct systems are found to contain construction debris at time of construction completion Contractor shall provide complete ductwork system cleaning in accordance with NADCA Standards.

3.17 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this Specification:
 - 1. Section 23 31 13.01, Schedules for HVAC: See the Drawing for schedules.

END OF SECTION

SECTION 23 34 00 HVAC FANS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Acoustical Society of America (ASA): S2.19, Mechanical Vibration— Balance Quality Requirements of Rigid Rotors—Part 1, Determination of Permissible Residual Unbalance.
 - 2. Air Movement and Control Association International (AMCA):
 - a. 99, Standards Handbook.
 - b. 201, Fans and Systems.
 - c. 203, Field Performance Measurement of Fan Systems.
 - d. 204, Balance Quality and Vibration Levels for Fans.
 - e. 210, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
 - f. 300, Reverberant Room Method for Sound Testing of Fans.
 - g. 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 3. American Bearing Manufacturers Association (ABMA): 9, Load Ratings and Fatigue Life for Ball Bearings.
 - 4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 5. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - c. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - d. D3363, Standard Test Method for Film Hardness by Pencil Test.
 - e. D4167, Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. National Electrical Manufacturers Association (NEMA).
 - 7. National Fire Protection Association (NFPA): 45, Standard on Fire Protection for Laboratories Using Chemicals.
 - 8. Occupational Safety and Health Act (OSHA).

- 9. Society for Protective Coatings (SSPC):
 - a. SP 3, Power Tool Cleaning.
 - b. SP 5, White Metal Blast Cleaning.
 - c. SP 6, Commercial Blast Cleaning.
 - d. SP 10, Near-White Blast Cleaning.
- 10. UL: 507, Safety Standard for Electric Fans.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. AC: Alternating Current.
 - 2. CISD: Chemical Industry, Severe-Duty.
 - 3. dB: Decibel.
 - 4. DWDI: Double Width, Double Inlet.
 - 5. FRP: Fiberglass Reinforced Plastic.
 - 6. hp: Horsepower.
 - 7. ODP: Open Drip Proof.
 - 8. SWSI: Single Width, Single Inlet.
 - 9. TEFC: Totally Enclosed, Fan Cooled.
 - 10. UV: Ultra Violet
 - 11. XP: Explosion Proof.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Provide following for specified products:
 - a. Identification as referenced in Contract Documents.
 - b. Manufacturer's name and model number.
 - c. Descriptive specifications, literature, and drawings.
 - d. Dimensions and weights.
 - e. Fan sound power level data (reference 10 to power minus
 - 12 watts) at design operating point.
 - f. Fan Curves:
 - 1) Performance Curves Indicating:
 - a) Relationship of flow rate to static pressure for various fan speeds.
 - b) Brake horsepower curves.
 - c) Acceptable selection range (surge curves, maximum revolutions per minute).
 - d) Static pressure, capacity, horsepower demand and overall efficiency required at duty point, including drive losses.

- 2) For variable air volume applications, indicate operating points at 100, 80, 60 and 40 percent of design capacity on fan curves including data to indicate effect of capacity control devices such as inlet vanes on flow, pressure, and brake horsepower.
- g. Capacities and ratings.
- h. Construction materials.
- i. Fan type, size, class, drive arrangement, discharge, rotation, and bearings.
- j. Wheel type, diameter, maximum revolutions per minute for fan class, operating revolutions per minute, and tip speed.
- k. Motor data, including service factor and operating horsepower.
- 1. Fan shaft first critical speed.
- m. Belt service factor.
- n. Drive assembly horsepower rating.
- o. Sheave horsepower rating.
- p. Power and control wiring diagrams, including terminals and numbers.
- q. Factory run test and vibration test reports.
- r. Vibration isolation.
- s. Factory finish system.
- t. Color selection charts where applicable.
- 2. "Or-equal" Equipment:
 - a. Where submitted equipment results in change to fan inlet or outlet ductwork configuration shown on the Drawings, submit system effect factor calculations indicating increased static pressure requirements as described in AMCA 201.
 - b. Where submitted equipment results in change to ductwork and equipment configuration shown on the Drawings, submit detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement to equipment furnished.
- B. Informational Submittals:
 - 1. Recommended procedures for protection and handling of products prior to installation.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
 - a. Motors specified to be premium efficient type.
 - b. FRP fans.
 - 4. Test reports.
 - 5. Operation and maintenance data including as-built version of equipment schedules.

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C. LEED Submittals:

- 1. Equipment and materials for Ticketing Building and Toilet Building.
- 2. Engineer reserves right to reject products and assemblies based on incomplete or noncompliance with LEED certification requirements.
- 3. Documentation required indicating compliance with Optimize Energy Performance—EA Credit 1.
- 4. Documentation required indicating compliance with Minimum IAQ Performance—EQ Prerequisite 1.
- 5. Documentation required indicating compliance with Low-Emitting Materials, Adhesives and Sealants—EQ Credit 4.1.

1.04 QUALITY ASSURANCE

- A. Performance Ratings: Tested in accordance with AMCA 210.
- B. Sound Ratings: Tested in accordance with AMCA 300.
- C. Fabrication: In accordance with AMCA 99.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULES

A. Some specific equipment requirements are listed in Equipment Schedule. Refer to the Drawings.

2.02 GENERAL

- A. Acoustical Levels: Equipment selections shall produce sound power levels in each octave band no greater than shown in Equipment Schedule.
- B. Fan Drives:
 - 1. Drive assembly shall be sized for a minimum 140 percent of fan motor horsepower rating.
 - a. Capable of providing 150 percent of motor horsepower.
 - 2. Drive Adjustment:
 - 3. Fan Shafts: First critical speed of at least 125 percent of fan maximum operating speed.
 - 4. Provide speed test openings at shaft locations.
 - 5. Motors:
 - a. Motors 20 hp or Smaller:
 - 1) Variable pitch V-belt sheaves allowing at least 20 percent speed variation.

- 2) Final operating point shall be at approximate sheave midpoint.
- 6. Weather Cover: For outdoor applications, factory fabricated drive assembly of same material as fan housing, unless specified otherwise.
- 7. Belt and Shaft Guards:
 - a. Easily removable and to enclose entire drive assembly, meeting federal, OSHA and State of Florida requirements.
 - b. Guard faces of expanded metal having minimum 60 percent free area for ventilation.
 - c. Bright yellow finish.
- C. Finishes:
 - 1. Carbon Steel Parts: Factory finish as follows, unless indicated otherwise.
 - a. Parts cleaned and chemically pretreated with phosphatizing process.
 - b. Alkyd enamel primer.
 - c. Air dry enamel topcoat.
 - 2. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
 - 3. Stainless Steel Parts: Finished smooth and left unpainted.
 - 4. Fiberglass Parts: Finished in accordance with Paragraph Fiberglass Material.

2.03 CABINET FAN

- A. General:
 - 1. Factory-assembled, ceiling, wall or inline mounted, centrifugal cabinet fan; including housing, fan wheel, drive assembly, motor and accessories.
 - 2. Bearing AMCA Certified Ratings Seal for sound and air performance.
- B. Housing:
 - 1. Material: Minimum 20-gauge galvanized steel.
 - 2. Construction:
 - a. Minimum 14-gauge blower and motor support frame.
 - b. Lined with minimum 1/2-inch acoustical insulation.
 - c. Outlet duct collar with integral reinforced aluminum backdraft damper, with nylon bushings.
 - d. Motor mounted on resilient vibration isolators.
 - e. Motor and blower removable from unit without cabinet disassembly.
 - f. Removable cabinet access panels.

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- g. Air Inlet: Field convertible for bottom or end air inlet configuration.
- h. Predrilled universal mounting brackets, adjustable.
- C. Wheel: Centrifugal forward curved type, galvanized steel or plastic construction.
- D. Shaft, Bearings, Drive:
 - 1. Shafts: Turned, ground and polished carbon steel.
 - 2. Bearings: Grease lubricated, precision antifriction ball, sealed type.
 - 3. Drives:
 - a. In accordance with Paragraph Fan Drives.
 - b. Factory set to specified fan revolutions per minute.
 - c. Type: Direct.

E. Electrical:

- 1. Integral wiring box.
- 2. Factory-installed disconnect receptacle.
- F. Accessories: Provide as scheduled in Equipment Schedule.
- G. Manufacturers and Products:
 - 1. Greenheck.

2.04 CORROSION PROTECTION COATING

- A. General:
 - 1. Factory-applied corrosion protection coating for application to fan components and accessories, where required by this section.
 - 2. Quality Control:
 - a. Verify dry film thickness before final baking.
 - b. Finished coating system shall be free from voids, checks, cracks, and blisters.
 - 3. Surface Cleaning: Clean parts to be coated as follows:
 - a. Immerse parts in heated cleaning solution to remove lubricants, machining oils, and residual factory contamination.
 - b. Follow with immersion in potable water bath to neutralize and remove cleaning solution.
 - c. Chemical Pretreatment: Immerse parts in heated chemical solution, iron phosphate for steel, clear/yellow chromate for aluminum.

- B. Baked Enamel:
 - 1. Material: Alkyd modified urea-melamine single component baking enamel.
 - 2. Surface Preparation: Clean surface to SSPC SP 3.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Oven baked at a metal temperature not to exceed 300 degrees F.
 - 5. Finished Thickness: 1-mil to 2-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Impact Resistance: 10-inch pounds, ASTM D2794 test method.
 - b. Pencil Hardness: 2H, ASTM D3363 test method.
 - c. Service Temperature: Maximum 230 degrees F, continuous.
- C. Baked Polyester:
 - 1. Material: Polyester.
 - 2. Surface Preparation: Sandblast surface to SSPC SP 5.
 - 3. Application: Electrostatic spray.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Finished Thickness: 1.5-mil to 2.5-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
 - d. Pencil Hardness: 2H, ASTM D3363 test method.
 - e. Service Temperature: Maximum 230 degrees F, continuous.
- D. Air-Dry Epoxy:
 - 1. Material: Two-part catalyzed epoxy.
 - 2. Surface Preparation: Clean surface to SSPC SP 3.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Air dry.
 - 5. Finished Thickness: 4-mil to 6-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,500-hour duration, ASTM B117 test method.
 - b. Pencil Hardness: H-2H, ASTM D3363 test method.
 - c. Service Temperature: Maximum 150 degrees F, continuous.
- E. Baked Epoxy:
 - 1. Material: Epoxy.
 - 2. Surface Preparation: Sandblast surface to SSPC SP 10.

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ROGER SCOTT POOL FACILITIES

- 3. Application: Electrostatic spray.
- 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
- 5. Finished Thickness: 2.5-mil to 3.5-mil dry film thickness.
- 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
 - d. Pencil Hardness: 2H, ASTM D3363 test method.
 - e. Service Temperature: Maximum 230 degrees F, continuous.
- F. Air Dry Phenolic:
 - 1. Material:
 - a. Phenolic resin, Heresite VR-500 Series "Or-equal."
 - b. For outdoor applications, apply an UV resistant topcoat, Heresite UC-5500 "Or-equal."
 - 2. Surface Preparation: Sandblast surface to SSPC SP 6.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Air dry.
 - 5. Finished Thickness: 4-mil to 6-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 500-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 500-hour duration, ASTM D2247 test method.
 - c. Service Temperature: Maximum 180 degrees F, continuous.
- G. Baked Phenolic:
 - 1. Material: Phenolic resin, Heresite P-403 "Or-equal."
 - 2. Surface Preparation: Sandblast surface to SSPC SP 5.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Finished Thickness: 5-mil to 7-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
 - d. Pencil Hardness: 2H, ASTM D3363 test method.
 - e. Service Temperature: Maximum 250 degrees F, continuous.

- H. Baked Epoxy Phenolic:
 - 1. Material:
 - a. Baking cross-linked epoxy-phenolic.
 - b. For outdoor applications, apply an UV-resistant topcoat.
 - 2. Surface Preparation: Sandblast surface to SSPC SP 5.
 - 3. Application: Electrostatic or conventional compressed air spray equipment.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Finished Thickness: 6-mil to 8-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - c. Impact Resistance: 160-inch pounds, ASTM D2794 test method.
 - d. Pencil Hardness: 3H, ASTM D3363 test method.
 - 7. Service Temperature: Maximum 350 degrees F, continuous.

2.05 MOTORS

- A. General:
 - 1. Provide integral self-resetting overload protection on single-phase motors.
 - 2. Motors for fans specified for use with variable frequency drives shall be inverter duty type.
 - 3. Motors shall not operate into service factor in any case.
- B. Motor requirements shall be as follows, unless designated otherwise on Equipment Schedule:
 - 1. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - 2. Winding Thermal Protection: None.
 - 3. Space Heater: No.
 - 4. Number of Speeds: Single.
 - 5. Number of Windings: One.
 - 6. Motor Efficiency: Energy efficient.
 - 7. Shaft Type: Solid, carbon steel.
 - 8. Mounting: As required for fan arrangement.
 - 9. Service Factor: 1.15.

2.06 ACCESSORIES

- A. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear engraved or diestamped black enamel filled equipment identification number and letters indicated in this Specification and as shown on the Drawings.
- B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

2.07 SOURCE QUALITY CONTROL

- A. General:
 - 1. Fan shall operate at single stable point as indicated by fan curve. Fans having two potential operating points are not acceptable.
 - 2. Fan and motor combination shall be capable of delivering 110 percent of scheduled air quantity and static pressure. Motor shall not operate into motor service factor in any listed case.
 - Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA 203, Appendix L.
- B. Testing Provisions:
 - 1. Provide tachometer access holes large enough to accept standard tachometer drive shaft.
 - 2. Center punch fan shaft to accommodate tachometer readings.
- C. Acoustical Levels:
 - 1. Perform noise tests in accordance with AMCA 300 and AMCA 301.
 - 2. Fan sound power levels (dB, Reference 10⁻¹² Watts) shall be no greater than scheduled values.
- D. Balancing:
 - 1. Unless noted otherwise, each fan wheel shall be statically and dynamically balanced to ASA S2.19 Grade G6.3.
 - 2. Fans controlled by variable frequency drives shall be dynamically balanced at speeds 25 percent, 50 percent, 75 percent, and 100 percent of design revolutions per minute.

- E. Vibration Test:
 - 1. Each fan furnished with 5-horsepower or larger motor shall have factory run vibration test, including vibration signatures taken on each bearing in horizontal, vertical, and axial direction.
 - 2. Vibration reading as measured at scheduled rotational speed shall not exceed the following values when fan is rigidly mounted:
 - a. Belt Drive (except Vane Axial): 0.15-inch per second peak velocity.
 - b. Belt Drive Vane Axial: 0.08-inch per second peak velocity.
 - c. Direct Drive: 0.08-inch per second peak velocity.
 - 3. Written records of run test and vibration test shall be made available upon request.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fans level and plumb.
- B. Secure roof-mounted fans to roof curbs with cadmium-plated steel Type 316 stainless steel hardware.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Scroll Drains: Pipe drain connection through running trap to floor drain.
- E. Labeling:
 - 1. Label fans in accordance with Article Accessories.
 - 2. Mark exhaust fans serving fume hoods with arrows to indicate proper direction of rotation, in accordance with NFPA 45.
- F. Service Access: Locate units to provide access spaces required for motor, drive, bearing servicing, and fan shaft removal.
- G. Equipment Support and Restraints:
 - 1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.
 - 2. Seismic Restraint Snubbers: Install with sufficient clearance so unit isolators are not restricted for proper free isolation, but do limit movement in all directions.
- H. Connections:
 - 1. Refer to Section 23 31 13, Metal Ducts and Accessories.
 - 2. Isolate duct connections to fans.
 - 3. Install ductwork adjacent to fans to allow proper service and maintenance.

3.02 FIELD QUALITY CONTROL

- A. Functional Tests:
 - 1. Verify blocking and bracing used during shipping are removed.
 - 2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.
 - 3. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 4. Verify cleaning and adjusting are complete.
 - 5. Disconnect fan drive from motor; verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.
 - 6. Reconnect fan drive system; align and adjust belts and install belt guards.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify manual and automatic volume control and fire and smoke dampers in connected ductwork are in fully open position.
- B. Performance Tests:
 - 1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated revolutions per minute.
 - b. Measure and record motor voltage and amperage.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.

3.03 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

D. Balancing:

- 1. Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- 2. Replace fan and motor sheaves as required to achieve design airflow.

E. Vibration Testing:

- 1. Perform field testing on rotating equipment, where specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC, to determine actual operating vibration.
- 2. If vibration limits described therein are exceeded, rebalance equipment in-place until design tolerances are met.
 - a. Vibration readings as measured at actual rotational speed shall not exceed the following values:
 - 1) Belt Drive, Flexibility Mounted: 0.25-inch per second peak velocity.
 - 2) Belt Drive, Rigidly Mounted: 0.16-inch per second peak velocity.

3.04 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. On completion of installation, internally clean fans according to manufacturers' written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

END OF SECTION

SECTION 23 34 05 ODOR CONTROL FANS

PART 1 GENERAL

1.01 EQUIPMENT NUMBERS

A. Odor Control Fan(s): EF-1, EF-3, and EF-4.

1.02 GENERAL

- A. Like items of equipment provided hereunder shall be the end products of one manufacturer to achieve standardization for operation, maintenance, spare parts, and manufacturers' services.
- B. Air flow balancing requirements: Conform to requirements of Section 23 05 93 Testing, Adjusting and Balancing for HVAC and Odor Control.

1.03 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Acoustical Society of America (ASA): S2.19, Mechanical Vibration— Balance Quality Requirements of Rigid Rotors—Part 1, Determination of Permissible Residual Unbalance.
 - 2. Air Movement and Control Association International (AMCA):
 - a. 99, Standards Handbook.
 - b. 99-0401 Classifications of Spark Resistant Construction.
 - c. 201, Fans and Systems.
 - d. 203, Field Performance Measurement of Fan Systems.
 - e. 210, Laboratory Methods of Testing Fans for Rating.
 - f. 300, Reverberant Room Method for Sound Testing of Fans.
 - g. 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - h. 99-2408, Operating Limits for Centrifugal Fans.
 - 3. American Bearing Manufacturers Association (ABMA): 9, Load Ratings and Fatigue Life for Ball Bearings.
 - 4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): HVAC Applications Handbook.
 - 5. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

- b. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
- c. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- d. D3363, Standard Test Method for Film Hardness by Pencil Test.
- e. D4167, Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.
- f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- 6. National Electrical Manufacturers Association (NEMA).
- 7. Occupational Safety and Health Act (OSHA).
- 8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Seismic Restraint Manual: Guidelines for Mechanical Systems.
- 9. Society for Protective Coatings (SSPC):
 - a. SP 3, Power Tool Cleaning.
 - b. SP 5, White Metal Blast Cleaning.
 - c. SP 6, Commercial Blast Cleaning.
 - d. SP 10, Near-White Blast Cleaning.
- 10. UL: 507, Electric Fans.
- 11. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

1.04 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. AC: Alternating Current.
 - 2. CISD: Chemical Industry, Severe-Duty.
 - 3. dB: Decibel.
 - 4. FRP: Fiberglass Reinforced Plastic.
 - 5. hp: Horsepower.
 - 6. ICCES: International Code Council Evaluation Services
 - 7. SWSI: Single Width, Single Inlet.
 - 8. TEFC: Totally Enclosed, Fan Cooled.
 - 9. UV: Ultraviolet.
 - 10. XP: Explosion Proof.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Provide for all products specified, as follows:
 - a. Identification as referenced in Contract Documents.
 - b. Manufacturer's name and model number.

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- c. Descriptive specifications, literature, and drawings.
- d. Dimensions and weights.
- e. Fan sound power level data (reference 10 to power minus 12 Watts) at design operating point.
- f. Fan Curves:
 - 1) Performance curves at design point indicating:
 - a) Curve showing relationship of flow rate to static pressure.
 - b) Brake horsepower curves.
 - c) Acceptable selection range (surge curves, maximum revolutions per minute).
 - d) Static pressure, capacity, horsepower demand and overall efficiency required at the duty point, including any estimated drive losses.
 - e) Fan wheel revolutions per minute and tip speed.
- g. Construction materials, including statement of resins and reinforcing proposed for use.
- h. Fan type, wheel type, wheel diameter, wheel maximum safe speed, size, class, drive arrangement, discharge, rotation, and bearing type.
- i. Vibration isolation.
- j. Factory finish system.
- k. Color selection charts where applicable.
- 1. Corrosion protection coating product data.
- m. Fan shaft first critical speed.
- n. Drive assembly horsepower rating.
- 2. Equipment anchorage and support drawings or cut sheets indicating size, material, spacing, embedment and edge distances of anchors and other relevant information. The Drawings should reflect the results of the calculations submitted below.
- 3. "Or-equal," approved Equipment:
 - a. Where submitted equipment results in change to fan inlet or outlet ductwork configuration shown on the Drawings, submit system effect factor calculations indicating increased static pressure requirements as described in AMCA 201.
 - b. Where submitted equipment results in change to ductwork and equipment configuration shown on the Drawings, submit detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement to equipment furnished.
- B. Informational Submittals:
 - 1. Recommended procedures for protection and handling of products prior to installation.

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- 2. Manufacturer's installation instructions.
- 3. Factory Test reports: Factory run test, dynamic balancing, performance test, sound test.
- 4. Operation and maintenance data including as-built version of equipment drawings and schedules.
- 5. Support and anchorage calculations stamped by an Engineer licensed in the State of project location. Anchorage, bracing and support design criteria and calculations shall conform to the manufacturer's requirements as well as design criteria indicated on the Structural General Notes on the Drawings and any other referenced standards. Provide ICC-ES reports and special inspection requirements for anchors to be drilled and installed into completed concrete or masonry. Anchor calculations shall indicate edge distance, embedment, concrete thickness and strength, and other conditions assumed in the design calculations. Verify field conditions prior to installation of the anchors and bracing.

1.06 QUALITY ASSURANCE

- A. Performance Ratings: Fan performance in accordance with AMCA 210.
- B. Sound Ratings: Rated in accordance with AMCA 300.
- C. Fabrication: In accordance with AMCA 99.

1.07 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:

Item	Quantity
Fan/motor shaft coupling	One per fan size
Fan shaft seal	One per fan size
Special tools required to maintain or dismantle	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

- 2.01 EQUIPMENT SCHEDULES
 - A. Some specific equipment requirements are listed in Equipment Schedules as shown on the Drawings.

ODOR CONTROL FANS 23 34 05 - 4

2.02 PERFORMANCE REQUIREMENTS

- A. Fan shall operate at single stable point as indicated by fan curve. Duty point shall be at least 10 percent below the crest of the fan curve.
- B. Fan shall operate at a speed not greater than 90 percent of the maximum safe speed at selected design point.
- C. Fan and motor combination shall be capable of operating at 105 percent of Supplier's selected speed at design point. Motor shall not operate into motor service factor over the published range of flow at this higher speed.
- D. Where inlet box is used, provide fan curves inclusive of inlet box losses.

2.03 NAMEPLATES

A. Units shall include factory installed permanently attached nameplate displaying unit model and serial number.

2.04 OPERATING LIMITS

A. Fans designated to meet a specified fan class shall comply with requirements of AMCA 99-2408.

2.05 ACOUSTICAL LEVELS

A. Equipment selections shall produce sound power levels in each octave band no greater than shown in Equipment Schedule.

2.06 FINISHES

- A. Carbon Steel Parts (including vibration isolation, unitary base, and seismic control devices): Factory finished in accordance with Article Corrosion Protection Coating.
- B. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
- C. Stainless Steel Parts: Finished smooth and left unpainted.
- D. Fiberglass Parts: Finished in accordance with Paragraph Fiberglass Material.

2.07 CORROSION PROTECTION COATING

- A. General:
 - 1. Provide factory-applied corrosion protection coating on fan steel components.

- 2. Coating system shall be baked enamel, air-dry epoxy, or baked epoxy.
- 3. Color shall be factory standard otherwise noted.
- 4. Quality Control:
 - a. Verify dry film thickness before final baking.
 - b. Finished coating system shall be free from voids, checks, cracks, and blisters.
- 5. Surface Cleaning:
 - a. Clean parts to be coated as follows:
 - 1) Immerse parts in heated cleaning solution to remove lubricants, machining oils, and residual factory contamination.
 - 2) Follow with immersion in potable water bath to neutralize and remove cleaning solution.
 - 3) Chemical Pretreatment: Immerse parts in heated chemical solution, iron phosphate for steel, clear/yellow chromate for aluminum.
- B. Baked Enamel:
 - 1. Material: Alkyd modified urea-melamine single component baking enamel.
 - 2. Surface Preparation: Clean surface to SSPC-SP 3.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Oven baked at a metal temperature not to exceed 300 degrees F.
 - 5. Finished Thickness: 1-mil to 2-mil dry film thickness.
 - 6. Performance:
 - a. Coating shall meet or exceed following criteria:
 - 1) Impact Resistance: 10-inch pounds, ASTM D2794 test method.
 - 2) Pencil Hardness: 2H, ASTM D3363 test method.
 - 3) Service Temperature: Maximum 230 degrees F, continuous.
- C. Air-Dry Epoxy:
 - 1. Material: Two-part catalyzed epoxy.
 - 2. Surface Preparation: Clean surface to SSPC-SP 3.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Air dry.
 - 5. Finished Thickness: 4-mil to 6-mil dry film thickness.
 - 6. Performance:
 - a. Coating shall meet or exceed following criteria:
 - 1) Salt Spray Test: Minimum 1,500-hour duration, ASTM B117 test method.
 - 2) Pencil Hardness: H-2H, ASTM D3363 test method.
 - 3) Service Temperature: Maximum 150 degrees F, continuous.

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- D. Baked Epoxy:
 - 1. Material: Epoxy.
 - 2. Surface Preparation: Sandblast surface to SSPC-SP 10.
 - 3. Application: Electrostatic spray.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Finished Thickness: 2.5-mil to 3.5-mil dry film thickness.
 - 6. Performance:
 - a. Coating shall meet or exceed following criteria:
 - 1) Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - 2) Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - 3) Impact Resistance: 100-inch pounds, ASTM D2794 test method.
 - 4) Pencil Hardness: 2H, ASTM D3363 test method.
 - 5) Service Temperature: Maximum 230 degrees F, continuous.

2.08 MOTORS

A. Motors shall not operate into service factor in any case.

2.09 SOURCE QUALITY CONTROL

- A. General:
 - 1. Factory run test and wheel dynamic balance for each fan.
 - 2. Factory test, performance test, and sound test for each fan.
- B. Acoustical Levels: Fan sound power levels (dB, Reference 10⁻¹² Watts) shall be no greater than scheduled values.
- C. Balancing: Unless noted otherwise, each fan wheel shall be statically and dynamically balanced to ASA S2.19 Grade G6.3.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fans level and plumb.
- B. Scroll Drains: Pipe drain connection through P-trap to drain location as indicated on the Drawings.
- C. Labeling: Label fans in accordance with Article Accessories.

- D. Service Access: Locate units to provide access spaces required for motor, bearing servicing, and fan wheel/shaft removal.
- E. Equipment Support and Restraints:
 - 1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.
 - 2. Seismic Restraint Snubbers: Install with sufficient clearance so unit isolators are not restricted for proper free isolation but do limit movement in all directions.
- F. Connections: Connect fan housing grounding connection to suitable ground.

3.02 FIELD QUALITY CONTROL

- A. Functional Tests:
 - 1. Verify blocking and bracing used during shipping are removed.
 - 2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.
 - 3. Verify proper thermal-overload protection is installed for motors, starters, and disconnect switches.
 - 4. Verify that cleaning and adjusting are complete.
- B. Performance Tests:
 - 1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated revolutions per minute.
 - b. Measure and record motor voltage and amperage.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.
 - 3. Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
 - 4. Test each fan to verify design air flow rates as specified.
 - 5. Adjust fan speed as required to achieve design airflow.
 - 6. Document the fan operating speed and static pressure at each fan inlet and discharge at the design flow rate.

3.03 ADJUSTING

A. Lubricate bearings.

ODOR CONTROL FANS 23 34 05 - 8 B. Balancing: Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.04 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. On completion of installation, internally clean fans according to manufacturers' written instructions. Remove foreign material and construction debris.

3.05 SUPPLEMENTS

- A. The supplement listed below, following "End of Section," is a part of this Specification.
 - 1. Schedule: See the Drawing for schedule.

END OF SECTION

SECTION 23 37 00 AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 880, Air Terminals.
 - 2. ASTM International (ASTM): C636/C636M, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - 3. UL.

1.02 DEFINITIONS

- A. NC: Noise Criteria; background sound rating method for indoor sound.
- B. VAV: Variable air volume.
- C. WC: Water column.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Manufacturer's data and descriptive literature for products specified.
 - b. Furnish the following information for each type of diffuser, register, and grille furnished.
 - 1) NC sound data.
 - 2) Static pressure loss data.
 - 3) Throw data.
 - 2. Samples: Finish color samples.

PART 2 PRODUCTS

- 2.01 EQUIPMENT SCHEDULES
 - A. Refer to the Drawings.

2.02 CEILING DIFFUSERS

- A. Louvered Face Diffusers CD-1, CD-2, CD-3, and CD-4:
 - 1. Construction: Refer to Equipment Schedule.
- B. Perforated Face Diffusers RD-1:
 - 1. Construction: Refer to Equipment Schedule.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Refer to architectural reflected ceiling plans for coordination of locations of ceiling-mounted air outlets and inlets with ceiling grids and lighting. Where locations of devices shown on mechanical drawings do not agree with locations that are shown on architectural reflected ceiling plans, reflected ceiling plans shall take precedence. If air outlets or inlets are shown on mechanical drawings, but are not shown on architectural reflected ceiling plans, devices shall be located as near as possible to locations shown on mechanical drawings when coordinating with ceiling.
- B. Install diffusers, grilles, and registers tight on their respective mounting surfaces, level, plumb, and true with room dimensions.
- C. Provide appropriate frame to adapt to mounting surface. Provide a 24-inch by 24-inch lay-in ceiling module for diffusers, registers, and grilles in lay-in ceilings.
- D. Support air inlets and outlets where installed in metal suspension systems for acoustical tile and lay-in panel ceilings as specified in ASTM C636/C636M and applicable building code.

END OF SECTION

SECTION 23 60 00 CENTRAL COOLING EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
 - a. 365, Commercial and Industrial Unitary Air-Conditioning Condensing Units.
 - b. 370, Sound Performance Rating of Large Air-Cooled Outdoor Refrigerating and Air-Conditioning Equipment.
 - c. 550/590, Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle.
 - d. 560, Absorption Water Chilling and Water Heating Packages.
 - 2. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE):
 - a. 15, Safety Standard for Refrigeration Systems.
 - b. 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. American Society of Mechanical Engineers (ASME): BPVC Section VIII, Rules for Construction of Pressure Vessels.
 - 4. ASTM International (ASTM):
 - a. B68/B68M, Standard Specification for Seamless Copper Tube, Bright Annealed.
 - b. B75/B75M, Standard Specification for Seamless Copper Tube.
 - c. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - d. B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - e. D523, Standard Test Method for Specular Gloss.
 - f. D870, Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
 - g. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - h. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - i. D3359, Standard Test Methods for Measuring Adhesion by Tape Test.
 - j. D3363, Standard Test Method for Film Hardness by Pencil Test.
 - k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

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- 5. FM Global (FM).
- 6. Hydraulic Institute Standards (HIS).
- 7. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
- 8. National Electrical Manufacturers' Association (NEMA):
 - a. MG 1, Motors and Generators.
 - b. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 9. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - c. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
- 10. Nationally Recognized Testing Laboratory (NRTL).
- 11. Occupational Safety and Health Act (OSHA).
- 12. UL:
 - a. 674, Standard for Safety Electric Motors and Generators for Use in Hazardous (Classified) Locations.
 - b. 1995, Standard for Safety Heating and Cooling Equipment.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature including make, model, dimensions, weight of equipment, and electrical schematics for equipment specified.
 - b. Cabinet dimensional drawings to scale, including location and sizes of access doors, control panels, and electrical cabinets and panels. Indicate required maintenance and electrical clearances for all access and maintenance locations.
 - c. Complete piping schematic for condenser unit(s).
- B. Informational Submittals:
 - 1. Manufacturer's installation instructions.
 - 2. Recommended procedures for protection and handling of materials prior to installation.
 - 3. Manufacturers' service reports.
 - 4. Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement or details shown to equipment furnished.
 - 5. Include as-built version of equipment schedules.

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- 6. Field test results.
- 7. List of recommended spare parts for equipment.
- 8. Special guarantees.
- C. LEED Submittals:
 - 1. Documentation required indicating compliance with Fundamental Refrigerant Management—EA Prerequisite 3.
 - 2. Documentation required indicating compliance with Optimize Energy Performance—EA Credit 1 with regards to mandatory provision for minimum equipment efficiencies of ASHRAE 90.1 Standard, Section 6.4.
 - 3. Documentation required indicating compliance with Enhanced Refrigerant Management—EA Credit 4.

1.03 QUALITY ASSURANCE

- A. Air handler coil data shall be reviewed by condensing unit manufacturer for compatibility with installed refrigeration system.
- B. Regulatory Requirements: Cooling equipment shall have minimum operating efficiencies as specified in ASHRAE 90.1 and the State of Florida Energy Code.

1.04 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of Work specified in this Specification found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

PART 2 PRODUCTS

2.01 AIR-COOLED CONDENSING UNIT CU-1, CU-2, AND CU-3.

- A. Factory assembled, single-piece, air-cooled condensing unit suitable for ground or rooftop installation.
- B. Condenser:
 - 1. Coil(s): constructed of aluminum fins mechanically bonded into seamless copper tubes.

- 2. Direct drive fan, propeller type.
- 3. Totally enclosed motor.
- 4. Contained in a weatherproof casing.
- 5. Bearing UL mark.
- C. Casing:
 - 1. 18-gauge zinc-coated steel phosphatized and finished in manufacturer's standard enamel paint.
 - 2. Supported on steel full-length mounting rails.
 - 3. Removable access panels to internal components.
 - 4. Protective guards on each fan discharge and each coil inlet.
- D. Cooling Components:
 - 1. Crankcase heater.
 - 2. Liquid line solenoid.
 - 3. Suction line accumulator.
 - 4. Condenser coil with seamless copper tubes bonded to aluminum fins.
 - 5. Rubber mounted upflow propeller condenser fans with direct-drive motor with integral thermal overload protection.
 - 6. Connections for refrigerant piping and specialties.
- E. Capacity: Refer to the Drawing schedule.

2.02 REFRIGERANT PIPING AND INSULATION

- A. As specified in Section 23 23 00, Refrigerant Piping, and Section 22 07 00, Plumbing Piping Insulation.
- B. Tubing:
 - 1. Hard-drawn copper tubing in accordance with ASTM B75/B75M or ACR copper tubing in accordance with ASTM B68/B68M and ASTM B280.
 - 2. Wrought copper fittings.
 - 3. Piping to be evacuated, charged with dry nitrogen, and capped at factory.
- C. Insulation:
 - 1. Flexible elastomer.
 - 2. Rated for 25/50 flame spread/smoke developed.
 - 3. Expanded, closed-cell.
 - 4. 1/2-inch thick.
 - 5. Thermal conductivity equals 0.27 or less.

CENTRAL COOLING EQUIPMENT 23 60 00 - 4 6. Armstrong, Armaflex AP.

2.03 ACCESSORIES

- A. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.
- B. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component control panel in a readily visible location. Plate shall bear 3/8 or 1/4-inch high engraved or die-stamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.
- C. Anchor Bolts: Factory furnished.
- D. Equipment Screens:
 - 1. Where shown on the Drawings, provide cottonwood and insect screen fabricated from a two-ply stackable material with first ply construction of heavy-duty commercial-grade bonded mesh and the second ply constructed of a fine unbonded mesh. Edge mesh ply with 1-inch width of fiber reinforced vinyl with grommets. Mount screen on an anodized aluminum track with UV-resistant spin knob fasteners.
 - 2. Manufacturers and Products:
 - a. Air Solution Company; Stackable HD Commercial. Permatron.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Condensing Units: Install refrigeration specialties, combination temperature/pressure gauges, piping, and refrigerant as required by manufacturer's installation instructions.
- B. Refrigerant Piping:
 - 1. Size, arrange, and install in accordance with condensing unit manufacturer's instructions for actual piping configuration.
 - 2. Provide silvaloy joints.
 - 3. Continuously purge piping with dry nitrogen during soldering.
 - 4. Evacuate piping system to 29.9 inches mercury. System shall hold vacuum for 24 hours without significant loss.

- C. Refrigerant Pipe Insulation:
 - 1. Install on suction and hot gas bypass lines.
 - 2. Install in accordance with manufacturer's instructions.
 - 3. Coat UV-exposed insulation to protect from deterioration in accordance with manufacturer's recommendation.

3.02 FIELD QUALITY CONTROL

- A. Functional Tests: Conduct on each chiller, condensing unit, and cooling tower as follows:
 - 1. Alignment: Prior to facility startup, test complete assemblies for correct rotation, proper alignment and connection, quiet operation, and satisfactory specified performance.
- B. Performance Test: Conduct on each condensing unit assisted by manufacturer's representative.
 - 1. Perform under actual or approved simulated operating conditions.
 - 2. Test for continuous 3-hour period without malfunction.
 - 3. Perform with Engineer present.
 - 4. Test Log: Upon completion of test, record and report results.
 - 5. Adjust, realign, or modify units and retest if necessary.

END OF SECTION

SECTION 23 77 00 AIR HANDLING UNITS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 410, Forced-Circulation Air-Cooling and Air-Heating Coils.
 - 2. Air Movement and Control Association International, Inc. (AMCA):
 - a. 201, Fans and Systems.
 - b. 203, Field Performance Measurement of Fan Systems.
 - c. 204, Balance Quality and Vibration Levels for Fans.
 - d. 300, Reverberant Room Method for Sound Testing of Fans.
 - e. 301, Methods for Calculating Fan Sound Ratings From Laboratory Test Data.
 - f. 99-0401, Classifications for Spark Resistant Construction.
 - g. 99-2408, Operating Limits for Centrifugal Fans.
 - 3. American Bearing Manufacturers Association (ABMA): 9, Load Ratings and Fatigue Life for Ball Bearings.
 - 4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - a. 15, Safety Standard for Refrigeration Systems.
 - b. 52.1, Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - d. 62.1, Ventilation for Acceptable Indoor Air Quality.
 - 5. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - c. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - d. D3363, Standard Test Method for Film Hardness by Pencil Test.
 - e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. CSA America (CSA):
 - a. B149.1, Natural Gas and Propane Installation Code.

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- b. Z83.4, Non-Recirculating Direct Gas-Fired Industrial Air Heaters.
- c. Z83.18, Recirculating Direct Gas-Fired Industrial Air Heaters.
- Institute of Electrical and Electronics Engineers, Inc. (IEEE): 841, Standard for Petroleum and Chemical Industry - Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 370 kW (500 hp).
- 8. International Standards Organization (ISO): 9001, Quality Management Systems Requirements.
- 9. National Electrical Manufacturers Association (NEMA).
- 10. National Fire Protection Association (NFPA):
 - a. 54, National Fuel Gas Code.
 - b. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - c. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
- 11. Occupational Safety and Health Act (OSHA).
- 12. Society of Protective Coatings (SSPC):
 - a. SP 3, Power Tool Cleaning.
 - b. SP 5, White Metal Blast Cleaning.
 - c. SP 6, Commercial Blast Cleaning.
 - d. SP 10, Near-White Blast Cleaning.
- 13. UL:
 - a. 181, Standard for Safety Factory-Made Air Ducts and Connectors.
 - b. 723, Standard for Safety Test for Surface Burning Characteristics of Building Materials.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. ac: alternating current.
 - 2. AFD: Adjustable Frequency Drive.
 - 3. AHU: Air Handling Unit.
 - 4. cfm: cubic feet per minute.
 - 5. CISD: Chemical Industry, Severe-Duty.
 - 6. dB: Decibel.
 - 7. DX: Direct Expansion.
 - 8. DWDI: Double Width, Double Inlet.
 - 9. ETL: ETL Testing Laboratories, Inc.
 - 10. FM: Factory Mutual Insurance.
 - 11. fpm: feet per minute.
 - 12. hp: Horsepower.
 - 13. IAQ: Indoor Air Quality.
 - 14. IEC: International Electro-technical Commission.

- 15. IRI: Industrial Risk Insurance.
- 16. MAU: Make-Up Air Unit.
- 17. NRC: Noise Reduction Coefficient.
- 18. OD: Outside Diameter.
- 19. ODP: Open Drip Proof.
- 20. O&M: Operations and Maintenance.
- 21. psi: pounds per square inch.
- 22. PVC: Polyvinyl Chloride.
- 23. rpm: revolutions per minute.
- 24. SCR: Silicon Control Rectifier.
- 25. SWSI: Single Width, Single Inlet.
- 26. TEFC: Totally Enclosed, Fan Cooled.
- 27. UV: Ultra Violet.
- 28. VFD: Variable Frequency Drive.
- 29. WC: Water Column.
- 30. XP: Explosion Proof.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Provide Shop Drawings for products specified, including, as a minimum:
 - a. Unit identification as referenced in Contract Documents.
 - b. Manufacturer's name and model number.
 - c. Descriptive specifications, literature, and drawings.
 - d. Dimensions and weights for unit, including fully assembled and shipping sections.
 - e. Acoustics:
 - Fan sound power level data (ref. 10 to power minus 12 Watts) at design operating point, based on AMCA 300 for unit discharge, inlet and casing.
 - 2) Additional requirements (including by others) to achieve specified sound performance levels.
 - f. Fans:
 - 1) Type, size, quantity, class, drive arrangement, discharge, rotation and bearings.
 - 2) Wheel type, diameter, rpm, and tip speed.
 - 3) Performance curves indicating:
 - a) Relationship of flow rate to static pressure for various fan speeds.
 - b) Brake horsepower curves.
 - c) Acceptable selection range (surge curves, maximum safe operating rpm).

- d) Static pressure, capacity, horsepower demand and overall efficiency required at the duty point, including drive losses.
- 4) For variable air volume applications, indicate operating points at 100, 80, 60, and 40 percent of design capacity on fan curves including data to indicate effect of capacity control devices such as inlet vanes on flow, pressure and brake horsepower.
- g. Coils:
 - Type, quantity, dimensions, material of construction, coatings, if applicable, energy transfer capacity, air pressure drop, air inlet, and discharge temperature at design conditions.
 - 2) Hydronic Coils: Water pressure drop at design conditions, water inlet and discharge temperature at design conditions, piping connection data, coil fin spacing, coil row depth.
 - 3) DX Coils: Refrigerant saturated suction temperature at design conditions, refrigerant piping configuration (row split, face split, intertwined), coil fin spacing, coil row depth.
 - 4) Steam Coils: Air pressure drop at design conditions, air discharge temperature and humidity at design conditions, piping connection data, steam consumption.
 - 5) Evaporative Coolers: Media air pressure drop at design conditions, make-up water consumption, air discharge temperature and humidity at design conditions, piping connection data.
 - 6) Electric Resistance Coils: Voltage, phase, number of stages, safety features, controls.
 - 7) Drain pan details.
 - 8) Coil pull details and dimensions for service.
- h. Motor(s) type, quantity, and performance data.
- i. Air filter(s) type, quantity, and performance data.
- j. Unit capacities and ratings, including airflow and static pressure summary.
- k. Construction materials.
- 1. Power and control wiring diagrams, including terminals and numbers.
- m. Vibration Isolation:
 - 1) Vibration isolation methods with maximum deflection data.
 - 2) Additional requirements (including by others) to achieve specified vibration isolation levels.
- n. Factory finish system, with color selection charts where applicable.

- 2. "Or-equal" Equipment:
 - a. Where submitted equipment results in change to fan inlet or outlet ductwork configuration shown on the Drawings, submit system effect factor calculations indicating increased static pressure requirements as described in AMCA 201.
 - b. Where submitted equipment results in change to ductwork and equipment configuration shown on the Drawings, submit detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement or details shown to equipment furnished.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 2. Sample copy of guarantee.
 - 3. Manufacturer's Test Reports for the following:
 - a. DX cooling coil.
 - b. Air handling unit leak tests.
 - c. Acoustical tests.
 - d. Vibration tests.
 - 4. Recommended procedures for protection and handling of products prior to installation.
 - 5. Manufacturer's installation instructions, including component spacing requirements.
 - 6. Operation and Maintenance Data:
 - a. Include as-built version of equipment schedules.
 - b. Methods for accessing components for maintenance with required service clearances.

1.04 QUALITY ASSURANCE

- A. Fans: Licensed to bear AMCA seal for air flow and sound performance.
- B. Manufacturer's Qualifications:
 - 1. The air handling unit manufacturer shall have been successfully manufacturing air handling units for a period of no less than 5 years.
 - 2. Manufacturer's qualifications are subject to review by the Owner/Engineer to determine acceptance.
- C. Fan Performance:
 - 1. Fan shall operate at single stable point as indicated by fan curve. Fans having two potential operating points are not acceptable.

- 2. Fan and motor combination shall be capable of delivering 110 percent of scheduled air quantity and static pressure.
- 3. Motor shall not operate into motor service factor in any listed case.
- 4. Accommodate drive efficiency in motor selection according to manufacturer's published recommendation, or according to AMCA 203, Appendix L.
- D. Thermal Insulation: Shall meet the erosion requirements of UL 181 facing the air stream and fire hazard classification of 25/50 (per ASTM E84 and UL 723).

1.05 DELIVERY, STORAGE, AND HANDLING

A. Air handling unit manufacturer shall coordinate with the Contractor as to the requirements for proper delivery, storage, and handling of the air handling unit and its components required in this Specification to ensure that the unit is properly cared for prior to final installation.

1.06 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials.

Item	Quantity
High Efficiency Filters	Two complete sets per unit
Special tools required to maintain or dismantle	One complete set for each different size unit

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

- 2.01 EQUIPMENT SCHEDULES
 - A. Refer to the Drawings.
- 2.02 OPERATING LIMITS
 - A. Fans designated to meet a specified Fan Class shall comply with requirements of AMCA 99-2408.

2.03 ACOUSTICAL LEVELS

- A. Equipment selections shall produce sound power levels in each octave band no greater than shown in fan equipment schedule.
- B. Perform noise tests in accordance with AMCA 300.

2.04 FINISHES

- A. Carbon Steel Parts: Factory finished as follows, unless indicated otherwise.
 - 1. Parts cleaned and chemically pretreated with a phosphatizing process.
 - 2. Alkyd enamel primer.
 - 3. Air-dry enamel topcoat.
- B. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
- C. Stainless Steel Parts: Finished smooth and left unpainted.

2.05 AIR HANDLING UNITS—MODULAR

- A. General:
 - 1. Modular air handling unit, constructed by assembly of factoryfabricated modules containing components such as fan units, motor and drive assembly, heat transfer devices, dampers, plenums, filters, condensate pans, heating units, control devices, and accessories.
 - 2. Required module types as indicated on plans and equipment schedule.
 - 3. Assembly shall be a complete and fully functioning system with all components and accessories as specified.
 - 4. Fan Air and Sound Performance: Tested and rated in accordance with AMCA and guaranteed by manufacturer.
- B. Module Casing:
 - 1. General:
 - a. Each module fully enclosed housing, with casing consisting of sheet metal side, floor and roof panels, mechanically fastened to structural metal internal frame.
 - b. Wall panels shall be easily removable. Panel removal shall not affect structural integrity of unit.
 - c. Height and width dimensions identical for each module type, for a given unit size.
 - d. Lifting lugs and unit support frames, factory installed, to facilitate installation.

- e. All casing insulated, formed and reinforced sheet metal panels; flat panel design not acceptable.
- f. For double wall units, distance between inner and outer panels as required to accommodate insulation thickness specified in Paragraph Insulation. Units are double wall, unless noted otherwise.
- g. Each panel shall be removable from outside of unit without affecting unit structural integrity.
- 2. Fasteners: Constructed of same material as respective module panel materials.
- 3. Outer Panels:
 - a. Material: manufacturer specified.
 - b. Indoor Units:
 - 1) Walls: Minimum 16-gauge (0.0625-inch minimum) thickness sheet metal.
 - 2) Roof: Minimum 16-gauge (0.0625-inch minimum) thickness sheet metal.
- 4. Inner Panels:
 - a. Walls and Roof:
 - 1) Material: manufacturer specified.
 - 2) Minimum 20-gauge (0.0348-inch minimum) thickness sheet metal
 - b. Floor Plate:
 - 1) Material: Type 304 stainless.
 - 2) Minimum 14-gauge (0.0800-inch) thickness sheet metal.
- 5. Frame:
 - a. Material: manufacturer specified.
 - b. Fabricated from minimum 16-gauge metal sections.
 - c. Metal sections joined to form a unitized assembly, for support of module internal components.
- 6. Joints:
 - a. Joints between exterior panels and structural frames shall have seals and gaskets with appropriate material type for air seal and acoustical break.
 - b. All seams caulked and sealed for an airtight unit.
 - c. Fully through-bolted module to module joints sealed with bulb type gasketing on both mating modules.
- 7. Insulation:
 - a. Single Wall Casing Units:
 - 1) Insulation secured with adhesive and metal pins.
 - 2) Longitudinal insulation joints and butt ends covered by a sheet metal break to prevent erosion of exposed edges.
 - b. Double Wall Casing Units: Insulation fully encased between outside and inside panels. Units are double wall, unless noted otherwise.

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- c. Properties:
 - 1) Units with Perforated Liner:
 - a) Black composite protective coating on surface exposed to airstream.
 - b) Exposed insulation is not acceptable.
 - 2) Maximum effective thermal conductivity (C) of 0.24 Btu inch per square foot degrees F.
 - 3) Minimum NRC of 0.70 per inch thickness.
- 8. Access Doors:
 - a. Heavy-gauge, oversized access doors insulated, double wall construction, internal sheet metal skin.
 - b. Sized and located to provide easy access to unit internal components.
 - c. Hinged, latched, and gasketed to provide a weatherproof seal.
 - d. Provide doors on one sides of each module.
 - e. Latches:
 - 1) "Ventlok" style noncorrosive alloy latches operable from inside and outside of unit.
 - 2) For access doors configured to open against unit operating pressure, provide safety latches that allow access doors to partially open after first handle movement and fully open after second handle movement.
- 9. Air Leakage: Maximum of 0.5 cfm per square foot of cabinet area at 5-inch WC static pressure.
- C. Module Drain Pans:
 - 1. Location: Inside each module, under each cooling coil and where indicated in these Specifications.
 - 2. IAQ style drain pans, complying with requirements of ASHRAE 62.1.
 - 3. Formed sections of minimum 16-gauge (0.0625 in.) Type 304 stainless steel or Type 316 stainless steel.
 - 4. Triple pitched for complete drainage, with no standing water in unit.
 - 5. Double Wall Construction:
 - a. Space between walls filled with foam insulation.
 - b. Sealed moisture tight.
 - c. Welded corners.
 - 6. Drain Connections:
 - a. Type 304 stainless steel, male pipe thread.
 - b. Both ends of pan.
 - c. Extended to exterior of unit cabinet.
 - d. Connection centerline shall be a minimum of 3 inches above base rail. Drain connections that protrude from the base rail are not acceptable.

- D. Unit Base:
 - 1. Full perimeter base frame.
 - 2. Minimum10-gauge (0.135-inch) structural steel construction, with C channel cross support members, on close centers.
 - 3. Joints fully welded.
 - 4. Fitted with lifting lugs at corner of unit or module.
 - 5. Attached to unit at factory unless noted otherwise for field assembly.
- E. Supply Fan Module:
 - 1. General:
 - a. Supply air module with fan assembly, consisting of housing (where applicable), wheel, fan shaft, bearings, motor, lockable disconnect switch, drive assembly, support structure and accessories.
 - b. Casing constructed in accordance with Article Module Casing.
 - c. Suitable to convey air at temperatures up to 250 degrees F.
 - d. Fan Performance: AMCA 99-2408 class rating corresponding to the static pressure at which the fan is designed to operate.
 - e. Fan Assemblies: Statically and dynamically balanced, designed for continuous operation at maximum rated fan speed and motor horsepower.
 - 2. Centrifugal Fan Housing:
 - a. Material: manufacturer specified.
 - b. Construction:
 - 1) Formed and reinforced sheet metal panels, curved scroll configuration with shaped cutoff, continuous seam welding and side angle reinforcement.
 - 2) Flanged and drilled outlet to permit duct connection.
 - 3) Spun-formed aerodynamic bell mouth inlet.
 - 4) Access doors or panels to allow entry to internal parts and components.
 - 5) Base:
 - a) All-welded heavy-gauge metal.
 - b) Fan and motor mounted on common base.
 - c) Motor Mount: Adjustable slide mount.
 - c. Plug Fans: Fabricate without fan scroll and volute housing.
 - d. Hardware: Plated steel.
 - 3. Fan Wheel:
 - a. Centrifugal, one-piece, blade type as scheduled.
 - b. Forward-Curved Fans:
 - 1) DWDI forward curved fan wheel.

- 2) Shallow blades with inlet and tip curved forward in direction of airflow, metal construction, mechanically secured to backplate and inlet flange.
- c. Backward Inclined Fans:
 - 1) DWDI backward inclined fan wheel.
 - 2) Nonoverloading performance characteristics.
 - 3) Backward inclined blades, heavy-gauge metal construction, continuously welded to backplate and curved inlet flange.
- d. Airfoil Fans:
 - 1) DWDI backward inclined fan wheel.
 - 2) Nonoverloading performance characteristics.
 - Backward inclined blades, hollow die-formed airfoil design, heavy gauge metal construction, continuously welded to backplate and smooth curved inlet flange.
- e. Plenum Fans:
 - 1) SWSI backward inclined fan wheel.
 - 2) Nonoverloading performance characteristics.
 - 3) Backward inclined blades, hollow die-formed airfoil design, heavy-gauge metal construction, continuously welded to backplate and smooth curved inlet flange.
- f. Material: manufacturer specified.
- g. Attached to fan shaft with split taper lock bushing.
- 4. Fan Shaft, Bearings, Drive:
 - a. Shafts:
 - 1) Turned, ground, and polished carbon steel.
 - 2) Ends drilled and countersunk for tachometer readings.
 - 3) Keyed for sheave installation.
 - 4) Coated with lubricating oil.
 - b. Bearings:
 - 1) Grease lubricated, precision anti-friction ball, self-aligning type.
 - 2) Mounted in cast iron pillow block housing.
 - Selected for average life (ABMA 9 L₅₀) of not less than 200,000 hours operation at maximum cataloged operating speed.
 - c. Drives:
 - 1) In accordance with Article Fan Drives.
 - 2) Factory set to specified fan revolutions per minute.
 - 3) Type: Direct.
 - 4) Arrangement: As specified.
- 5. Internal Vibration Isolation:
 - a. Fan/Motor Base: Isolate base from unit casing with open spring isolators with 2-inch deflection.

- F. Refrigerant Coil Module:
 - 1. General:
 - a. Fin-tube direct expansion refrigerant cooling and heating coil, complete with refrigerant controls, and related accessories.
 - b. Casing constructed in accordance with Article Module Casing.
 - c. AHRI 410 performance rated and certified.
 - d. Factory tested with air at 300 psig while immersed in an illuminated water tank.
 - e. Designed and tested in accordance with ASHRAE 15.
 - f. Coil shipped with end connections sealed and filled with a charge of dry nitrogen.
 - g. Coils designed for use with refrigerant type in associated refrigerant compressor.
 - 2. Coil Assembly:
 - a. Refrigerant Piping Connections:
 - 1) On same side of module.
 - 2) Extended a minimum of 5 inches beyond the exterior of the unit casing, by the manufacturer.
 - b. Coils removable from the unit at header end, unless shown otherwise on the Drawings.
 - c. Clearly label liquid and suction headers on outside of module.
 - 3. Refrigerant Circuiting:
 - a. Distributor arrangement as scheduled.
 - b. Alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions.
 - c. Refrigerant Distributors: Brass, replaceable nozzle type, connected to the coil by copper tubes.
 - 4. Fins:
 - a. Die-formed plate type, rippled for maximum heat transfer.
 - b. Continuous metal across coil casing; split fins not acceptable.
 - c. Shall have fully drawn collars and be mechanically bonded to tubes by mechanical expansion of tubes.
 - d. Material: Specified by manufacturer.
 - e. Fin density no greater than 12 fins per inch.
 - 5. Tubes:
 - a. Material: Specified by manufacturer.
 - b. Intermediate tube supports shall be supplied on coils over 44-inch fin length with an additional support every 42-inch multiple thereafter.
 - 6. Headers:
 - a. Located inside module.
 - b. Constructed from seamless copper tubing with die formed tube holes and brazed joints.

- c. Refrigerant Piping Connections: Terminate with OD sweat copper.
- 7. Casings:
 - a. Construct from minimum 16-gauge (0.0625-inch)
 - b. Formed end supports and top and bottom channels.
- 8. Drain Pan:
 - a. Construction in accordance with Paragraph, Module Drain Pans.
 - b. Furnish drain pan under each cooling coil.
 - c. Intermediate Drain Pan:
 - 1) Provide intermediate drain pans on all stacked cooling coils.
 - 2) Intermediate pan shall drain to main drain pan through a copper downspout.
- G. Access Module:
 - 1. Access module to allow improved access to air handling internal components.
 - 2. Casing constructed in accordance with Article Module Casing.
 - 3. Double wall, hinged, removable access doors on one side of module.
 - 4. Minimum depth of 16 inches, larger where shown on the Drawings.
- H. Filter Module:
 - 1. General:
 - a. Air filtration module, complete with filter media and filter racks.
 - b. Casing constructed in accordance with Article Module Casing.
 - c. Double wall, hinged, removable access doors on one side of module.
 - d. Maximum 500 fpm face velocity across filters.
 - 2. Media Schedule:
 - a. Main Filter:
 - 1) Vertical arrangement.
 - 2) Disposable Pleated Type.
 - 3. Media Construction:
 - a. General:
 - 1) Contain in a rigid frame.
 - 2) Meet UL Class 2 standards.
 - 3) Rigid supporting mesh across the leaving face of media.
 - 4) Quality certified by ISO 9001.
 - b. Preformed, Disposable Dry Extended Area Type: Rated at mean efficiency of 60 percent to 65 percent and average arrestance of 98 percent in accordance with ASHRAE 52.1, by ASHRAE Atmospheric Dust Test Method.
 - c. Disposable Pleated Type:
 - 1) Pleated panel disposable filters.

- 2) Nonwoven reinforced cotton/poly fabric media with a metal support grid and heavy duty beverage board-enclosing frame.
- 3) 2-inch thickness.
- 4) MERV 8 efficiency per ASHRAE 52.2.
- 5) Minimum 30 percent dust spot efficiency and 90 percent average arrestance in accordance with ASHRAE 52.1.
- 4. Frame and Filter Assembly:
 - a. Suitable for space indicated.
 - b. Permanent re-usable, side-loading 20-gauge (0.0625-inch) galvanized steel holding frame, retainer, and sealer frame.
 - c. Filter blank-offs to prevent air bypass around filters, same material as frame.
- 5. Manufacturers:
 - a. Farr.
 - b. Flanders.
 - c. Tri-Dim.
 - d. American Air Filter.
- I. Outside Air Intake Module:
 - 1. Weather Hood: Fully welded construction, fabricated from same material as unit casing.
 - 2. Louver: Drainable type, S-shaped rainproof blades, spaced 2 inches maximum.
 - 3. 1/2-inch mesh PVC-coated galvanized bird screen on inside face of louver.
- J. Control Dampers:
 - 1. Internally mounted ultra low leak dampers.
 - 2. Parallel blade action for two-position applications and opposed blade action for modulating applications.
 - 3. Construction: See the Drawing Schedule.
- K. Unit Electrical and Controls:
 - 1. General:
 - a. Electrical and control components shall meet requirements of Division 26 Electrical.
 - b. All electrical and controls components and assemblies UL or ETL listed and labeled.
 - c. Factory wired units shall bear an ETL or UL label with all necessary identification marks, electrical data, and cautions, as required by NEC.

- d. Provide as-built wiring diagrams and schematics for electrical and control systems, secured to inside of control panel door, or enclosed in plastic jackets placed inside control panel.
- e. For additional requirements, refer to Specification paragraphs for individual modules, and Section 23 09 00, Instrumentation and Control Devices for HVAC.
- 2. Factory Installed Disconnects:
 - a. Provide main electric power disconnect for unit.
 - b. Provide electric power lockable disconnect for each module containing electrical components.
 - c. Nonfused type.
- 3. Control Damper Actuators:
 - a. To suit factory installed control dampers.
 - b. Type: Electric, 120V factory installed, and wired to junction box.
 - c. Manufacturer: Belimo.
- 4. Factory Installed Control System.
- L. Manufacturers and Products:
 - 1. Trane.

2.06 MOTORS

- A. General:
 - 1. Provide integral manual reset or self-resetting overload protection on single-phase motors. Provide IEEE 841 motor, unless noted otherwise.
 - 2. Motors for fans specified for use with variable frequency drives shall be inverter duty type.
 - 3. Fan motors shall not operate into service factor in any case.
- B. Motor requirements shall be as follows unless designated otherwise on fan equipment schedule:
 - 1. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - 2. Winding Thermal Protection: None.
 - 3. Space Heater: No.
 - 4. Number of Speeds: Single.
 - 5. Number of Windings: One.
 - 6. Motor Efficiency: Energy efficient.
 - 7. Shaft Type: Solid, carbon steel.
 - 8. Mounting: As required for fan arrangement.
2.07 ACCESSORIES

- A. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear engraved or diestamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.
- B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

2.08 SOURCE QUALITY CONTROL

- A. Factory Tests and Adjustments: Test equipment actually identical to that furnished.
- B. Testing Provisions:
 - 1. Provide tachometer access holes large enough to accept standard tachometer drive shaft.
 - 2. Center punch fan shaft to accommodate tachometer readings.
- C. Manufacturer's Tests:
 - 1. DX Coil Test: Leak tested under water with 300 psi air.
 - 2. Electrical Circuits:
 - a. Tested and checked as to proper function.
 - b. Perform dielectric strength test.
 - 3. Air Handling Unit Cabinet Tests:
 - a. Air Pressure Leak Testing: For modules under positive pressure located on discharge side of a fan, maximum permissible air leakage shall not exceed one percent of specified airflow, when subject to 8-inch water gauge differential pressure.
 - Panel Deflection Testing: For modules under negative pressure located on the suction side of the fan, maximum permissible panel deflection shall not exceed 1/200th of panel length, when subject to 8-inch water gauge differential pressure.
 - c. Leakage Test Failure Guarantee: Upon completion of leakage test, if unit does not meet specified performance for deflection or leakage, Owner may elect to have unit modified to meet specified performance or may request a credit according to performance failure.

- D. Acoustical Test:
 - 1. Perform factory noise tests in accordance with AMCA 300 and AMCA 301.
 - 2. Fan sound power levels (dB, Reference 10⁻¹² Watts) shall be no greater than scheduled values.
- E. Balancing:
 - 1. Completed fan assemblies shall be dynamically balanced to minimum grade of G 6.3 per AMCA 204 at design operating speed.
 - 2. Fans controlled by variable frequency drives shall be dynamically balanced at speeds 25 percent, 50 percent, 75 percent, and 100 percent of design RPM.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb.
- B. Install floor-mounted units on concrete bases designed to withstand, without damage to equipment, the seismic force required by code.
- C. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.
- D. Inspect internal casing insulation, seal all exposed edges, and butt joints with mastic to ensure insulation will not be loosened during operation.
- E. All condensate drain connections piped and trapped separately for proper drainage.
- F. Labeling: In accordance with Article Accessories.
- G. Service Access: Locate units to provide access spaces required for filter changing; motor, drive, and bearing servicing; and fan shaft and coil removal.
- H. Equipment Restraints:
 - 1. Restrain equipment against seismic forces as required by Code.
 - 2. Restrain equipment against wind loads as required by Code.
- I. Connections:
 - 1. Isolate sheet metal duct connections from all noninternally spring-isolated fan units or other rotating equipment.

- 2. Install ductwork adjacent to fans so as to allow proper service and maintenance.
- 3. Pipe drain pan connection through trap running to floor drain.

3.02 FIELD QUALITY CONTROL

- A. Functional Tests:
 - 1. Verify shipping blocking and bracing are removed.
 - 2. Verify unit is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.
 - 3. Verify proper thermal-overload protection is installed in motors, starters and disconnect switches.
 - 4. Verify cleaning and adjusting are complete.
 - 5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.
 - 6. Reconnect fan drive system, align and adjust belts and install belt guards.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify manual and automatic volume control and fire and smoke dampers in connected ductwork are in fully open position.
- B. Performance Tests:
 - 1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated rpm.
 - b. Measure and record motor voltage and amperage.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.

3.03 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate non-sealed bearings prior to startup.
- D. Air Balancing: Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.04 CLEANING

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION

SECTION 23 84 00 HUMIDITY CONTROL EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 410, Forced-Circulation Air-Cooling and Air-Heating Coils.
 - 2. Air Moving and Conditioning Association (AMCA): 300, Reverberant Room Method for Sound Testing of Fans.
 - 3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - a. 52.1, Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - b. 84, Method of Testing Air-to-Air Heat Exchangers.
 - c. 90.1 IP/SI, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 4. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - c. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning Plastics in a Horizontal Position.
 - d. D2370, Standard Test Method for Tensile of Organic Coatings.
 - e. D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 5. Canadian Standards Association (CSA).
 - 6. Electrical Test Laboratories (ETL).
 - 7. International Standards Organization (ISO): 9001, Quality Management Systems Requirements.
 - 8. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - b. 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - c. 255, Standard Method of Test for Surface Burning Characteristics of Building Materials.

- 9. Nationally Recognized Testing Laboratories (NRTL).
- 10. UL: 1995, UL Standard for Safety Heating and Cooling Equipment.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. AC: Air Conditioning.
 - 2. COP: Coefficient of Performance.
 - 3. DX: Direct Expansion.
 - 4. EER: Energy Efficiency Ratio.
 - 5. HP: Heat Pump.
 - 6. IR: Infrared.
 - 7. LED: Light Emitting Diode.
 - 8. OSA: Outside Air.
 - 9. PSC: Permanent Split Capacitor.
 - 10. PTAC: Packaged Terminal Air Conditioner.
 - 11. SPST: Single Pole, Single Throw.
 - 12. TXV: Thermostatic Expansion Valve.
 - 13. UV: Ultraviolet.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings.
 - Specifications, descriptive drawings, catalog cuts, and descriptive literature; include make, model, dimensions, weight of products, and electrical schematics for the following equipment:

 AC-1.
 - 3. Manufacturer's standard finish color selection for enclosure finishes.
 - 4. Complete performance data that indicates full compliance with Specifications:
 - a. Include fan sound power level data (ref. 10 watts to 12 watts) at design operating point, based on AMCA 300, Setup No. 1.
 - b. Include heating and cooling performance data at design operating conditions.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate of Compliance, in accordance with Section air-conditioning units motors.
 - 2. Recommended procedures for protection and handling of equipment and materials prior to installation.

- 3. Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt the arrangement or details shown to equipment furnished.
- 4. Operation and maintenance data.
- 5. Special guarantees.

1.04 QUALITY ASSURANCE

A. Heating and Cooling Equipment: Minimum operating efficiencies, defined as Coefficient of Performance (COP) and Energy Efficiency Ratio (EER), specified in Chapter 6 of ASHRAE 90.1 IP/SI.

1.05 SPECIAL GUARANTEE

- A. Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee.
- B. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of the Work specified in this Specification found defective during a period of 5 years after date of Substantial Completion.
- C. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.

1.06 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:

Item	Quantity
Filters	One complete set per unit
Special tools required to maintain or dismantle	One complete set for each different size unit

PART 2 PRODUCTS

2.01 GENERAL

A. Specified components of this section, including insulation, facings, mastics, and adhesives shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.

ROGER SCOTT POOL FACILITIES

2.02 EQUIPMENT SCHEDULES

A. Refer to the Drawings.

2.03 DEHUMIDIFIER, PACKAGED DX 100 PERCENT OSA

A. General:

- 1. Match with associated indoor unit.
- 2. Consisting of the following components:
 - a. Condenser coil.
 - b. Fan.
 - c. Motor.
 - d. Reciprocating or scroll compressor.
 - e. Refrigerant specialties.
 - f. Controls.
- 3. Contained in a weatherproof casing.
- 4. Bearing UL label.
- 5. Unit shall be designed to conform to ETL or CSA standards.
- 6. Coils shall be UL or CSA listed.
- 7. Fan motor and compressor shall be UL or CSA listed.
- 8. Refrigerant Pipe: Type L Copper; vinyl coated for corrosion prevention.
- 9. Units shall be completely factory assembled, wired, piped, precharged with R-410A, and fully tested in all modes of operation.
- 10. Controls shall be factory adjusted and preset to design conditions.
- 11. Test report shall be available on request. Engineer reserves the right to witness factory performance testing.
- 12. Manufacturer shall have a minimum of 5 years' experience in the production of dehumidification systems.
- B. Cabinet:
 - 1. Supported on steel full-length mounting rails.
 - 2. Removable access panels to internal components and electrical panel without impairing unit operation.
 - 3. Protective guards on each fan discharge and each coil inlet.
- C. Paint Finish: Manufacturer typical finish.
- D. Compressor: Manufacturer specified.
- E. Evaporator Coil:
 - 1. AHRI 410 rated.
 - 2. Designed for heavy moisture removal.

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- 3. Aluminum or Copper plate fins formed on multiple rows of seamless copper tubing arranged in a staggered tube configuration.
- 4. Tubes shall be mechanically expanded, firmly bonding tube to shoulder of each fin.
- F. Condenser Coil:
 - 1. Aluminum or Copper plate fins formed on multiple rows of seamless copper tubing arranged in a staggered tube configuration.
 - 2. Tubes shall be mechanically expanded, firmly bonding tube to shoulder of each fin.
- G. Condenser Fan and Motor: Manufacturer Specified.
- H. Evaporator Fan and Motor: Manufacturer Specified.
- I. Refrigerant Circuit:
 - 1. Manufacturer Specified.
 - 2. Compressor.
 - 3. Crankcase heater.
 - 4. Liquid line solenoid.
 - 5. Suction line accumulator.
 - 6. Condenser coil.
 - 7. Rubber mounted upflow propeller condenser fans.
 - 8. Connections for refrigerant piping and specialties.
 - 9. High latent heat evaporator coil.
 - 10. Thermal expansion valve.
 - 11. Filter drier.
 - 12. Sight glass moisture indicator.
 - 13. Suction line accumulator.
 - 14. Refrigerant pressure service valves.
- J. Controls:
 - 1. Compressor, fan, and fan motor contactors or starters with thermal protection (auto-reset) on all inductive loads.
 - 2. Overload protection in each leg.
 - 3. Control transformer.
 - 4. Complete with transducers, thermostats, and electrical control circuit factory pre-wired in the control panel.
 - 5. Terminal strip for connection of remote controls.
 - 6. Compressor winding and overheat protection.
 - 7. Hot gas bypass valve and compressor unloader shall provide capacity modulation of the first-stage cooling coil.

- 8. Refrigerant controls shall include a high pressure control (manual-reset), low pressure control (auto-reset), head pressure control, field adjustable refrigerant system lock-out, and compressor antishort cycle timer.
- K. Filters: 2-inch disposable type.
- L. Accessories: Provide as scheduled in Equipment Schedule.
- M. Manufacturers:
 - 1. Trane.
 - 2. Mitsubishi.

2.04 OUTDOOR UNIT, SPLIT SYSTEM DX COOLING SYSTEM

- A. General:
 - 1. Match with associated indoor unit.
 - 2. Consisting of the following components:
 - a. Condenser coil.
 - b. Fan.
 - c. Motor.
 - d. Reciprocating or scroll compressor.
 - e. Refrigerant specialties.
 - f. Controls.
 - 3. Contained in a weatherproof casing.
 - 4. Bearing the UL label.
 - 5. Design to conform to ETL or CSA standards.
 - 6. Coils shall be UL or CSA listed.
 - 7. Fan motor and compressor shall be UL or CSA listed.
 - 8. Refrigerant Pipe: Type L copper; vinyl coated for corrosion prevention.
 - 9. Units shall be completely factory assembled, wired, piped, precharged with R-410A, and fully tested in all modes of operation.
 - 10. Controls shall be factory adjusted and preset to design conditions.
 - 11. Test report shall be available on request. Engineer reserves right to witness factory performance testing.
 - 12. Manufacturer shall have a minimum of 5 years' experience in production of dehumidification systems.
- B. Cabinet:
 - 1. Supported on steel full-length mounting rails.
 - 2. Removable access panels to internal components and electrical panel without impairing unit operation.
 - 3. Protective guards on each fan discharge and each coil inlet.

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- 4. Constructed of G-90 galvanized steel with minimum gauge of:
 - a. Base: 16 gauge (0.0625 in.).
 - b. Corner Posts and Tops: 18 gauge (0.0475 in.).
 - c. Access Panels: 20 gauge (0.0348 in.).
- 5. Paint internally and externally, as detailed below.
- C. Base:
 - 1. Unit base pan shall be poured with minimum 1/4-inch hot asphalt (tar) to prevent rain or condensate from contacting steel on the bottom of the base pan.
 - 2. Asphalt shall be poured prior to final factory assembly to assure protection of all steel areas.
- D. Paint Finish:
 - 1. Thoroughly clean exterior parts chemically, zinc-phosphate coat, and seal with chromic rinse.
 - 2. Electrically deposited by immersion dipping in a cationic electrodeposition paint system.
 - 3. Baked for a minimum of twenty minutes at 400 degrees F.
 - 4. Minimum paint film thickness of 1 mil.
 - 5. Finish shall meet or exceed a 1,000-hour salt spray test per ASTM B117.
- E. Hardware:
 - 1. Exterior Nuts, Bolts, and Washers: Type 304 stainless steel.
 - 2. Exterior Screws: Type 304 stainless steel or coated with an epoxy finish that meets or exceeds minimum 4,000-hour salt spray test per ASTM B117.
- F. Compressor:
 - 1. Hermetic type, scroll type suction gas cooled, suitable for refrigerant R-410A, equipped with internal thermal protection, and resilient type external mounting.
 - 2. Provide with crankcase heaters and motors equipped with internal overheat-overload protection.
 - 3. Compressor manufacturer shall have a wholesale outlet for replacement parts in nearest major city.
 - 4. Warranty: 5 years.

- G. Condenser Coil:
 - 1. Aluminum plate fins formed on multiple rows of seamless copper tubing arranged in a staggered tube configuration.
 - 2. Tubes shall be mechanically expanded, firmly bonding tube to shoulder of each fin.
- H. Condenser Fan and Motor:
 - 1. Fan: Propeller type, electronically balanced, and direct-driven by fan motor.
 - 2. Motor: Inherent protected, with sealed ball bearings that do not require lubrication.
 - 3. Outdoor air shall be discharged through a vinyl coated fan guard.
- I. Refrigerant Circuit:
 - 1. Spring mounted hermetic compressor.
 - 2. Crankcase heater.
 - 3. Liquid line solenoid.
 - 4. Suction line accumulator.
 - 5. Condenser coil.
 - 6. Rubber mounted upflow propeller condenser fans.
 - 7. Connections for refrigerant piping and specialties.
 - 8. Filter-drier.
 - 9. Sight glass-moisture indicator.
 - 10. Suction line accumulator.
 - 11. Refrigerant pressure service valves.
- J. Controls:
 - 1. Compressor and fan motor contactors or starters with thermal protection (auto-reset) on inductive loads.
 - 2. Overload protection in each leg.
 - 3. Complete with transducers, thermostats, and electrical control circuit factory prewired in control panel.
 - 4. Terminal strip for connection of remote controls.
 - 5. Compressor winding and overheat protection.
 - 6. Hot gas bypass valve and compressor unloader shall provide capacity modulation of the first-stage cooling coil.
 - 7. Refrigerant controls shall include a high pressure control (manual-reset), low pressure control (auto-reset), head pressure control, field adjustable refrigerant system lock-out, and compressor anti-short cycle timer.
- K. Manufacturer: Trane or Mitsubishi.

HUMIDITY CONTROL EQUIPMENT 23 84 00 - 8

2.05 FACTORY DIP-APPLIED PROTECTIVE COATING

A. General:

- 1. Factory dip-applied protective coating for application to plate fin and tube coils.
- 2. Coil factory assembled and tested before coating application.
- 3. Coating suitable for coils with maximum 30 fins per inch fin density. Bridging of product across coil fins is unacceptable.
- 4. After application and proper curing, product shall endure bending of coil assembly in standard manufacturing process without cracking.
- B. Use one of the following coating materials:
 - 1. Epoxy modified phenolic. Straight phenolic materials are not acceptable.
 - 2. Epoxy or epoxy-urethane.
 - 3. Polyelastomer: Complex chain linked polyelastomer material.
- C. Coating Process:
 - 1. Coil Inspection and Sealing:
 - a. Inspect coil for open tubes, headers, capillary tubes; repair as necessary.
 - b. Fill with dry nitrogen, cap and seal, to prevent contamination of internal coil surfaces with cleaning or coating solutions.
 - 2. Coil Cleaning:
 - a. Immerse coil in heated alkaline cleaning solution to remove lubricants, machining oils, and residual factory contamination.
 - b. Followed with immersion in potable water bath to neutralize and remove cleaning solution.
 - 3. Coating Application:
 - a. Immerse coil assembly in coating bath, including headers, casing, and heat exchange surfaces.
 - b. Coil shall be completely removed from equipment during coating application.
 - c. Spray-on coatings are not acceptable.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Quality Control: Free from voids, checks, cracks and blisters.
- D. Coil finish shall meet or exceed the following criteria:
 - 1. Salt Spray Test: In accordance with ASTM B117, minimum 3,000-hour duration, with no fin corrosion or degradation.
 - 2. Thermal Efficiency: Loss no greater than 1 percent after coating application.

- 3. UV inhibited life of minimum 10 years when exposed to sun in the State of Florida.
- E. Manufacturers and Products:
 - 1. Aero-Marine Engineering Inc.; Technicoat 10-1.
 - 2. AST ElectroFin Inc; ElectroFin.

2.06 ELECTRICAL

- A. General:
 - 1. Units shall include high and low voltage terminal block connections.
 - 2. Motor Starters/Contactors: Factory installed with equipment, unless otherwise noted.
 - 3. Disconnects: Factory installed nonfused disconnects or circuit breakers on each unit, unless otherwise noted.
- B. Motors:
 - 1. Unless otherwise stated, electric motors shall comply with the following:
 - a. Voltage, Phase, Horsepower, Synchronous Speed: Refer to Equipment Schedule for motor driven equipment.
 - b. Enclosure: ODP, unless specified otherwise.
 - c. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - d. Winding Thermal Protection: Manufacturer's standard.
 - e. Space Heater: Manufacturer's standard.
 - f. Multispeed Motors, Synchronous Speed, Number of Windings: Manufacturer's standard.
 - g. Motor Efficiency: Energy efficient.
 - h. Shaft Type: Solid, carbon steel.
 - i. Mounting: As required for fan arrangement.
 - j. Service Factor: 1.15.

2.07 ACCESSORIES

A. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8 or 1/4-inch high engraved or die-stamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown on the Drawings.

HUMIDITY CONTROL EQUIPMENT 23 84 00 - 10 B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

PART 3 EXECUTION

3.01 INSTALLATION

A. Filters: Install a complete set of filters in each unit before operating, and leave in place during startup and testing to keep equipment and ductwork clean.

3.02 ADJUSTING AND CLEANING

- A. Air System Balancing: As specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- B. Air Handlers:
 - 1. Lubricate nonsealed bearings prior to startup.
 - 2. Do not operate units until filters are installed. If operated without filters, completely clean coils and interior of units.
- C. Vibration:
 - 1. Statically and dynamically balance fan equipment.
 - 2. Perform field testing on rotating equipment, as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC, to determine actual operating vibration.
 - 3. If vibration limits described therein are exceeded, rebalance equipment in-place, if directed by Engineer, until design tolerances are met.

END OF SECTION

SECTION 26 00 00 SUMMARY OF ELECTRICAL WORK

PART 1 BACKGROUND

1.01 EXISTING

- A. Office/Ticket Building:
 - 1. This building is an elevated office building, with a basement area and a separate ticket booth.
 - 2. The basement area has an existing Office Main Breaker Panel, and conduit runs to office building branch circuits, main pool equipment circuits, main pool lighting and other circuits. The Office Main Breaker Panel also powers the shed building breaker panel and the bathroom building circuits.
 - 3. The sole 200A service meter and the associated disconnect are located between the ticket building and the office mounted on a utility pole. There are two circuits running out of the disconnect: to the Office Main Breaker Panel in the office basement, and to the Kid Pool PP1 Panel.
 - 4. Outside of the west wall of office, there is a small area with an overhanging roof for pool pumps and equipment. Existing control panels, switches, outlets, pool light transformers and a twist-lock outlet are some items located on the west wall.
 - 5. Two pool light transformers are located under the stairs that run up into office building.
 - 6. The office and ticket building are to be demolished and replaced with a joint office-ticket building in same location.
 - 7. The service meter is to be demolished when the new building is built, as well as the pole it is mounted on since the pole will be conflicting with location for the proposed office entrance ramp.
- B. Bathroom Building:
 - 1. The existing bathroom building was located on the South East corner of site, adjacent to the wading pool.
 - 2. Pool equipment was located on the outside south wall of building.
 - 3. Power to the bathroom building was supplied by the Office Main Breaker Panel. Power to some equipment located outside the south wall of building is supplied by PP1 at kid pool.
 - 4. The bathroom building has been demolished and replaced temporarily with portable bathroom trailers for the 2024 pool season. Trailers will be replaced with a new bathroom building in the 2025 construction process.

C. Shed Building:

- 1. There is a Shed building existing at the South area of site.
- 2. This Shed serves as a breakroom for the lifeguards, as well as a storage and a vending machine area.
- 3. The breaker panel located in the shed is supplied from the Office Main Breaker Panel.
- 4. The Shed breaker panel supplies power for shed building circuits, 4 pool lights, the sign on exterior of facility, some outside lighting and the wading pool filter pump.
- 5. The Shed building will be demolished but not replaced with new building.

1.02 PROPOSED

- A. Office/Ticket Building:
 - 1. A office and ticket building is to be constructed in place of the old one.
 - 2. The basement area is to be abandoned and filled in during new construction.
 - 3. A new 400A service meter panel and a disconnect will be located on the outside north wall of the new office building's electrical/maintenance room, and will be fed power from existing utility pole on north exterior of site.
 - 4. 2 new breaker panels to be constructed inside the electrical/mechanical room: MCB-1A (3-phase) and MCB-1B (1-phase).
 - a. MCB-1A will supply power to PP1 (Kid Pool), MCB-3A (New Bathroom Building Electrical Room), MCB-1B, and the 3-phase power required for main pool/office area equipment.
 - b. MCB-1A will receive power from disconnect on other side of wall via conduit run horizontal through wall.
 - 5. Outside of the west wall of the new office, the small area with overhanging roof, the existing pool pumps and equipment is to be reconnected to new office panels MCB-1A or MCB-1B. Existing control panels, switches, outlets, four pool light transformers and a twist-lock outlet is to be relocated on the west wall. All equipment to be at least 6 feet north of a new shower located at the south end on the west wall.
 - 6. The two pool light transformers located under stairs that run up into office building are to be relocated to west wall with four other transformers, and in-ground conduit runs are to be tied into new location to avoid tearing up the pool deck. This will require pulling new wire to the lights.
 - 7. A ticket area will be located inside the office building, and a bathroom will also be inside this office building.

- 8. Main power fed from the local utility will be connected to weatherhead above the meter on north wall. Follow the suppling utility (FPL) requirements for the meter and weatherhead.
- B. Bathroom Building:
 - 1. The new bathroom building will be located in same general location as the demolished bathroom building.
 - 2. The pool equipment located outside south wall of the bathroom building is to be preserved and not moved.
 - 3. Power to bathroom building to be supplied from the MCB-1A (Office Building Electrical Room) to new breaker panel MCB-3A located in the bathroom building electrical/maintenance room.
 - 4. MCB-3A will supply power to MCB-3B. MCB-3A is a 3-phase power panel.
 - 5. The bathroom building will have a men's restroom, women's restroom, and family restroom along with the electrical/maintenance room.
 - 6. Entrances to restrooms will be on north wall, and the maintenance/electrical room entrance is on the south wall.
 - 7. Bathroom building breaker panels will supply power to circuits previously powered by shed breaker panel that require power in this location.
- C. Shed Building:
 - 1. Shed building will cease to exist, and will be demolished and not replaced.
 - 2. All cables and raceways, except for the four pool lighting and the two sign power in-ground conduits, are to be demolished with the shed building. Remove the cable and cap the six in-ground conduits noted for later use.
 - 3. A new Utility Junction Cabinet is to be put in place on top of a concrete pad, furnished and installed by this contract, at the south side of the existing shed building location. This cabinet will house four pool light transformers, previously located on the shed wall, a photocell for the sign backlighting and a spare receptacle mounted on the outside of the cabinet.
 - 4. Existing in-ground conduit runs for pool lights and sign power to be preserved in-place, and this cabinet will be located on top of these conduits, where the enter/exit the ground. Power to this cabinet will be supplied from MCB-3B.

1.03 EXECUTION

- A. The following is a partial list of work to be performed. It is intended to be supplemental to highlight of some work details required. See the drawings and the specifications for the complete scope.
- B. Demolition Notes:
 - 1. Yard Lighting:
 - a. There are five light mounted on poles powered from the existing electrical panels. Contractor shall verify source/location of the existing power prior to demo and ensure power is restored to the lights as part of this work. These lights are identified by the large red circles in the Drawing below.



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- 2. Pool Lighting:
 - a. There are ten pool lights powered from ten transformers. Because the conduit runs are below the pol concrete deck, care must be taken to preserve these existing conduit runs so they can be reutilized. A sketch of the pool lighting is below. The contractor should verify this information prior to demo.



- 3. Partial list of the office Building Equipment to be preserved:
 - a. Motor Starters, existing pumps, blowers, specialized pool electrical equipment.
 - b. In-ground conduit runs to pool lights two location.
 - c. In-ground conduit run to Kid pool, PP1.
 - d. In-ground conduit runs to the outside, pole-mounted lighting.
 - e. Local control switches and specialized pool equipment mounted on the inside (basement) and the outside (under roof) West wall. Contractor should make careful notes and sketches of this equipment and its associated wiring to ensure it is properly re-wired when completing this work. Photo showing four switches that control the blower and pumps are shown below.



West Wall Office Building, outside under roof

- 4. Shed: In addition to the pool lighting, there are two conduit runs to the sign that should be preserved during demolition.
- 5. Motor Rotation: Motor rotation should be verified for all 3-phase motors including motors powered from Kid Pool PP1. A clear mark of the rotation direction should be made on the motor as needed. Submit the plans for checking motor rotation before project demolition and for project turnover/startup.
- C. Construction Notes:
 - 1. Coordinate with local utility (FPL) as needed in a timely manner.
 - 2. Upgrade the 200 amp incoming service to 400 amp.
 - 3. Install and wire up new weatherhead, meter service panel and main fused disconnect.
 - 4. Install ground rods per NEC requirements.
 - 5. The ground rods are to be bonded to the neutral in the disconnect housing. From the disconnect to MCB-1A the wiring is three phases, the neutral and the ground. All panels require separated grounds and neutrals.
 - 6. Pool and outside pole-mounted lights will need an additional conduit and new wire pulls as identified from pre-demolition checks. No belowground splices will be allowed.
 - 7. Furnish and install a disconnect for the following electrical-equipment connected by the new wiring:
 - a. 40 A 3 phase blower on the west side of the new office.
 - b. 60 A 3 phase 15 Hp pump on the west side of the new office.
 - c. 30 A 1 phase HVAC on the north side of the new office.

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- d. 20 A 1 phase grinder pump located on the north side of the new office.
- e. 25 A 1 phase HVAC on the east side of the new bathroom building.
- f. 35 A 3 phase HVAC on the east side of the new bathroom building.
- g. 20 A 1 phase Wading Pool Filter Pump on the south side of the new bathroom building.
- h. 15 A 1 phase indoor HVAC unit located in the new bathroom building.
- 8. Motor rotation should be check before turn-over of any panel. The owner or engineer should be given the opportunity to witness the rotational checks.

PART 2 GENERAL

2.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The completed Work will provide Owner with improvements to their electrical infrastructure as follows:
 - 1. Upgrade from 200A service to 400A service.
 - 2. Four new breaker panels: two in office building electrical room, and two in bathroom building electrical room.
 - 3. New power and branch circuits for the new office and bathroom buildings.
 - 4. All existing pool equipment, the street sign, pool lights and outdoor pole-mounted lights to be repowered as needed from the new panels.

END OF SECTION

SECTION 26 05 01 ELECTRICAL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Association of State Highway Transportation Officials (AASHTO).
 - 2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. A240/A240M, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
 - c. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - d. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - e. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - 3. Electronic Industries Association (EIA/TIA): 569, Commercial Building Standard for Telecommunications Pathways and Spaces.
 - 4. Federal Specifications (FS):
 - a. W-C-596, Connector, Electrical, Power, General Specification for.
 - b. W-S-896, Switch, Toggle (Toggle and Lock), Flush Mounted (General Specification).
 - 5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - b. PC62.41.1, Draft Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - c. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
 - d. 114, IEEE Standard Test Procedure for Single-Phase Induction Motors.
 - 6. International Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - 7. National Electrical Contractor's Association, Inc. (NECA): 1, Standard Practices for Good Workmanship in Electrical Contracting.

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- 8. National Electrical Manufacturers Association (NEMA):
 - a. C80.1, Rigid Steel Conduit-Zinc Coated.
 - b. C80.3, Electrical Metallic Tubing-Zinc Coated.
 - c. C80.6, Intermediate Metal Conduit-Zinc Coated (IMC).
 - d. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - e. ICS 1, Industrial Control and Systems: General Requirements.
 - f. MG 1, Motors and Generators.
 - g. PB 1, Panelboards.
 - h. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - i. ST 20, Dry Type Transformers for General Applications.
 - j. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - k. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 1. WC 55, Instrumentation Cables and Thermocouple Wire.
 - m. WC 70, Standard for Non-Shielded Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy.
 - n. WD 1, General Color Requirements for Wiring Devices.
- 9. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
- 10. UL:
 - a. 1, Flexible Metal Conduit.
 - b. 6, Electrical Rigid Metal Conduit—Steel.
 - c. 44, Thermoset Insulated Wires and Cables.
 - d. 62, Flexible Cord and Fixture Wire.
 - e. 67, Panelboards.
 - f. 98, Enclosed and Dead-Front Switches.
 - g. 198C, High Interrupting Capacity Fuses, Current Limiting Types.
 - h. 198E, Class R Fuses.
 - i. 360, Liquid-Tight Flexible Steel Conduit.
 - j. 486A, Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - k. 486C, Splicing Wire Connectors.
 - 1. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - m. 510, Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
 - n. 514B, Fittings for Cable and Conduit.
 - o. 651, Schedule 40 and 80 PVC Conduit.
 - p. 797, Electrical Metallic Tubing.
 - q. 854, Service-Entrance Cables.
 - r. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
 - s. 943, Ground-Fault Circuit Interrupters.
 - t. 1059, Terminal Blocks.
 - u. 1242, Intermediate Metal Conduit.

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- v. 1449, Surge Protection Devices (SPDs).
- w. 1561, Dry-Type General Purpose and Power Transformers.
- x. 2111, Overheating Protection for Motors.

1.02 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction.
- B. MCOV: Maximum Allowable Continuous Operating Voltage.
- C. MOV: Metal Oxide Varistor.
- D. SASD: Silicon Avalanche Suppressor Diode.
- E. SVR: Surge Voltage Rating.
- F. SPD: Surge Protective Device

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Service entrance and metering equipment.
 - 2. Boxes and device plates.
 - 3. Junction and pullboxes.
 - 4. Enclosures and panelboards.
 - 5. Circuit breakers and switches.
 - 6. Conduit, fittings, and accessories.
 - 7. Conductors, cable, and accessories.
 - 8. Grounding materials.
 - 9. Luminaires.
- B. Informational Submittals:
 - 1. Field test reports.
 - 2. Signed permits indicating Work is acceptable to regulatory authorities having jurisdiction.
 - 3. Operation and Maintenance Data:
 - a. Provide for all equipment, as well as each device having features that can require adjustment, configuration, or maintenance.
 - b. Minimum information shall include manufacturer's preprinted instruction manual, one copy of the approved submittal information for the item, tabulation of any settings, and copies of any test reports.

1.04 APPROVAL BY AUTHORITY HAVING JURISDICTION

- A. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by UL, shall conform to those standards and shall have an applied UL listing mark or label.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Products shall comply with all applicable provisions of NFPA 70.
 - B. Like Items of Equipment: End products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
 - C. Equipment Finish:
 - 1. Manufacturer's standard finish color, except where specific color is indicated.
 - 2. If manufacturer has no standard color, finish equipment in accordance with color finish as approved by Engineer.

2.02 SERVICE ENTRANCE EQUIPMENT AND METERING

A. Equipment, installation arrangement, and scope of work shall be provided in accordance with requirements of the local electric utility.

2.03 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.
- B. Cast Metal:
 - 1. Box: Cast ferrous metal.
 - 2. Cover: Gasketed, weatherproof, and cast ferrous metal with stainless steel screws.
 - 3. Hubs: Threaded.
 - 4. Lugs: Cast Mounting.

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- 5. Manufacturers and Products, Nonhazardous Locations:
 - a. Crouse-Hinds; Type FS or FD.
 - b. Appleton; Type FS or FD.
- 6. Manufacturers and Products, Hazardous Locations:
 - a. Crouse-Hinds; Type GUA or EAJ.
 - b. Appleton; Type GR.
- C. PVC-Coated Cast Metal:
 - 1. Type: One-piece.
 - 2. Material: cast aluminum.
 - 3. Coating:
 - a. All Exterior Surfaces; 40 mils PVC.
 - b. All Interior Surfaces, 2 mils urethane.
 - 4. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.

2.04 JUNCTION AND PULL BOXES

- A. Outlet Boxes Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.
- B. Conduit Bodies Used as Junction Boxes: As specified under Article Conduit and Fittings.
- C. Large Sheet Steel Box:
 - 1. NEMA 250, Type 1.
 - 2. Box: Code-gauge, galvanized steel.
 - 3. Cover: Full access, screw type.
 - 4. Machine Screws: Corrosion-resistant.
- D. Large Cast Metal Box:
 - 1. NEMA 250, Type 4
 - 2. Box: Cast ferrous metal, electrogalvanized finished, with drilled and tapped conduit entrances and exterior mounting lugs.
 - 3. Cover: Nonhinged with clamps.
 - 4. Gasket: Neoprene.
 - 5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 6. Manufacturers and Products, Surface Mounted Nonhinged Type:
 - a. Crouse-Hinds; Series W.
 - b. O-Z/Gedney; Series Y.
 - 7. Manufacturer and Product, Surface Mounted, Hinged Type: O-Z/Gedney; Series YW.

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- 8. Manufacturers and Products, Recessed Type:
 - a. Crouse-Hinds; Type WJBF.
 - b. O-Z/Gedney; Series YR.

2.05 WIRING DEVICES

- A. Switches:
 - 1. NEMA WD 1 and FS W-S-896.
 - 2. Industrial grade, totally enclosed, ac type, with quiet tumbler switches and screw terminals.
 - 3. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
 - 4. Rating: 20 amps, 120/277 volts.
 - 5. Color: Gray.
 - 6. Automatic grounding clip and integral grounding terminal on mounting strap.
 - 7. Manufacturers and Products:
 - a. Leviton; 1221 Series.
 - b. Bryant; 4901 Series.
 - c. Hubbell; 1221 Series.
- B. Receptacle, Single, Duplex and Quadplex:
 - 1. NEMA WD 1 and FS W-C-596.
 - 2. Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.
 - 3. High strength, thermoplastic base color.
 - 4. Color: Gray.
 - 5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
 - 6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
 - 7. One-piece mounting strap with integral ground contact (rivetless construction).
 - 8. Manufacturers and Products:
 - a. Arrow Hart; 5262 Series.
 - b. Leviton; 5262/5362 Series.
 - c. Bryant; 5262/5362 Series.
 - d. Hubbell; 5262/5362 Series.
- C. Receptacle, Ground Fault Circuit Interrupter:
 - 1. Duplex, listed Class A to UL Standard 943, tripping at 5 mA.
 - 2. Color: Gray.
 - 3. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
 - 4. Size: For 2-inch by 4-inch outlet boxes.

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- 5. Standard Model: NEMA WD 1, with provisions for testing.
- 6. Feed-Through Model: NEMA WD 1, with provisions for testing.
- 7. Impact resistant nylon face.
- 8. Manufacturers:
 - a. Bryant.
 - b. Hubbell.
 - c. Leviton.
- D. Receptacle, Special-Purpose: Rating and number of poles as shown or as required for anticipated purpose.

2.06 DEVICE PLATES

- A. General: Sectional type plates not permitted.
- B. Plastic:
 - 1. Material: Specification grade, 0.10-inch minimum thickness, noncombustible, thermosetting.
 - 2. Color: To match associated wiring device.
 - 3. Mounting Screw: Oval-head metal, color matched to plate.
- C. Metal:
 - 1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
 - 2. Finish: ASTM A167, Type 302/304, satin.
 - 3. Mounting Screw: Oval-head, finish matched to plate.
- D. Engraved:
 - 1. Character Height: 1/4-inch.
 - 2. Filler: White.
- E. Weatherproof:
 - 1. For Receptacles, Damp Locations:
 - a. Gasketed, cast-aluminum, with individual cap over each receptacle opening.
 - b. Mounting Screw and Cap Spring: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; Type WLRD-1.
 - 2) Appleton; Type FSK-WRD.
 - 2. For Receptacles, Wet Locations:
 - a. Impact-resistant, nonmetallic, single-gang, horizontal-mounting, providing, while in-use, NEMA 3R rating.

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- b. Stainless steel mounting and hinge hardware.
- c. Lockable, paintable.
- d. Color: Gray.
- e. Manufacturers:
 - 1) Carlon.
 - 2) Leviton.
- 3. For Switches:
 - a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
 - b. Mounting Screw: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; DS-181 or DS-185.
 - 2) Appleton; FSK-1VTS or FSK-1VS.

2.07 LIGHTING AND POWER DISTRIBUTION PANELBOARD

- A. NEMA PB 1, NFPA 70, and UL 67.
- B. Panelboards and Circuit Breakers: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- C. Short-Circuit Current Equipment Rating: Fully rated; series connected unacceptable.
- D. Rating: Applicable to a system with available short-circuit current of at least 10,000 amperes rms symmetrical at 120/240 volts. 22,000 ampere rating could be required based on utility transformer impedance.
- E. Cabinet:
 - 1. NEMA 250, Type 1.
 - 2. Material: Code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
 - 3. Wiring Gutter: Minimum 4-inch square; both sides, top and bottom.
 - 4. Front: Fastened with adjustable clamps.
 - a. Trim Size: As required by mounting.
 - b. Finish: Manufacturer's standard.
 - 5. Interior:
 - a. Factory assembled; complete with circuit breakers.
 - b. Spaces: Cover openings with easily removable metal cover.
 - 6. Door Hinges: Concealed.
 - 7. Locking Device:
 - a. Flush type.
 - b. Doors Over 30 inches in Height: Multipoint.
 - c. Identical keylocks, with two milled keys each lock.

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- 8. Circuit Directory: Metal frame with transparent plastic face and enclosed card on interior of door.
- F. Bus Bar:
 - 1. Material: Copper full sized throughout length.
 - 2. Neutral: Insulated, rated same as phase bus bars with at least one terminal screw for each branch circuit.
 - 3. Ground: Copper, installed on panelboard frame, bonded to box with at least one terminal screw for each circuit.
 - 4. Lugs and Connection Points:
 - a. Suitable for either copper or aluminum conductors.
 - b. Solderless main lugs for main, neutral, and ground bus bars.
 - c. Subfeed or through-feed lugs as shown.
- G. Circuit Breakers:
 - 1. UL 489.
 - 2. Thermal-magnetic, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle.
 - 3. Type: Bolt-on circuit breakers in all panelboards.
 - 4. Multipole circuit breakers designed to automatically open all poles when an overload occurs on one pole.
 - 5. Do not use tandem or dual circuit breakers in normal single-pole spaces.
 - 6. Ground Fault Circuit Interrupter (GFCI): UL Class A GFCI, 5 mA trip, and 10,000 amps interrupting capacity circuit breakers. This rating may be increased after the short circuit calculations are final.
- H. Manufacturers:
 - 1. Eaton.
 - 2. ABB/GE.
 - 3. Square D Co./Schneider Electric
 - 4. Siemens

2.08 FUSED SWITCH, INDIVIDUAL, 0 TO 600 VOLTS

- A. UL 98 listed for use and location of installation.
- B. NEMA KS 1 and UL 98 Listed for application to system with available shortcircuit current of as specified amps rms symmetrical.
- C. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

- D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- E. Fuse mountings shall reject Class H fuses and accept only current-limiting fuses specified.
- F. Enclosure: As specified under Execution.
- G. Interlock: Enclosure and switch to prevent opening cover with switch in ON position.
- H. Manufacturers:
 - 1. Eaton.
 - 2. ABB/GE.
 - 3. Square D Co. / Schneider Electric.
 - 4. Siemens.

2.09 NONFUSED SWITCH, INDIVIDUAL, 0 TO 600 VOLTS

- A. NEMA KS 1.
- B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- C. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- D. Enclosure: As specified under Execution.
- E. Interlock: Enclosure and switch to prevent opening cover with switch in the ON position.
- F. Manufacturers:
 - 1. Eaton.
 - 2. ABB/GE.
 - 3. Square D Co. / Schneider Electric.
 - 4. Siemens.

2.10 SWITCH, MOTOR-RATED

A. Type: Two- or three-pole, manual motor starting/disconnect switch without overload protection.

- B. Enclosure/Mounting and Rating:
 - 1. General Purpose:
 - a. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts. Listed UL 508.
 - b. General Purpose Rating: 30 amperes, 600V ac.
 - c. Minimum Motor Ratings:
 - 1) 2 hp for 120V ac, single-phase, two-pole.
 - 2) 3 hp for 240V ac, single-phase, two-pole.
 - d. Screw-type terminals.
- C. Manufacturers:
 - 1. General Purpose:
 - a. Bryant.
 - b. Hubbell.

2.11 FUSE, 0 TO 600 VOLTS

- A. Current-limiting, with 200,000 ampere rms interrupting rating.
- B. Provide to fit mountings specified with switches and features to reject Class H fuses.
- C. Feeder and Service Circuits, 0 to 250 Volt:
 - 1. Amperage: 0 to 600.
 - 2. UL 198E, Class RK-1, dual element, with time delay.
 - 3. Manufacturers and Products:
 - a. Bussmann; Type LPN-RK.
 - b. Littelfuse, Inc.; Type LLN-RK.

2.12 PUSHBUTTONS, INDICATING LIGHTS, AND SELECTOR SWITCHES

- A. Type: Heavy-duty, oiltight. Provide contact arrangements, colors, inscriptions, and functions as shown.
- B. Contact Rating: NEMA ICS 2, Type A600.
- C. Unless otherwise shown, provide the following features:
 - 1. Selector Switch Operating Lever: Standard.
 - 2. Indicating Lights: Push-to-test, transformer-type.
 - 3. Pushbutton Color:
 - a. ON or START: Red.
 - b. OFF or STOP: Green.

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- 4. Pushbuttons and selector switches lockable in OFF position where indicated.
- D. Legend Plate:
 - 1. Material: Aluminum.
 - 2. Engraving: Indicating specific function, or as shown.
 - 3. Letter Height: 7/64-inch.
- E. Manufacturers and Products:
 - 1. General Electric Co.; Type CR 104P.
 - 2. Square D Co.; Type T.
 - 3. Eaton; Type 10250T.

2.13 TERMINAL BLOCKS

- A. Type: UL 1059. Compression screw clamp, with current bar providing direct contact with wire and yoke, with individual rail mounted terminals. Marking system shall permit use of preprinted or field-marked tags.
- B. Yokes and Clamping Screws: Zinc-plated, hardened steel.
- C. Rating:600V ac.
- D. Manufacturers:
 - 1. Weidmuller, Inc.
 - 2. Ideal.

2.14 SUPPORT AND FRAMING CHANNELS

- A. Carbon Steel Framing Channel:
 - 1. Material: Rolled, mild strip steel, 12 gauge, ASTM A1011/A1011M, Grade 33.
 - 2. Finish: Hot-dip galvanized after fabrication.
- B. Stainless Steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12 gauge.
- C. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Unistrut Corp.

2.15 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment: Adhesive.
- C. Color: Black, engraved to a white core.
- D. Engraving:
 - 1. Devices and Equipment: Name or tag shown, or as required.
 - 2. Panelboards:
 - a. Designation.
 - b. Service voltage.
 - c. Phases.
 - 3. Minimum Requirement: Label metering and power distribution equipment, local control panels, junction boxes, motor controls, and transformers.
- E. Letter Height:
 - 1. Pushbuttons, Selector Switches, and Other Devices: 1/8-inch.
 - 2. Equipment and Panelboards: 1/4-inch.

2.16 SURGE PROTECTIVE DEVICES (SPD) EQUIPMENT

- A. General:
 - 1. Units shall be suitable for the service voltage and configuration (phases and wires) shown.
 - 2. Protection Modes:
 - a. Normal, differential, and common.
 - b. Bipolar or bi-directional.
 - 3. Ratings: Short-circuit current rating shall equal or exceed that of protected distribution equipment. Surge Voltage Rating (SVR) shall not exceed those specified under UL 1449 for the associated nominal system voltage. Maximum Allowable Continuous Operating Voltage (MCOV) shall be at least 115 percent of the nominal system voltage.
 - 4. Unit shall be UL-listed.
 - 5. Provide status indicators for unit ON-LINE and unit operation NORMAL.
 - 6. Provide common alarm contact output.
 - 7. Provide fusible disconnect switch (integral with TVSS unit, where available) where not shown connected via branch circuit device of protected distribution equipment.

- 8. Minimum Enclosure Rating: NEMA 250, Type 2. Provide Type 4/4X for outdoor or wet locations.
- B. Type 1 SPD:
 - 1. Requirements: High surge current device designed for location/exposure Category C3, per IEEE C62.41. Provide surge current rating per phase as shown. Unit shall utilize symmetrically balanced Metal Oxide Varistor (MOV) technology.
 - 2. Manufacturer and Product: Transtector; Model Aegis SP.
- C. Type 2 SPD:
 - 1. Requirements: Designed for critical loads at service equipment (Category C3/B3) or distribution panelboard (Category C2/B3) locations. Unit shall utilize voltage-matched Silicon Avalanche Suppressor Diode (SASD) technology. Unit shall utilize modular, plug-in suppressor design.
 - 2. Manufacturer and Product: Transtector; Model Apex III (nonservice entrance distribution panelboard) or Apex IV (service equipment).
- D. Type 3 SPD:
 - 1. Requirements: Designed for noncritical loads at distribution panelboards with location/exposure Category C3. Unit shall utilize symmetrically balanced Metal Oxide Varistor (MOV) technology. Unit shall utilize modular, plug-in suppressor design.
 - 2. Manufacturer and Product: Transtector; Model SPD.

2.17 CONDUIT AND FITTINGS

- A. Rigid Galvanized Steel Conduit (RGS):
 - 1. Meet requirements of NEMA C80.1 and UL 6.
 - 2. Material: Hot-dip galvanized, with chromated protective layer.
- B. Intermediate Metal Conduit (IMC):
 - 1. Meet requirements of NEMA C80.6 and UL 1242.
 - 2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.
- C. Electrical Metallic Tubing (EMT):
 - 1. Meet requirements of NEMA C80.3 and UL 797.

- 2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.
- D. PVC Schedule 40 Conduit:
 - 1. Meet requirements of NEMA TC 2 and UL 651.
 - 2. UL listed for concrete encasement, underground direct burial, concealed, or direct sunlight exposure, and 90 degrees C insulated conductors.
- E. PVC-Coated Rigid Galvanized Steel Conduit:
 - 1. Meet requirements of NEMA RN 1.
 - 2. Material:
 - a. Meet requirements of NEMA C80.1 and UL 6.
 - b. Exterior Finish : PVC coating, 40 mils nominal thickness, bond to metal shall have tensile strength greater than PVC.
 - c. Interior finish: Urethane coating, 2 mils nominal thickness.
 - 3. Threads: Hot-dipped galvanized and factory coated with urethane.
 - 4. Bendable without damage to either interior or exterior coating.
- F. Flexible Metal, Liquid-Tight Conduit:
 - 1. UL 360 listed for 105 degrees C insulated conductors.
 - 2. Material: Galvanized steel, with an extruded PVC jacket.
- G. Fittings:
 - 1. Provide bushings, grounding bushings, conduit hubs, conduit bodies, couplings, unions, conduit sealing fittings, drain seals, drain/breather fittings, expansion fittings, and cable sealing fittings, as applicable.
 - 2. Rigid Galvanized Steel and Intermediate Metal Conduit:
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, galvanized.
 - 3. Electrical Metallic Tubing:
 - a. Meet requirements of UL 514B.
 - b. Type: Steel body and locknuts with steel or malleable iron compression nuts. Setscrew and drive-on fittings not permitted.
 - c. Electro zinc-plated inside and out.
 - d. Raintight.
 - 4. PVC Conduit:
 - a. Meet requirements of NEMA TC 3.
 - b. Type: PVC, slip-on.
 - 5. PVC-Coated Rigid Galvanized Steel Conduit:
 - a. Meet requirements of UL 514B.

- b. Fittings: Rigid galvanized steel type, PVC-coated by conduit manufacturer.
- c. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC-coated by conduit manufacturer.
- d. Finish: 40-mil PVC exterior, 2-mil urethane interior.
- e. Overlapping pressure sealing sleeves.
- f. Conduit Hangers, Attachments, and Accessories: PVC-coated.
- g. Manufacturers:
 - 1) Robroy Industries.
 - 2) Ocal.
- h. Expansion Fitting Manufacturer and Product: Ocal; Ocal-Blue XJG.
- 6. Flexible Metal, Liquid-Tight Conduit:
 - a. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
 - b. Insulated throat and sealing O-rings.

2.18 CONDUCTORS AND CABLES

- A. Conductors 600 Volts and Below:
 - 1. Conform to applicable requirements of NEMA WC 71, WC 72, and WC 74.
 - 2. Conductor Type:
 - a. 120-Volt Lighting, No. 10 AWG and Smaller: Solid copper.
 - b. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
 - c. All Other Circuits: Stranded copper.
 - 3. Insulation: Type THHN/THWN. XHHW-2 for #6AWG or larger.
 - 4. Direct Burial and Aerial Conductors and Cables:
 - a. Type USE/RHH/RHW insulation, UL 854 listed or Type RHW-2/USE-2.
 - b. Conform to physical and minimum thickness requirements of NEMA WC 70.

B. Accessories:

- 1. Tape:
 - a. General Purpose, Flame Retardant: 7 mils, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
 - b. Flame Retardant, Cold and Weather Resistant: 8.5 mils, vinyl plastic, Scotch Brand 88.

- c. Arc and Fireproofing:
 - 1) 30 mils, elastomer.
 - 2) Manufacturers and Products:
 - a) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - b) Plymount; Plyarc 53, with Plyglas 77 glass cloth tapebinder.
- 2. Identification Devices:
 - a. Sleeve-type, permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturer and Products: Raychem; Type D-SCE or ZH-SCE.
- 3. Connectors and Terminations:
 - a. Nylon, Self-Insulated Crimp Connectors:
 - 1) Manufacturers and Products:
 - a) Thomas & Betts; Sta-Kon.
 - b) Burndy; Insulug.
 - c) ILSCO.
- 4. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. Plated steel, square wire springs.
 - b. UL Standard 486C.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
- 5. Cable Lugs:
 - a. In accordance with NEMA CC 1.
 - b. Rated 600 volts of same material as conductor metal.
 - c. Uninsulated Crimp Connectors and Terminators:
 - Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - 2) Manufacturers and Products:
 - a) Thomas & Betts; Color-Keyed.
 - b) Burndy; Hydent.
 - c) ILSCO.
 - d. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - 1) Manufacturers and Products:
 - a) Thomas & Betts; Locktite.
 - b) Burndy; Quiklug.
 - c) ILSCO.
- 6. Cable Ties:
 - a. Nylon, adjustable, self-locking, and reusable.
 - b. Manufacturer and Product: Thomas & Betts; TY-RAP.
- 7. Heat Shrinkable Insulation:
 - a. Thermally stabilized, crosslinked polyolefin.
 - b. Manufacturer and Product: Thomas & Betts; SHRINK-KON.

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2.19 GROUNDING

- A. Ground Rods: Provide a minimum at each location of two copper or copper-clad with minimum diameter of 5/8-inch, and minimum length of 20 feet.
- B. Ground Conductors: As specified in Section 26 05 05, Conductors, paragraph Conductors and Cable.
- C. Connectors:
 - 1. Exothermic Weld Type:
 - a. Outdoor Weld: Suitable for exposure to elements or direct burial.
 - b. Indoor Weld: Use low-smoke, low-emission process.
 - c. Manufacturers:
 - 1) Erico Products, Inc.; Cadweld and Cadweld Exolon.
 - 2) Thermoweld.
 - 2. Compression Type:
 - a. Compress-deforming type; wrought copper extrusion material.
 - b. Single indentation for conductors 6 AWG and smaller.
 - c. Double indentation with extended barrel for conductors 4 AWG and larger.
 - d. Single barrels prefilled with oxide-inhibiting and antiseizing compound.
 - e. Manufacturers:
 - 1) Burndy Corp.
 - 2) Thomas and Betts Co.
 - 3) ILSCO.

2.20 LUMINAIRES AND ACCESSORIES

A. Specific requirements relating to fixture type, lamp type, and mounting hardware are provided in the Luminaire Schedule on the Drawings.

2.21 LIGHTING CONTROL

- A. Photocell:
 - 1. Automatic ON/OFF switching photo control.
 - 2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
 - 3. Setting: ON at dusk and OFF at dawn.
 - 4. Time delay feature to prevent false switching.
 - 5. Field adjustable to control operating levels.

- 6. Manufacturers:
 - a. Tork.
 - b. Paragon Electric Company.

PART 3 EXECUTION

3.01 GENERAL

- A. Install materials and equipment in accordance with manufacturer's instructions and recommendations.
- B. Work shall comply with all applicable provisions of NECA 1.
- C. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

3.02 DEMOLITION

- A. General Demolition:
 - 1. Where shown, de-energize and disconnect nonelectrical equipment for removal by others.
 - 2. Where shown, de-energize, disconnect, and remove electrical equipment.
 - 3. Remove affected circuits and raceways back to serving panelboard or control panel. Where affected circuits are consolidated with others, remove raceways back to first shared condulet or box. Where underground or embedded raceways are to be abandoned, remove raceway to 1-inch below surface of structure or 12 inches belowgrade and restore existing surface.
 - 4. Client has a right of refusal for any electrical equipment.

3.03 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation.
- B. Cap conduit runs during construction with manufactured seals.
- C. Close openings in boxes or equipment during construction.
- D. Energize space heaters furnished with equipment.

3.04 SERVICE ENTRANCE EQUIPMENT AND METERING

A. Unless otherwise specified or shown, schedule and coordinate work of serving utility as required to provide electric service to the Work.

B. Provide weatherhead at height specified by providing utility, at location indicated and with wiring to meet providing utility's requirements.

3.05 OUTLET AND DEVICE BOXES

- A. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
- B. Size:
 - 1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
 - a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
 - 2. Ceiling Outlet: Minimum 4-inch octagonal sheet steel device box, unless otherwise required for installed fixture.
 - 3. Switch and Receptacle: Minimum 2-inch by 4-inch sheet steel device box.
- C. Locations:
 - 1. Drawing locations are approximate.
 - 2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
 - 3. Light Switch: Install on lock side of doors.
- D. Mounting Height:
 - 1. General:
 - a. Dimensions given to centerline of box.
 - b. Where specified heights do not suit building construction or finish, mount as directed by Engineer.
 - 2. Switches: 48 inches above floor.
 - 3. Thermostat: 54 inches above floor.
 - 4. Telephone Outlet: 6 inches above counter tops or 15 inches above floor.
 - 5. Wall Mounted Telephone Outlet: 52 inches above floor.
 - 6. Receptacles:
 - a. General Indoor Areas: 15 inches above floor.
 - b. General Indoor Areas (Counter Tops): Install device plate bottom or side flush with top of splashback, or 6 inches above counter tops without splashback.
 - c. Industrial Areas, Workshops: 48 inches above floor.
 - d. Outdoor, All Areas: 24 inches above finished grade.
- E. Install plumb and level.

- F. Flush Mounted:
 - 1. Install with concealed conduit.
 - 2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
- G. Support boxes independently of conduit by attachment to building structure or structural member.
 - 1. Indoor Wet Locations:
 - a. Exposed Raceways: Cast metal.
 - b. Concealed Raceways: Cast metal.
 - 2. Cast-in-Place Concrete Slabs: Sheet steel.
- H. Box Type, Corrosive Locations (PVC-Coated rigid Galvanized Steel Raceway System): PVC-coated cast metal with matching cover.

3.06 JUNCTION AND PULL BOXES

- A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
- B. Install pull boxes where necessary in raceway system to facilitate conductor installation.
- C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.
- D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
- E. Use conduit bodies as junction and pull boxes where no splices are required and their use is allowed by applicable codes.
- F. Installed boxes shall be accessible.
- G. Do not install on finished surfaces.
- H. Install plumb and level.
- I. Support boxes independently of conduit by attachment to building structure or structural member.
- J. At or Belowgrade:
 - 1. Install boxes for belowgrade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.

- 2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
- 3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
- 4. Use boxes and covers suitable to support anticipated weights.
- K. Flush Mounted:
 - 1. Install with concealed conduit.
 - 2. Holes in surrounding surface shall be no larger than required to receive box.
 - 3. Make edges of boxes flush with final surface.
- L. Mounting Hardware:
 - 1. Noncorrosive Indoor Dry Areas: Galvanized.
 - 2. Outdoor or Noncorrosive Indoor Wet Areas: Stainless steel.
 - 3. Corrosive Areas: Stainless steel.
- M. Location/Type:
 - 1. Indoor, Dry: NEMA 250, Type 1.
 - 2. Indoor and Outdoor, Wet: NEMA 250, Type 4.
 - 3. Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X, stainless steel.
 - 4. Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.
 - 5. Underground Conduit: Concrete.
 - 6. Corrosive: NEMA 250, Type 4X, stainless steel.
 - 7. Outdoor, Where Indicated Weatherproof (WP): NEMA 250, Type 3R.
 - 8. Industrial Use in Areas Not Otherwise Classified: NEMA 250, Type 12, unless otherwise shown.

3.07 PRECAST HANDHOLES

- A. Do not install until final raceway grading has been determined.
- B. Install such that raceways enter at nearly right angles and as near as possible to one end of wall, unless otherwise shown.

3.08 WIRING DEVICES

- A. Switches:
 - 1. Mounting Height: See Article Outlet and Device Boxes.
 - 2. Install with switch operation in vertical position.

- 3. Install single-pole, two-way switches such that toggle is in up position when switch is on.
- B. Receptacles:
 - 1. Install with grounding slot down, except where horizontal mounting is shown, in which case install with neutral slot down.
 - 2. Weatherproof Receptacles:
 - a. Install in cast metal box.
 - b. Install such that hinge for protective cover is above receptacle opening.
 - 3. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for "downstream" conventional receptacles.
 - 4. Special-Purpose Receptacles: Install in accordance with manufacturer's instructions.

3.09 DEVICE PLATES

- A. Securely fasten to wiring device; ensure a tight fit to box.
- B. Flush Mounted: Install with all four edges in continuous contact with finished wall surfaces without use of mats or similar materials. Plaster fillings will not be acceptable.
- C. Surface Mounted: Plate shall not extend beyond sides of box, unless plates have no sharp corners or edges.
- D. Install with alignment tolerance to box of 1/16-inch.
- E. Engrave with designated titles.
- F. Types (Unless Otherwise Shown):
 - 1. Outdoor: Weatherproof.
 - 2. Indoor:
 - a. Flush Mounted Boxes: Metal.
 - b. Surface Mounted, Metal Boxes: Cast.

3.10 PANELBOARDS

- A. Install securely, plumb, in-line and square with walls.
- B. Install top of cabinet 6 feet above floor, unless otherwise shown.
- C. Provide typewritten circuit directory for each panelboard.

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- D. Cabinet Location/Type:
 - 1. Indoor Dry: NEMA 250, Type 1.
 - 2. Wet or Outdoor: NEMA 250, Type 3R, Outdoor.
 - 3. Industrial Use in Areas Not Otherwise Classified: NEMA 250, Type 12, unless otherwise shown.

3.11 CIRCUIT BREAKERS AND SWITCHES

- A. Location and Enclosure Type:
 - 1. Wet or Outdoor: NEMA 250, Type 4.
 - 2. Corrosive: NEMA 250, Type 4X.
 - 3. Wet and Corrosive: NEMA 250, Type 4X.
 - 4. Indoor Dry, Industrial Use: NEMA 250, Type 12.
 - 5. Indoor Dry, General Purpose: NEMA 250, Type 1.
 - 6. Where Denoted WP: NEMA 250, Type 3R.

3.12 SWITCH, MOTOR RATED

- A. Install with switch operation in vertical position such that toggle is in up position when ON.
- B. Install within sight of motor when used as a disconnect switch.
- C. Mounting Height: See Article Outlet and Device Boxes.
- D. Enclosure Type:
 - 1. General Purpose: See Articles Outlet and Device Boxes and Device Plates.
 - 2. Explosion-proof: See product specification.

3.13 NAMEPLATES

A. Provide identifying nameplate on all equipment.

3.14 SURGE PROTECTION DEVICE (SPD) EQUIPMENT

- A. Install in accordance with manufacturer's instructions, including lead length, overcurrent protection, and grounding.
- 3.15 CONDUIT AND FITTINGS
 - A. General:
 - 1. Crushed or deformed raceways not permitted.

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- 2. Maintain raceway entirely free of obstructions and moisture.
- 3. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- 4. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- 5. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- 6. Group raceways installed in same area.
- 7. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- 8. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- 9. Block Walls: Do not install raceways in same horizontal course with reinforcing steel.
- 10. Install watertight fittings in outdoor, underground, or wet locations.
- 11. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
- 12. Metal conduit to be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- 13. Do not install raceways in concrete equipment pads, foundations, or beams.
- 14. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- 15. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
- 16. Install conduits for fiber optic cables, telephone cables, and Category 5 data cables in strict conformance with the requirements of EIA/TIA 569.
- B. Installation in Cast-in-Place Structural Concrete:
 - 1. Minimum cover 2 inches, including all fittings.
 - 2. Conduit placement shall not require changes in reinforcing steel location or configuration.
 - 3. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.
 - 4. Conduit larger than 1-inch shall not be embedded in concrete slabs, walls, foundations, columns or beams, unless approved by Engineer.
 - 5. Slabs and Walls:
 - a. Trade size of conduit not to exceed one-fourth of the slab or wall thickness.
 - b. Install within middle two-fourths of slab or wall.
 - c. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.

- d. Separate conduit 2 inches and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
- e. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1-inch.
- f. Separate conduit by a minimum six times the outside dimension of expansion and deflection fittings at expansion joints.
- g. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.
- 6. Columns and Beams:
 - a. Trade size of conduit not to exceed one-fourth of beam thickness.
 - b. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.
- C. Conduit Application:
 - 1. Diameter:
 - a. Interior Minimum: 1/2-inch.
 - b. Exterior Minimum: 3/4-inch.
 - 2. Outdoor, Exposed: Rigid galvanized steel.
 - 3. Indoor, Exposed: Rigid galvanized steel.
 - 4. Indoor, Concealed (Not Embedded in Concrete): Rigid galvanized steel.
 - 5. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors: Intermediate metal.
 - 6. Direct Earth Burial: PVC Schedule 40.
 - 7. Under Slabs-On-Grade: PVC Schedule 40.PVC-coated rigid galvanized steel.
 - 8. Corrosive Areas: PVC-coated rigid galvanized steel.
- D. Connections:
 - 1. For motors-, wall-, or ceiling-mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:
 - a. General: Flexible metal, liquid-tight conduit.
 - b. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.
 - c. Wet or Corrosive Areas: Flexible metal liquid-tight.
 - d. Length: 18 inches minimum, 60 inches maximum, sufficient to allow movement or adjustment of equipment.
 - 2. Lighting Fixtures in Dry Areas: Flexible metal, liquid-tight conduit.
 - 3. Outdoor areas, process areas exposed to moisture, and areas required to be oiltight and dust-tight: Flexible metal, liquid-tight conduit.
 - 4. Transition From Underground or Concrete Embedded to Exposed: PVC-coated rigid steel conduit.

- 5. Under Equipment Mounting Pads: Rigid galvanized steel.
- 6. Exterior Light Pole Foundations: Rigid galvanized steel.
- E. Penetrations:
 - 1. Make at right angles, unless otherwise shown.
 - 2. Notching or penetration of structural members, including footings and beams, not permitted.
 - 3. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating using fire penetration seal as specified in Section 07 92 00, Joint Sealants.
 - 4. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack.
 - 5. Entering Structures:
 - a. General: Seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the entrance of gases or liquids from one area to another.
 - b. Concrete Roof or Membrane Waterproofed Wall or Floor: Provide watertight seal.
 - c. Heating, Ventilating, and Air Conditioning Equipment:
 - 1) Penetrate equipment in area established by manufacturer.
 - 2) Terminate conduit with flexible metal conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.
 - Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
 - d. Corrosive-Sensitive Areas:
 - 1) Seal all conduit passing through chlorine room walls.
 - 2) Seal conduit entering equipment panelboards and field panels containing electronic equipment.
 - 3) Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
 - e. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
 - f. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
 - 1) Provide Schedule 40 galvanized pipe sleeve or watertight entrance seal device.
 - 2) Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint on each side.
 - g. Handholes:
 - 1) Metallic Raceways: Provide insulated grounding bushings.
 - 2) Nonmetallic Raceways: Provide bell ends flush with wall.

- F. Support:
 - 1. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 10 feet. Do not support from piping, pipe supports, or other raceways.
 - 2. Application/Type of Conduit Strap:
 - a. Steel Conduit: Zinc-coated steel, pregalvanized steel, or malleable iron.
 - b. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
 - c. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
 - 3. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
 - a. Hollow Masonry Units: Toggle bolts.
 - b. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
 - c. Steelwork: Machine screws.
 - d. Location/Type of Hardware:
 - 1) Dry, Noncorrosive Areas: Galvanized.
 - 2) Wet, Noncorrosive Areas: Stainless steel.
 - 3) Corrosive Areas: Stainless steel.
- G. Bends:
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance.
 - 2. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
 - 3. Install with symmetrical bends or cast metal fittings.
 - 4. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
 - 5. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
 - 6. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run and raceways are same size.
 - 7. PVC Conduit:
 - a. Bends 30 Degrees and Larger: Provide factory-made elbows.
 - b. Use manufacturer's recommended method for forming smaller bends.
 - 8. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

- H. Expansion and Deflection Fittings: Provide on all raceways at structural expansion joints and in long tangential runs.
- I. PVC Conduit:
 - 1. Solvent Welding:
 - a. Provide manufacturer recommended solvent; apply to all joints.
 - b. Install such that joint is watertight.
 - 2. Adapters:
 - a. PVC to Metallic Fittings: PVC terminal type.
 - b. PVC to Rigid Metal Conduit or IMC: PVC female adapter.
 - 3. Belled-End Conduit: Bevel the unbelled end of the joint prior to joining.
- J. PVC-Coated Rigid Steel Conduit:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. All tools and equipment used in the cutting, bending, threading, and installation of PVC-coated rigid steel conduit shall be designed to limit damage to the PVC coating.
 - 3. Provide PVC boot to cover all exposed threading.
- K. Termination at Enclosures:
 - 1. Cast Metal Enclosure: Provide manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.
 - 2. Nonmetallic, Cabinets, and Enclosures: Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
 - 3. Sheet Metal Boxes, Cabinets, and Enclosures:
 - a. Rigid Galvanized and Intermediate Metal Conduit:
 - 1) Provide one lock nut each on inside and outside of enclosure.
 - 2) Install grounding bushing.
 - 3) Provide bonding jumper from grounding bushing to equipment ground bus or ground pad; if neither ground bus nor pad exists, connect jumper to lag bolt attached to metal enclosure.
 - 4) Install insulated bushing on ends of conduit where grounding is not required.
 - 5) Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
 - 6) Utilize sealing locknuts or threaded hubs on outside of NEMA 3R and NEMA 12 enclosures.
 - 7) Terminate conduits with threaded conduit hubs at NEMA 4 and 4X boxes and enclosures.

- b. Electric Metallic Tubing: Provide gland compression, insulated connectors.
- c. Flexible Metal Conduit: Provide two-screw type, insulated, malleable iron connectors.
- d. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
- e. PVC Schedule 40 Conduit: Provide PVC terminal adapter with locknut.
- 4. Free-Standing Enclosures:
 - a. Terminate metal conduit entering bottom with grounding bushing; provide a grounding jumper extending to equipment ground bus or grounding pad.
 - b. Terminate PVC conduit entering bottom with bell end fittings.
- L. Underground Raceways:
 - 1. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.
 - 2. Cover: Maintain minimum 2-foot cover above conduit, unless otherwise shown.
 - 3. Make routing changes as necessary to avoid obstructions or conflicts.
 - 4. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.
 - 5. Union type fittings not permitted.
 - 6. Spacers:
 - a. Provide preformed, nonmetallic spacers, designed for such purpose, to secure and separate parallel conduit runs in a trench.
 - b. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.
 - 7. Support conduit so as to prevent bending or displacement during backfilling.
 - 8. Installation with Other Piping Systems:
 - a. Crossings: Maintain minimum 12-inch vertical separation.
 - b. Parallel Runs: Maintain minimum 12-inch separation.
 - c. Installation over valves or couplings not permitted.
 - 9. Metallic Raceway Coating: Along entire length, coat with raceway coating.
 - 10. Provide expansion fittings that allow minimum of 4 inches of movement in vertical 1.5-inch or larger conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.
 - 11. Provide deflectional/expansion fittings in conduit runs that exit building or structure belowgrade. Conduit from building wall to fitting shall be PVC-coated rigid steel.

- M. Empty Raceways:
 - 1. Provide permanent, removable cap over each end.
 - 2. Provide PVC plug with pull tab for underground raceways with end bells.
 - 3. Provide nylon pull cord.
 - 4. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.
- N. Identification Devices:
 - 1. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of runs.
- O. Raceway Band: Install wherever metallic conduit emerges from concrete slabs. Not required with PVC-coated RGS conduit. Center band at slab surface and install according to manufacturer's instructions.
 - 1. Slip-on Type: Clean conduit surface at installation location. Cut tubing to 4-inch minimum lengths and slip onto raceway prior to slab placement and termination of conduit. Heat-shrink onto conduit.
 - 2. Wrap-around Type: Use where slip-on access to conduit is not possible. Clean conduit surface at installation location. Apply primer. Apply wraps to provide two layers of tape. Neatly finish tape end to prevent unraveling.

3.16 CONDUCTORS AND CABLES

- A. Conductor storage, handling, and installation shall be in accordance with manufacturer's recommendations.
- B. Do not exceed manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- C. Conduit system shall be complete prior to drawing conductors. Lubricate prior to pulling into conduit. Lubrication type shall be as approved by conductor manufacturer.
- D. Terminate all conductors and cables, unless otherwise shown.
- E. Do not splice conductors, unless specifically indicated or approved by Engineer.

- F. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches.
- G. Wiring within Equipment and Local Control Panels: Remove surplus wire, dress, bundle, and secure.
- H. Power Conductor Color Coding:
 - 1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 inches to 2 inches wide.
 - 2. No. 8 AWG and Smaller: Provide colored conductors.
 - 3. Colors:
 - a. Neutral Wire: White.
 - b. Live Wires, 120/240-Volt, Single-Phase System: Black, red.
 - c. Live Wires, 120/208-Volt, Three-Phase System: Black, red, or blue.
 - d. Live Wires, 277/480-Volt, Three-Phase System: Brown, orange, or yellow.
 - e. Ground Wire: Green.
- I. Circuit Identification:
 - 1. Circuits Appearing in Circuit Schedules: Identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
 - 2. Circuits Not Appearing in Circuit Schedules: Assign circuit name based on device or equipment at load end of circuit. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.
 - 3. Method: Identify with sleeves. Taped-on markers or tags relying on adhesives not permitted.
- J. Connections and Terminations:
 - 1. Install wire nuts only on solid conductors.
 - 2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control circuit conductors.
 - 3. Tape insulate all uninsulated connections.
 - 4. Install crimp connectors and compression lugs with tools approved by connector manufacturer.

3.17 GROUNDING

- A. Grounding shall be in compliance with NFPA 70 and as shown.
- B. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.
- C. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.
- D. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- E. Shielded Instrumentation Cables:
 - 1. Ground shield to ground bus at power supply for analog signal.
 - 2. Expose shield minimum 1-inch at termination to field instrument and apply heat shrink tube.
 - 3. Do not ground instrumentation cable shield at more than one point.
- F. Equipment Grounding Conductors: Provide in all conduits containing power conductors and control circuits above 50 volts.
- G. Ground Rods: Install full length with conductor connection at upper end. Install one ground rod in each handhole.

3.18 LUMINAIRES AND ACCESSORIES

- A. Install in accordance with manufacturer's recommendations.
- B. Install plumb and level at mounting heights shown.
- C. Provide proper hangers, pendants, and canopies as necessary for complete installation.
- D. Install symmetrically with suspended ceiling pattern in finished areas.
- E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.
- F. Building Exterior: Provide flush-mounted back box and concealed conduit, unless otherwise shown.

3.19 LIGHTING CONTROL

A. Outdoor Luminaires: Photocells shall switch lights ON at dusk and OFF at dawn.

3.20 FIELD QUALITY CONTROL

- A. General:
 - 1. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.
 - 2. Test instrument calibration shall be in accordance with NETA ATS.
 - 3. Perform inspection and electrical tests after equipment has been installed.
 - 4. Perform tests with apparatus de-energized whenever feasible.
 - 5. Inspection and electrical tests on energized equipment are to be:
 - a. Scheduled with Owner prior to de-energization.
 - b. Minimized to avoid extended period of interruption to the operating plant equipment.
- B. Tests and inspection shall establish that:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances.
 - 2. Installation operates properly.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and NFPA 70.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- D. Adjust mechanisms and moving parts for free mechanical movement.
- E. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- F. Verify nameplate data for conformance to Contract Documents.
- G. Realign equipment not properly aligned and correct unlevelness.
- H. Properly anchor electrical equipment found to be inadequately anchored.
- I. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.

- J. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- K. Provide proper lubrication of applicable moving parts.
- L. Investigate and repair or replace:
 - 1. Electrical items that fail tests.
 - 2. Active components not operating in accordance with manufacturer's instructions.
 - 3. Damaged electrical equipment.
- M. Electrical Enclosures:
 - 1. Remove foreign material and moisture from enclosure interior.
 - 2. Vacuum and wipe clean enclosure interior.
 - 3. Remove corrosion found on metal surfaces.
 - 4. Repair or replace, as determined by Engineer, door and panel sections having damaged surfaces.
 - 5. Replace missing or damaged hardware.
- N. Provide certified test report(s) documenting the successful completion of specified testing. Include field test measurement data.
- O. Test the following equipment and materials:
 - 1. Conductors: Insulation resistance, No. 4 and larger only.
 - 2. Panelboards, switches, and circuit breakers.
 - 3. Motor controls.
 - 4. Grounding electrodes.
 - 5. Motors.
- P. Controls:
 - 1. Test control and signal wiring for proper termination and function.
 - 2. Test local control panels and other control devices for proper terminations, configuration and settings, and functions.
 - 3. Demonstrate control, monitoring, and indication functions in presence of Owner and Engineer.
- Q. Balance electrical load between phases on panelboards and mini-power centers after installation.

R. Voltage Testing:

- 1. When installation is complete and facility is in operation, check voltage at point of termination of electric utility supply system to Project.
- 2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
- If unbalance exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make written request to electric utility to correct condition.
- 4. If corrections are not made, obtain written statement from a responsible electric utility official that voltage variations and/or unbalance are within their normal standards.
- S. Equipment Line Current:
 - 1. Check line current in each phase for each piece of equipment.
 - 2. If electric utility makes adjustments to supply voltage magnitude or balance, make line current check after adjustments are made.

END OF SECTION

SECTION 26 05 02 BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
 - National Electrical Manufacturers Association (NEMA):
 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. Z535.4, Product Safety Signs and Labels.
 - 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.03 ELECTRIC SERVICE DIVISION OF RESPONSIBILITY

A. Incoming aerial electrical service facilities provided by the serving utility as part of its normal obligation to customers is work provided outside this Contract. Schedule and coordinate work of serving utility as required to provide electric service to the Work.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Provide manufacturers' data for the following:
 - a. Electrical service components.
 - b. Nameplates, signs, and labels.

1.05 QUALITY ASSURANCE

A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark or label.

1.06 ENVIRONMENTAL CONDITIONS

- A. The following areas are classified nonhazardous and wet. Use materials and methods required for such areas.
 - 1. Outdoor abovegrade areas.
 - 2. Below grade areas.
- B. The following areas are classified as indoor and dry:
 - 1. Office and Restroom Buildings.
 - 2. Electrical Maintenance Rooms.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
 - B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.
 - C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated in Section 01 61 00, Common Product Requirements.

2.02 EQUIPMENT FINISH

- A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with gray color finish as approved by Engineer.
- 2.03 NAMEPLATES
 - A. Material: Laminated plastic.

- B. Attachment Screws: Stainless steel.
- C. Color: Black, engraved to a white core.
- D. Letter Height:
 - 1. Pushbuttons/Selector Switches: 1/4-inch.
 - 2. Other Electrical Equipment: 3/8-inch.

2.04 SIGNS AND LABELS

- A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.
- B. Warning labels for arc flash shall be provided per NEC code.
- C. Based on the results of arc-flash calculations performed as specified in Section 26 05 70, Electrical Systems Analysis, provide adequate warning labels on all electrical equipment.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.
 - B. Coordinate the conduit installation with other trades and the actual supplied equipment. Obtain information relevant to the placement of electrical work and in case of any interference with other work, process as directed by the Engineer and furnished all labor and materials necessary to complete the Work in an approved manner.
 - C. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on the Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.
 - D. Install work in accordance with NECA Standard of Installation, unless otherwise specified.
 - E. Keep openings in boxes and equipment closed during construction.

- F. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.
- G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the approved equipment at no additional cost to the Owner.
- H. Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement, or equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.
- I. Surface-mounted panel boxes, junction boxes, conduit, etc., shall be supported with 1/2-inch spacers to provide a clearance between the wall and equipment.
- J. All floor-mounted electrical equipment shall be placed on 4-inch thick (3/4-inch, 45-degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.
- K. The Contractor shall coordinate with the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Owner. In case interference develops, the Engineer is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.
- L. Raceways and conductors for lighting, switches, receptacles, and other miscellaneous low voltage power and signal system as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or

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PW\JA\CITY OF PENSACOLA\D3754400 JUNE 6, 2024 ©COPYRIGHT 2024 JACOBS along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

- M. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.
- N. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

3.02 COMBINING CIRCUITS INTO COMMON RACEWAY

- A. Homerun circuits shown on the Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:
 - 1. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).
 - a. Lighting Circuits: Combine no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - b. Receptacle Circuits, 120 Volt Only: Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - c. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

3.03 NAMEPLATES, SIGNS, AND LABELS

- A. Arc Flash Protection Warning Signs:
 - 1. Field mark panelboards to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.
 - 2. Use arc flash hazard boundary, energy level, PPE level and description, shock hazard, bolted fault current, and equipment name from study required in Section 26 05 70, Electrical Systems Analysis as basis for warning signs.

ROGER SCOTT POOL FACILITIES

- B. Available Fault Current Signs:
 - 1. Install label on service equipment to indicate the maximum available fault current at the equipment. Labels shall be of sufficient durability for the environment in which the equipment is installed. Labels shall include the following information:
 - a. Equipment name or identification.
 - b. Available fault current at the equipment.
 - c. Date the fault current calculations were performed.
 - 2. Use bolted fault current and equipment name from study required in Section 26 05 70, Electrical Systems Analysis as basis for the label.
 - 3. Where existing electrical systems are modified, completely remove existing fault current labels if present, and install new labels in accordance with the above requirements.
- C. Equipment Nameplates:
 - 1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
 - 2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
 - 3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
 - 4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.04 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.05 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

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- B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain Shop Drawings and templates from equipment vendors or other subcontractors and locate the concealed conduits before the floor slab is poured.
- C. Where setting Drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installation of such conduits to be exposed. Request for this deviation must be submitted in writing. No additional compensation for such change will be allowed.
- D. Seal all openings, sleeves, penetrations, and slots as specified in Section 26 05 01, Electrical.

3.06 CUTTING AND PATCHING

- A. Cutting and patching shall be done in a thoroughly workmanlike manner.
- B. Install work at such time as to require the minimum amount of cutting and patching.
- C. Do not cut joists, beams, girders, columns, or any other structural members.
- D. Cut openings only large enough to allow easy installation of the conduit.
- E. Patching to be of the same kind and quality of material as was removed.
- F. The completed patching work shall restore the surface to its original appearance or better.
- G. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.
- H. Remove rubble and excess patching materials from the premises.

3.07 CLEANING AND TOUCHUP PAINTING

- A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.
- B. Touchup Paint:
 - 1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.

2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.08 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.
- B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

SECTION 26 05 04 BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
 - b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
 - 2. Canadian Standards Association (CSA).
 - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
 - 4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C12.1, Code for Electricity Metering.
 - c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
 - d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
 - 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 7. UL:
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 810, Standard for Capacitors.
 - g. 943, Standard for Ground-Fault Circuit-Interrupters.

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- h. 1059, Standard for Terminal Blocks.
- i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Provide manufacturers' data for the following:
 - a. Control devices.
 - b. Control relays.
 - c. Circuit breakers.
 - d. Fused switches.
 - e. Nonfused switches.
 - f. Timers.
 - g. Fuses.
 - h. Magnetic contactors.
 - i. Intrinsic safety barriers.
 - j. Firestopping.
 - k. Enclosures: Include enclosure data for products having enclosures.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

- A. General:
 - 1. Type: Molded case.
 - 2. Trip Ratings: 15 amps to 800 amps.
 - 3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.
 - 4. Suitable for mounting and operating in any position.
 - 5. UL 489.
- B. Operating Mechanism:
 - 1. Overcenter, trip-free, toggle type handle.
 - 2. Quick-make, quick-break action.
 - 3. Locking provisions for padlocking breaker in OPEN position.
 - 4. ON/OFF and TRIPPED indicating positions of operating handle.
 - 5. Operating handle to assume a CENTER position when tripped.
- C. Trip Mechanism:
 - 1. Individual permanent thermal and magnetic trip elements in each pole.

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- 2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
- 3. Two and three pole, common trip.
- 4. Automatically opens all poles when overcurrent occurs on one pole.
- 5. Test button on cover.
- 6. Calibrated for 40 degrees C ambient, unless shown otherwise.
- 7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.
- D. Short Circuit Interrupting Ratings:
 - 1. Not less than the following rms symmetrical currents for the indicated trip ratings:
 - a. Up to 100A, less than 250V ac: 10,000 amps.
 - b. Over 100A22,000amps.
- E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).
 - 1. Ground fault sensor shall be rated same as circuit breaker.
 - 2. Push-to-test button.
- F. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker specified above with ground fault sensor and rated to trip on 30-mA ground fault (UL-listed for equipment ground fault protection).
- G. Connections:
 - 1. Supply (line side) at either end.
 - 2. Mechanical wire lugs, except crimp compression lugs where shown.
 - 3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
 - 4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
- H. Enclosures for Independent Mounting:
 - 1. See Article Enclosures.
 - 2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
 - 3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.
2.02 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

- A. UL 98 listed for use and location of installation.
- B. NEMA KS 1.
- C. Short Circuit Rating: 200,000 amps rms symmetrical with Class R, Class J, or Class L fuses installed.
- D. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- E. Connections:
 - 1. Mechanical lugs, except crimp compression lugs where shown.
 - 2. Lugs removable/replaceable.
 - 3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.
- F. Fuse Provisions:
 - 1. 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.
 - 2. 601-amp rated and greater shall accept Class L fuses, unless otherwise shown.
- G. Enclosures: See Article Enclosures.
- H. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.03 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

- A. NEMA KS 1.
- B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- C. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.
- D. Enclosures: See Article Enclosures.
- E. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.04 FUSE, 250-VOLT AND 600-VOLT

- A. Power Distribution, General:
 - 1. Current-limiting, with 200,000 ampere rms interrupting rating.
 - 2. Provide to fit mountings specified with switches.
 - 3. UL 248.
- B. Power Distribution, Ampere Ratings 1 Amp to 600 Amps:
 - 1. Class: RK-1.
 - 2. Type: Dual element, with time delay.
 - 3. Manufacturers and Products:
 - a. Bussmann; Types LPS-RK (600 volts) and LPN-RK (250 volts).
 - b. Littelfuse; Types LLS-RK (600 volts) and LLN-RK (250 volts).
- C. Cable Limiters:
 - 1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
 - 2. Manufacturer and Product: Bussmann; K Series.
- D. Ferrule:
 - 1. 600V or less, rated for applied voltage, small dimension.
 - 2. Ampere Ratings: 1/10 amp to 30 amps.
 - 3. Dual-element time-delay, time-delay, or nontime-delay as required.
 - 4. Provide with blocks or holders as indicated and suitable for location and use.
 - 5. Manufacturers:
 - a. Bussmann.
 - b. Littlefuse, Inc.

2.05 TERMINAL BLOCK, 600 VOLTS

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.
- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals:
 - 1. Capable of wire connections without special preparation other than stripping.
 - 2. Capable of jumper installation with no loss of terminal or rail space.
 - 3. Individual, rail mounted.
- I. Marking system, allowing use of preprinted or field-marked tags.
- J. Manufacturers:
 - 1. Weidmuller, Inc.
 - 2. Ideal.
 - 3. Electrovert USA Corp.

2.06 SUPPORT AND FRAMING CHANNELS

- A. PVC-Coated Framing Channel: Aluminum steel framing channel with 40-mil polyvinyl chloride coating.
- B. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.
- C. Extruded Aluminum Framing Channel:
 - 1. Material: Extruded from Type 6063-T6 aluminum alloy.
 - 2. Fittings fabricated from Alloy 5052-H32.
- D. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Unistrut Corp.
 - 3. Aickinstrut.

2.07 INTRINSIC SAFETY BARRIER

A. Provides a safe energy level for exposed wiring in a Class I, Division 1 or Division 2 hazardous area when circuit is connected to power source in nonhazardous area.

- B. Rating: Power source shall be rated 24 volts dc, nominal, with not more than 250 volts available under fault conditions.
- C. Contact Rating: 5 amps, 250 volts ac.
- D. Mounting: Rail or surface.
- E. Manufacturers and Products:
 - 1. MTL, Inc.; Series 2000 or Series 3000.
 - 2. R. Stahl, Inc.

2.08 SWITCHBOARD MATTING

- A. Provide matting having a breakdown of 20 kV minimum.
- B. Manufacturer: U.S. Mat and Rubber Company.

2.09 FIRESTOPS

- A. General:
 - 1. Provide UL 1479 classified hourly fire rating equal to, or greater than, the assembly penetrated.
 - 2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
 - 3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by UL, or other testing and inspection agency acceptable to authorities having jurisdiction.

2.10 ENCLOSURES

- A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.
- B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.
- C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

- D. Enclosure Selections:
 - 1. Except as shown otherwise, provide electrical enclosures according to the following table:

Enclosures						
Location	Finish	Environment	NEMA 250 Type			
Indoor	Finished	Dry	1			
Indoor	Unfinished	Dry	1			
Indoor	Unfinished	Industrial Use	12			
Indoor and Outdoor	Any	Wet	4			
Indoor and Outdoor	Any	Denoted "WP"	3R			
Indoor and Outdoor	Any	Wet and Corrosive	4X			
Indoor and Outdoor	Any	Wet, Dust or Oil	13			
Indoor and Outdoor	Any	Hazardous Gas	7			
Indoor and Outdoor	Any	Hazardous Dust	9			

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Install equipment in accordance with manufacturer's recommendations.

3.02 SUPPORT AND FRAMING CHANNEL

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel Type:
 - 1. Interior, Wet or Dry (Noncorrosive) Locations:
 - a. Aluminum Raceway: Extruded aluminum or stainless steel with neoprene material isolators.
 - b. PVC-Coated Conduit: PVC coated.
 - c. Steel Raceway and Other Systems Not Covered: Stainless steel or paint coated.
 - 2. Interior, Corrosive (Wet or Dry) Locations:
 - a. Aluminum Raceway: Extruded aluminum.
 - b. PVC Conduit: Type 316 stainless steel or nonmetallic.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered:
 - Type 316 stainless steel, nonmetallic, or PVC-coated steel.
 - 3. Outdoor, Noncorrosive Locations:
 - a. Steel Raceway: Stainless steel or paint coated framing channel.

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- b. Aluminum Raceway and Other Systems Not Covered: Aluminum framing channel or carbon steel with neoprene material isolators.
- 4. Outdoor Corrosive Locations:
 - a. PVC Conduit: Type 316 stainless steel.
 - b. Aluminum Raceway: Aluminum with neoprene material isolators.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel.
- C. Paint cut ends prior to installation with the following:
 - 1. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
 - 2. Nonmetallic Channel: Epoxy resin sealer.
 - 3. PVC-Coated Channel: PVC patch.

3.03 INTRINSIC SAFETY BARRIERS

- A. Install in compliance with ISA RP12.06.01.
- B. Arrange conductors such that wiring from hazardous areas cannot short to wiring from nonhazardous area.
- C. Stencil "INTRINSICALLY SAFE CIRCUIT" on all boxes enclosing barriers.

3.04 SWITCHBOARD MATTING

- A. Install 36-inch width at switchgear, switchboard, motor control centers, and panelboards.
- B. Matting shall run full length of all sides of equipment that have operator controls or afford access to devices.

3.05 FIRESTOPS

- A. Install in strict conformance with manufacturer's instructions. Comply with installation requirements established by testing and inspecting agency.
- B. Sealant: Install sealant including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

SECTION 26 05 05 CONDUCTORS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
 - 2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
 - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
 - b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
 - 4. Insulated Cable Engineer's Association, Inc. (ICEA):
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 - b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
 - c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
 - 5. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.
 - b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
 - c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

- d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.
- e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- 7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
- 8. UL:
 - a. 13, Standard for Safety for Power-Limited Circuit Cables.
 - b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
 - c. 62, Standard for Safety for Flexible Cord and Cables.
 - d. 486A-486B, Standard for Safety for Wire Connectors.
 - e. 486C, Standard for Safety for Splicing Wire Connectors.
 - f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - g. 854, Standard for Safety for Service-Entrance Cables.
 - h. 1072, Standard for Safety for Medium-Voltage Power Cables.
 - i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - j. 1569, Standard for Safety for Metal-Clad Cables.
 - k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Wire and cable.
 - b. Wire and cable accessories.
 - c. Cable fault detection system.
 - 2. Cable Pulling Calculations:
 - a. Ensure submitted and reviewed before cable installation.
 - b. Provide for the following cable installations: Multiconductor 600-volt cable sizes larger than 2 AWG that cannot be hand pulled.

1.03 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

- 2.01 CONDUCTORS 600 VOLTS AND BELOW
 - A. Conform to applicable requirements of NEMA WC 70.
 - B. Conductor Type:
 - 1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
 - 2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
 - 3. All Other Circuits: Stranded copper.
 - C. Insulation: Type THHN/THWN-2 except for AWG No 6 and larger, with XHHW-2 insulation.
 - D. Direct Burial and Aerial Conductors and Cables:
 - 1. Type USE/RHH/RHW insulation, UL 854 listed, or Type RHW-2/USE-2.
 - 2. Conform to physical and minimum thickness requirements of NEMA WC 70.
 - E. Flexible Cords and Cables:
 - 1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
 - 2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.02 600-VOLT RATED CABLE

- A. General:
 - 1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
 - 2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
 - 3. Suitable for installation in open air, in cable trays, or conduit.
 - 4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
 - 5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.
- B. Type 2, Multiconductor Power Cable:
 - 1. General:
 - a. Meet or exceed UL 1581 for cable tray use.
 - b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
 - c. Overall Jacket: PVC.
 - 2. Conductors:
 - a. Class B stranded, coated copper.
 - b. Insulation: Chemically cross-linked ethylene-propylene or crosslinked polyethylene.
 - c. UL rated VW-1 or listed Type XHHW-2.
 - d. Color Code:
 - 1) Conductors, size 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
 - 2) Conductors, size 6 AWG and larger, ICEA S-73-532, Method 4.
 - 3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
 - 4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2	0.42	45
		3	0.45	
		4	0.49	
10	10	2	0.54	60
		3	0.58	
		4	0.63	

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Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
8	10	3 4	0.66 0.75	60
6	8	3 4	0.74 0.88	60
4	6	3 4	0.88 1.04	60 80
2	6	3 4	1.01 1.16	80
1	6	3 4	1.10 1.25	80
1/0	6	3 4	1.22 1.35	80
2/0	4	3 4	1.32 1.53	80
3/0	4	3 4	1.40 1.60	80
4/0	4	3 4	1.56 1.78	80 110

- 5. Manufacturers:
 - a. Okonite Co.
 - b. Southwire.

2.03 300-VOLT RATED CABLE

- A. General:
 - 1. Type PLTC, meeting requirements of UL 13 and NFPA 70, Article 725.
 - 2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
 - 3. Suitable for installation in open air, in cable trays, or conduit.
 - 4. Minimum Temperature Rating: 105 degrees C.
 - 5. Passes Vertical Tray Flame Test.
 - 6. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

2.04 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW XLPE or THHN/THWN, insulation.

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B. Direct Buried: Bare stranded tinned copper.

2.05 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

- A. Tape:
 - General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
 - 2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
 - 3. Arc and Fireproofing:
 - a. 30-mil, elastomer.
 - b. Manufacturers and Products:
 - 1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - 2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices:

- 1. Sleeve:
 - a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturers and Products:
 - 1) Raychem; Type D-SCE or ZH-SCE.
 - 2) Brady, Type 3PS.
- 2. Heat Bond Marker:
 - a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
 - b. Self-laminating protective shield over text.
 - c. Machine printed black text.
 - d. Manufacturer and Product: 3M Co.; Type SCS-HB.
- 3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
- 4. Tie-On Cable Marker Tags:
 - a. Chemical-resistant white tag.
 - b. Size: 1/2-inch by 2 inches.
 - c. Manufacturer and Product: Raychem; Type CM-SCE.
- 5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.
- C. Connectors and Terminations:
 - 1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.

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- 2) Burndy; Insulug.
- 3) ILSCO.
- 2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO; ILSCONS.
- 3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. UL 486C.
 - b. Plated steel, square wire springs.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
- 4. Self-Insulated, Set Screw Wire Connector:
 - a. Two piece compression type with set screw in brass barrel.
 - b. Insulated by insulator cap screwed over brass barrel.
 - c. Manufacturers:
 - 1) 3M Co.
 - 2) Thomas & Betts.
 - 3) Marrette.
- D. Cable Lugs:
 - 1. In accordance with NEMA CC 1.
 - 2. Rated 600 volts of same material as conductor metal.
 - 3. Uninsulated Crimp Connectors and Terminators:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Manufacturers and Products:
 - 1) Thomas & Betts; Color-Keyed.
 - 2) Burndy; Hydent.
 - 3) ILSCO.
 - 4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.
- E. Cable Ties:
 - 1. Nylon, adjustable, self-locking, and reusable.
 - 2. Manufacturer and Product: Thomas & Betts; TY-RAP.

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- F. Heat Shrinkable Insulation:
 - 1. Thermally stabilized cross-linked polyolefin.
 - 2. Single wall for insulation and strain relief.
 - 3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
 - 4. Manufacturers and Products:
 - a. Thomas & Betts; SHRINK-KON.
 - b. Raychem; RNF-100 and ES-2000.

2.06 PULLING COMPOUND

- A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Approved for intended use by cable manufacturer.
- D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.
- E. Manufacturers:
 - 1. Ideal Co.
 - 2. Polywater, Inc.
 - 3. Cable Grip Co.

2.07 SOURCE QUALITY CONTROL

A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Conductor installation shall be in accordance with manufacturer's recommendations.
 - B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
 - C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
 - D. Terminate conductors and cables, unless otherwise indicated.

- E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors and aluminum conductors.
- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-tocenter spacing as required by equipment terminals.
- G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.
- H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

- A. Conductors 600 Volts and Below:
 - 1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
 - 2. 8 AWG and Smaller: Provide colored conductors.
 - 3. Colors:

System	Conductor	Color	
All Systems	Equipment Grounding	Green	
240/120 Volts, Single-Phase, Three- Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red	
240/120 Volts, Three- Phase, Four-Wire, Delta, Center Tap, Ground on Single- Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue	
	1. 1	1 •	

Note: Phase A, B, C implies direction of positive phase rotation.

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

- A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.
- C. Circuits Not Appearing in Circuit Schedules:
 - 1. Assign circuit name based on device or equipment at load end of circuit.
 - 2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.
- D. Method:
 - 1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
 - 2. Cables and Conductors 2 AWG and Larger:
 - a. Identify with marker plates or tie-on cable marker tags.
 - b. Attach with nylon tie cord.
 - 3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.
- C. Connections and Terminations:
 - 1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
 - 2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
 - 3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
 - 4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.

- 5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
- 6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
- 7. Place no more than one conductor in any single-barrel pressure connection.
- 8. Install crimp connectors with tools approved by connector manufacturer.
- 9. Install terminals and connectors acceptable for type of material used.
- 10. Where aluminum conductors are provided, apply oxide-inhibiting compound at joints and terminations.
- 11. Compression Lugs:
 - a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - b. Install connectors designed for aluminum conductors utilizing compression barrel termination of conductor and terminating in dual rated lug.
 - c. Do not use plier type crimpers.
- D. Do not use soldered mechanical joints.
- E. Splices and Terminations:
 - 1. Insulate uninsulated connections.
 - 2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
 - 3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
 - 4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.
- F. Cap spare conductors with UL listed end caps.
- G. Cabinets, Panels, and Motor Control Centers:
 - 1. Remove surplus wire, bridle and secure.
 - 2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.
- H. Control and Instrumentation Wiring:
 - 1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.

- 2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
- 3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
- 4. Cable Protection:
 - a. Under Infinite Access Floors: May install without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2-inch in diameter.
 - c. Maintain integrity of shielding of instrumentation cables.
 - d. Ensure grounds do not occur because of damage to jacket over shield.

END OF SECTION

SECTION 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
 - 2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).
 - 3. UL.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Product data for the following:
 - 1) Ground rod.

1.03 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within scope of standards published by UL:
 - a. Confirm conformance with UL standards.
 - b. Supply with an applied UL listing mark.

PART 2 PRODUCTS

- 2.01 GROUND ROD
 - A. Material: Copper or Copper-clad.
 - B. Diameter: Minimum 5/8-inch.
 - C. Length: 20 feet.

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2.02 GROUND CONDUCTORS

A. As specified in Section 26 05 05, Conductors.

2.03 CONNECTORS

- A. Exothermic Weld Type:
 - 1. Outdoor Weld: Suitable for exposure to elements or direct burial.
 - 2. Indoor Weld: Use low-smoke, low-emission process.
 - 3. Manufacturers and Product:
 - a. NVent ERICO Products, Inc.
 - b. ThermOweld.
- B. Compression Type:
 - 1. Compress-deforming irreversible type; wrought copper extrusion material.
 - 2. Single indentation for conductors 6 AWG and smaller.
 - 3. Double indentation with extended barrel for conductors 4 AWG and larger.
 - 4. Barrels prefilled with oxide-inhibiting and anti-seizing compound and sealed.
 - 5. Manufacturers and Products:
 - a. Burndy Corp.; Hyground Compression.
 - b. Thomas and Betts Co.; EZGround Compression.
 - c. NVent ILSCO.
- C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.
 - 1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. O-Z Gedney.

2.04 GROUNDING WELLS

- A. Precast Concrete: Ground rod box complete with cast-iron riser ring and H-20 rated cast iron traffic cover marked "GROUND ROD".
- B. Manufacturers and Products:
 - 1. Christy Co.
 - 2. Harger Lightning and Grounding.
 - 3. Oldcastle Infrastructure; Non-Traffic rated.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide Grounding in compliance with NFPA 70 and IEEE C2.
- B. Bond electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.
- C. Bond each separately derived system neutral with common grounding electrode conductor to grounding electrode system.
- D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.
- E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- D. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.
- E. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.03 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

- B. Motors Less Than 10 hp: Use furnished ground lug in motor connection box. If none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.
- C. Motors 10 hp and Above: Use furnished ground lug in motor connection box. If none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.
- D. Circuits 20 Amps or Above: Tap motor frame or equipment housing. Install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

- A. Install full length with conductor connection at upper end.
- B. Install with connection point below finished grade, unless otherwise shown.
- C. Space multiple ground rods by a minimum of one rod length.
- D. Install to 8 feet below local frost depth.

3.05 GROUNDING WELLS

- A. Install for ground rods located inside buildings, asphalt and paved areas, and where shown on the Drawings.
- B. Install riser ring and cover flush with surface.
- C. Place 6 inches of crushed rock in bottom of each well.

3.06 CONNECTIONS

- A. General:
 - 1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
 - 2. Belowgrade Connections: Install exothermic weld or compression type connectors.
 - 3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
 - 4. Notify Engineer prior to backfilling ground connections.
- B. Exothermic Weld Type:
 - 1. Wire brush or file contact point to bare metal surface.

- 2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
- 3. Avoid using badly worn molds.
- 4. Mold to be completely filled with metal when making welds.
- 5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.
- C. Compression Type:
 - 1. Install in accordance with connector manufacturer's recommendations.
 - 2. Install connectors of proper size for grounding conductors and ground rods specified.
 - 3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.
- D. Mechanical Type:
 - 1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
 - 2. Install in accordance with connector manufacturer's recommendations.
 - 3. Do not conceal mechanical connections.

END OF SECTION

SECTION 26 05 70 ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI).
 - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - d. 1584, Guide for Performing Arc Flash Hazard Calculations.
 - 3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 - 5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

1.02 SUBMITTALS

- A. Action Submittals Signed and Sealed by Professional Engineer (PE) in Florida::
 - 1. Short circuit study.
 - 2. Protective Device Coordination Study.
 - 3. Arc Flash Study.
 - 4. Arc flash warning labels.

1.03 QUALITY ASSURANCE

- A. Short circuit and protective device coordination and arc flash studies shall be prepared by manufacturer furnishing equipment for incoming service or a professional electrical engineer registered in the State of Florida.
- B. The short circuit, protective device coordination and arc flash studies shall be signed and sealed by a professional engineer (PE) registered in the State of Florida.

1.04 SEQUENCING AND SCHEDULING

- A. Initial complete short circuit study shall be submitted and reviewed before Engineer will review Shop Drawings for overcurrent protective equipment for incoming service equipment.
- B. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study. It is imperative that the electrical subcontractor begin this Work immediately after award of the Contract. This task requires extensive coordination and work with numerous Vendors. Failure of the electrical subcontractor to provide the initial complete short circuit study before any Shop Drawing for any overcurrent protective equipment will result in rejection of the Shop Drawing without revie
- C. Revised short circuit, protective device coordination, and arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.
- D. Final short circuit, protective device coordination, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.
- E. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to Project Substantial Completion.

1.05 GENERAL STUDY REQUIREMENTS

- A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on the Drawings.
- B. Short circuit, protective device coordination and arc-flash studies shall be performed as a minimum on the following pieces of equipment:
 - 1. Main Disconnect
 - 2. Panelboards: MBC-1A, MCB-1B, MCB-3A and MCB-3B.
- C. Perform studies using one of the following electrical engineering software packages:
 - 1. SKM Power Tools for Windows.
 - 2. ETAP.
 - 3. Easy Power.

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- D. Perform complete fault calculations for each ultimate source combination.
 - 1. Source combination may include present and future power company supply circuits, large motors, or generators. Obtain and verify with the Power Company in writing all information needed to conduct this study. Provide this correspondence and information including contacts and phone numbers with the Study Submittal.
- E. Utilize proposed load data for study obtained from Contract Documents and field investigation of system configuration, wiring information, and equipment.
- F. Existing System and Equipment:
 - 1. Extent of existing system to be included in study is limited to system elements that affect new system and equipment.
 - 2. Include fault contribution of existing motors and equipment in study.
 - 3. Include impedance elements that affect new system and equipment.
 - 4. Include protective devices in series with new equipment.
- G. Device coordination time-current curves for low voltage distribution system; include individual protective device time-current characteristics.

1.06 SHORT CIRCUIT STUDY

- A. General:
 - 1. Prepare in accordance with IEEE 399.
 - 2. Use cable impedances based on copper conductors, except where aluminum conductors are specified or shown.
 - 3. Use bus impedances based on copper bus bars, except where aluminum bus bars are specified or shown.
 - 4. Use cable and bus resistances calculated at 25 degrees C.
 - 5. Use medium-voltage cable reactances based on use of typical dimensions of shielded cables with 133 percent insulation levels.
 - 6. Use 600-volt cable reactances based on use of typical dimensions of THHN/THWN conductors.
 - 7. Use transformer impedances 92.5 percent of "nominal" impedance based on tolerances specified in IEEE C57.12.00.
- B. Provide:
 - 1. Calculation methods and assumptions.
 - 2. Typical calculation.
 - 3. Tabulations of calculated quantities.
 - 4. Results, conclusions, and recommendations.

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- 5. Selected base per unit quantities.
- 6. One-line diagrams.
- 7. Source impedance data, including electric utility system and motor fault contribution characteristics.
- 8. Impedance diagrams.
- 9. Zero-sequence impedance diagrams.
- C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:
 - 1. Electric utility's supply termination point.
 - 2. Main Disconnect.
 - 3. Low-voltage switchboards.
 - 4. Branch circuit panelboards.
 - 5. Future load contributions as shown on one-line diagram.
- D. Verify:
 - 1. Equipment and protective devices are applied within their ratings.
 - 2. Adequacy of bus bars to withstand short circuit stresses.
 - 3. Cable and busway sizes for ability to withstand short circuit heating, in addition to normal load currents.
- E. Tabulations:
 - 1. General Data:
 - a. Short circuit reactances of rotating machines.
 - b. Cable and conduit material data.
 - c. Bus data.
 - d. Transformer data.
 - e. Circuit resistance and reactance values.
 - 2. Short Circuit Data:
 - a. Fault impedances.
 - b. X to R ratios.
 - c. Asymmetry factors.
 - d. Motor contributions.
 - e. Short circuit kVA.
 - f. Symmetrical and asymmetrical fault currents.
 - 3. Equipment Evaluation:
 - a. Equipment bus bracing, equipment short circuit rating,
 - transformer, cable, busway.
 - b. Maximum fault current available.
- F. Written Summary:
 - 1. Scope of studies performed.

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- 2. Explanation of bus and branch numbering system.
- 3. Prevailing conditions.
- 4. Selected equipment deficiencies.
- 5. Results of short circuit study.
- 6. Comments or suggestions.
- G. Suggest changes and additions to equipment rating and/or characteristics.
- H. Notify Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.
- I. Revise data for "as-installed" condition.

1.07 PROTECTIVE DEVICE COORDINATION STUDY

- A. General:
 - 1. Prepare in accordance with IEEE 242.
 - 2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
 - a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
 - b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four to six.
 - c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
 - d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
 - e. Apply motor protection methods that comply with NFPA 70.
- B. Plot Characteristics on Curve Sheets:
 - 1. Electric utility's relays.
 - 2. Electric utility's fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - 3. Medium-voltage equipment relays.
 - 4. Medium-voltage and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - 5. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
 - 6. Pertinent transformer full-load currents at 100 percent.
 - 7. Transformer magnetizing inrush currents.

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- 8. Transformer damage curves; appropriate for system operation and location.
- 9. ANSI transformer withstand parameters.
- 10. Significant symmetrical and asymmetrical fault currents.
- 11. Motor overload relay settings for motors greater than 40 hp.
- 12. Ground fault protective device settings.
- 13. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.
- C. Primary Protective Device Settings for Delta-Wye Connected Transformer:
 - 1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
 - 2. Secondary Line-to-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.
- D. Tabulate Recommended Protective Device Settings:
 - 1. Relays:
 - a. Current tap.
 - b. Time dial.
 - c. Instantaneous pickup.
 - d. Electronic settings data file.
 - 2. Circuit Breakers:
 - a. Adjustable pickups.
 - b. Adjustable time-current characteristics.
 - c. Adjustable time delays.
 - d. Adjustable instantaneous pickups.
 - e. I^2t In/Out.
 - f. Zone interlocking.
 - g. Electronic settings data file.
- E. Written Summary:
 - 1. Scope of studies performed.
 - 2. Summary of protective device coordination methodology.
 - 3. Prevailing conditions.
 - 4. Selected equipment deficiencies.
 - 5. Results of coordination study.
 - 6. Appendix of complete relay and circuit breaker electronic setting files.
 - 7. Comments or suggestions.
 - 8. Suggest changes and additions to equipment rating and/or
 - characteristics for proper coordination.

F. Notify Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.

1.08 ARC FLASH STUDY

- A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted.
- B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.
- C. Base Calculation: For each major part of electrical power system, determine the following:
 - 1. Arc-Flash Hazard:
 - a. Arc-flash hazard protection boundary.
 - b. Incident energy level.
 - c. Working distance.
 - 2. Shock Hazard:
 - a. Limited approach boundary.
 - b. Restricted approach boundary.
 - c. Prohibited approach boundary.
 - d. Bus voltage.
 - e. Glove class.
- D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.
 - 1. Bus name.
 - 2. Calculation Method.
 - 3. Label expiration date.
 - 4. Reference to NFPA 70 E for PPE requirements.
- E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:
 - 1. Bus name.
 - 2. Upstream protective device name, type, and settings.
 - 3. Bus line-to-line voltage.
- F. Produce arc flash evaluation summary sheet listing the following additional items:
 - 1. Bus name.
 - 2. Upstream protective device name, type, settings.
 - 3. Bus line-to-line voltage.

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- 4. Bus bolted fault.
- 5. Protective device bolted fault current.
- 6. Arcing fault current.
- 7. Protective device trip/delay time.
- 8. Breaker opening time.
- 9. Solidly grounded column.
- 10. Equipment type.
- 11. Gap.
- 12. Arc flash boundary.
- 13. Working distance.
- 14. Incident energy.
- 15. Required protective fire rated clothing type and class.
- 16. Table of required PPE.
- G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm². Propose approaches to reduce energy levels.
- H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:
 - 1. Equipment manufacturer's information used to prepare study.
 - 2. Assumptions made during study.
 - 3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
 - 4. Arc flash evaluations summary spreadsheet.
 - 5. Bus detail sheets.
 - 6. Arc flash warning labels printed in color on thermally bonded adhesive backed UV and weather-resistant labels.
- I. Replace existing Arc Flash warning labels with new labels as required per Arc Flash study results.

PART 2 PRODUCTS

2.01 ARC FLASH WARNING LABELS

A. Arc flash warning labels printed in color on thermally bonded adhesive backed, UV- and weather-resistant labels.

PART 3 EXECUTION

3.01 GENERAL

- A. Adjust relay and protective device settings according to values established by coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Engineer in writing of required major equipment modifications.
- D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.
- E. Provide arc flash warning labels on equipment as specified in this section.

END OF SECTION

SECTION 26 43 00 SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI).
 - 2. Department of Defense: MIL-STD-220C, Test Method Standard Method of Insertion Loss Measurement.
 - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - b. C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
 - c. C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits.
 - 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 5. UL:
 - a. 497A, Standard for Secondary Protectors for Communications Circuits.
 - b. 1283, Standard for Electromagnetic Interference Filters.
 - c. 1449, Standard for Surge Protective Devices.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product data on each suppressor type, indicating component values, part numbers, and conductor sizes. Include dimensional drawing for each, showing mounting arrangements.
 - 2. Electrical single-line diagram showing location of each SPD.
 - 3. Manufacturer's UL certified test data and nameplate data for each surge protective device (SPD).
1.03 QUALITY ASSURANCE

- A. UL Compliance and Labeling:
 - 1. SPDs for Power and Signal Circuits: Comply with UL 1449 and complimentary listed to UL 1283 as an electromagnetic interference filter. Provide units listed and labeled by UL.
 - 2. SPDs for Telephone Circuit Protection: Comply with UL 497A.
- B. ANSI Compliance: Use SPD devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Eaton, SPD Series.
- B. Square D, Schneider.
- C. Advanced Protection Technologies, Inc.
- D. CITEL, MDS Series.

2.02 GENERAL

- A. SPD must be appropriate and suitable for open delta with high leg.
- B. Unless indicated otherwise, provide direct bus-connected and factory-installed SPDs inside distribution equipment.
- C. SPD Operating Conditions: Capable of performing at ambient temperatures between minus 40 degrees C and 60 degrees C, at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.
- D. Connect SPDs through a fused switch or circuit breaker as selected by manufacturer. Provide overcurrent protection to allow full surge handling capabilities and afford safety protection from thermal overloads and short circuits.
- E. SPD Short Circuit Current Rating (SCCR): No less than the SCCR of distribution equipment.
- F. Design SPD devices to protect all modes (L-L, L-N, L-G, N-G) of electrical system being used.

- G. Power Filter: Include a high-frequency extended range power filter for each SPD complimentary listed to UL 1283 as an electromagnetic interference filter.
- H. Provide SPDs with the following monitoring and diagnostics:
 - 1. LED-type indication lights to show normal and failed status of each protected phase.
 - 2. Surge event counter.
 - 3. Form C dry contact which operates when unit fails.
- I. Provide UL Type 2 SPDs.
- J. EMI/RFI Noise Suppression: -50dB attenuation at 100 kHz, tested per MIL-STD 220C.
- K. Voltage Protection Rating (VPR):

Voltage Rating	L-N	N-G	L-G	L-L
208Y/120	800	800	800	1200
480Y/277	1200	1200	1200	2000
240 Δ			1200	1200
480 Δ			2000	2000

2.03 SERVICE ENTRANCE AND DISTRIBUTION SPD

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category C.
- B. Surge Current Capacity:
 - 1. Service Entrance:
 - a. 200kA per phase.
 - b. 100kA per mode.
 - 2. Distribution:
 - a. 120kA per phase.
 - b. 60kA per mode.
- C. Maximum Continuous Operating Voltage (MCOV): Not less than 115 percent of nominal system voltage.
- D. Nominal Discharge Current (I_N): 20kA.

2.04 PANELBOARD SPD

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category B.
- B. Surge Current Capacity:
 - 1. Distribution: 120kA per phase; 60kA per mode.
 - 2. Branch: 80kA per phase; 40kA per mode
- C. Maximum Continuous Operating Voltage (MCOV): Not less than 125 percent of the nominal system voltage.
- D. Nominal Discharge Current (I_N): 10kA.

PART 3 EXECUTION

3.01 APPLICATION REQUIREMENTS

- A. Provide SPDs when indicated on the Drawings or in the equipment specifications.
- B. Provide factory-installed SPDs as integral components to new switchgear, switchboards, motor control centers, panelboards and transfer switches. Externally mounted SPDs are not acceptable for new distribution equipment.
- C. Externally mounted SPDs are acceptable for SPDs added to existing equipment as described below.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install suppressors according to manufacturer's recommendations.
- B. Install suppressors directly to the cabinet which houses the circuit to be protected so that the suppressor leads are straight and short, with conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.
- C. Provide connecting wires as short as possible with gently twisted conductors, tied together, to prevent separation.
 - 1. Maximum Length: 24 inches.

- D. Field Installed Conductors: As specified for building wire, not smaller than 8 AWG and not larger than 4 AWG. Provide device leads not longer than the maximum length recommended by manufacturer, unless specifically reviewed and approved by manufacturer.
- E. Provide dedicated disconnecting means for SPD devices installed at main service entrance location, switchgear, and motor control centers. Provide dedicated 30-60-ampere circuit breakers (size dependent upon wire size used) with number of poles as required, as disconnecting means for SPD devices. Provide circuit breakers with interrupting capacity equal to that specified for other breakers at that location.

END OF SECTION

SECTION 26 50 00 LIGHTING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. A572/A572A, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, with 50 ksi Minimum Yield Point to 4-in. Thick.
 - e. A595/A595M, Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
 - f. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - g. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - h. D6576, Standard Specification for Flexible Cellular Rubber Chemically Blown.
 - i. G154, Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
 - 2. American Wood Protection Association (AWPA): M6, Brands Used on Forest Products.
 - 3. Canadian Standards Association (CSA).
 - 4. Certified Ballast Manufacturer (CBM).
 - 5. Federal Communications Commission (FCC).
 - 6. Illuminating Engineering Society of North America (IESNA).
 - a. HB-9, Lighting Handbook.
 - b. LM-79, IES Electrical and Photometric Measurements of Solid-State Lighting Products.
 - c. LM-80, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.

- d. RP (Recommended Practices) Series.
- e. TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.
- Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- 8. National Electrical Manufacturers Association (NEMA):
- 9. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- 10. ICS 6, Industrial Control and Systems: Enclosures.
- 11. National Energy Policy Act.
- 12. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC) Softbound Version.
- 13. Rural Utilities Service (RUS): 1728F-700, Specification for Wood Poles, Stubs and Anchor Logs.
- 14. UL:
 - a. 773, UL Standard for Safety Plug-In Locking Type Photocontrols for Use with Area Lighting Fourth Edition; Reprint with Revisions Through and Including March 08, 2002.
 - b. 844, Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
 - c. 924, Emergency Lighting and Power Equipment.
 - d. 1598, UL Standard for Safety Luminaires.
 - e. 2108, UL Standard for Safety Low Voltage Lighting Systems -First Edition; Reprint with Revisions through and Including February 24, 2014.
 - f. 8750, UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products - First Edition; Reprint with Revisions Through and Including April 1, 2015.
- 15. U.S. Environmental Protection Agency and U.S. Department of Energy: Energy Star.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. General:
 - 1) Provide catalog data sheets and pictures for all products listed below.

- 2) Proposed Luminaire Substitutions (Interior and Exterior): Provide an electronic photometric file in standard '.ies' file format per the Illumination Engineering Society of North America (IESNA) for any proposed luminaire substitution not identified on the project Luminaire Schedule. Obtain file from the luminaire manufacturer or approved independent photometric testing laboratory. Include the proposed substitute luminaire with all options identified on the project Luminaire Schedule.
- b. Interior Luminaires:
 - 1) Catalog data sheets with pictures.
 - 2) Luminaire material, finish, dimensions, and metal gauge.
 - 3) Lens material, pattern, and thickness.
 - 4) Candle power distribution curves in two or more planes.
 - 5) Candle power chart 0 degree to 90 degrees.
 - 6) Lumen output chart.
 - 7) Average maximum brightness data in foot lamberts.
 - 8) Coefficients of utilization for zonal cavity calculations.
 - 9) Mounting or suspension details.
- c. Exterior Luminaires:
 - 1) Catalog data sheets with pictures. Luminaire material, finish, dimensions, and metal gauge.
 - 2) Lens material, pattern, and thickness. Filters.
 - 3) IESNA lighting classification (BUG rating).
 - 4) Isolux diagram.
 - 5) Lighting distribution data and lighting distribution classification type as defined in IESNA HB 9.
 - 6) Fastening details to wall, pendant, or pole.
 - 7) Ballast type, location, and method of fastening.
- d. Lamps:
 - 1) Voltages.
 - 2) Watts.
 - 3) Correlated Color Temperature (CCT).
 - 4) Color Rendering Index (CRI).
 - 5) Published rated life (in hours). Provide number of hours per start and operating temperature for published rated life hours indicated.
 - 6) Published rated initial and mean lumens.
 - 7) Lumen maintenance curve.
 - 8) Lamp type (ANSI designation, dimensions, shape, and base).
- e. LED Source Systems:
 - 1) General:
 - a) IESNA LM-80 test reports.
 - b) IESNA TM-21 ratings.

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- c) Operating temperature range. Data sheet (chart/graph) describing life as a function of temperature.
- d) Warranty: Light engine and driver.
- e) Rated life.
- f) Surge protection.
- g) Thermal control device, heat sink.
- h) Enclosure and wiring information.
- i) Operating voltage range.
- 2) Electronic Module/Light Engine:
 - a) Correlated Color Temperature (CCT).
 - b) Color Rendering Index (CRI).
- 3) Drivers:
 - a) Input Current Total Harmonic Distortion.
 - b) Power factor.
 - c) Sound rating.
- f. Photoelectric Switches (Photocells):
 - 1) Voltage.
 - 2) Power consumption.
 - 3) Load capacity (watts).
 - 4) Contact ratings and configuration.
 - 5) Time delay.
 - 6) Light operating level controls.
 - 7) Enclosure type and dimensions.
 - 8) Mounting type.
 - 9) Temperature range.
 - 10) Features and options.
 - Occupancy Sensors:
 - 1) Type.
 - 2) Switching capacity.
 - 3) Coverage.
 - 4) Time delay AUTO/OFF adjustment.
- B. Informational Submittals: Manufacturer's printed installation instructions.

1.03 QUALITY ASSURANCE

g.

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.

- 2. Provide materials and equipment manufactured within the scope of standards published by UL in conformance with those standards and with an applied UL listing mark.
- B. Standard Products:
 - 1. Provide materials and equipment of manufacturers regularly engaged in the production of products specified in this section and that are of equal material, design, and workmanship.
 - 2. Provide products that have been in satisfactory commercial or industrial use for 2 years prior to Bid opening in similar applications under similar circumstances and of similar size. Provide products that have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
 - 3. Material and Equipment Manufacturing Date: Do not use products manufactured more than 3 years prior to date of delivery to Site.

PART 2 PRODUCTS

2.01 LUMINAIRES

- A. Specific requirements relative to execution of the Work of this section are located in Luminaire Schedule on the Drawings. Provide luminaires and components tested, listed, and labeled by UL, or other approved testing agency.
- B. Provide luminaires with Illumination Engineering Society of North America (IESNA) formatted photometric files, ".ies" format, certified by the luminaire manufacturer for use with lighting software.
- C. Luminaire Labels:
 - 1. External label per ANSI C136.15.
 - 2. Internal label per ANSI C136.22.
- D. Provide luminaires rated by the manufacturer to start and operate to their full lumen capacity for rated life of the luminaire at the minimum low and maximum high ambient temperatures as defined in the Contract Documents at their installation location.
- E. Feed-through type, or separate junction box.
- F. Wire Leads: Minimum 18 AWG.
- G. Component Access: Accessible and replaceable without removing luminaire from ceiling.

- H. Soffit Installations (Interior or Exterior Damp Locations):
 - 1. UL Labeled: SUITABLE FOR DAMP LOCATIONS.
 - 2. Ballast: Removable, prewired.
- I. Exterior Installations:
 - 1. UL Labeled: SUITABLE FOR WET LOCATIONS.
 - 2. Ballast: Removable, prewired.
 - 3. When factory-installed photocells are provided, entire assembly shall have UL label.
- J. Illuminated Exit Signs:
 - 1. Body: As scheduled.
 - a. Letters:
 - 1) 6-inch high by 3/4-inch stroke.
 - 2) Color: As required by the AHJ.
 - 2. Directional Arrows: As indicated on the Drawings.

2.02 LIGHTING CONTROL

- A. Photoelectric Switch (Photocell):
 - 1. Automatic Solid State ON/OFF Switching Photo Control:
 - a. Dry Contacts: Compatible with connected load device indicated on the Drawings.
 - 2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
 - 3. Mounting Type: 1/2-inch conduit entry or Single-gang plate.
 - 4. Setting: ON at dusk and OFF at dawn.
 - 5. Time delay feature to prevent false switching.
 - 6. Field adjustable to control operating light levels.
 - 7. Integral surge protection.
 - 8. Manufacturers:
 - a. Tork.
 - b. Intermatic.
 - c. Paragon Electric Company.
- B. Occupancy Sensors:
 - 1. General:
 - a. Capable of operating normally with any electronic ballast and PL lamp systems.

- b. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to cycling of air conditioner or heating fans.
- c. Provide sensors with readily accessible, user adjustable controls for time delay and sensitivity.
- d. Provide a bypass manual OVERRIDE ON key on each sensor to allow operation in the event of sensor failure. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. Recess bypass control to prevent tampering.
- 2. Sensor Technology:
 - a. Passive Infrared (PIR):
 - 1) Provide sensors that respond to human heat and movement to detect occupants in the coverage area.
 - 2) Temperature compensated pyroelectric sensor.
 - 3) High immunity to false triggering due to RFI and EMI noise.
 - 4) Provide passive infrared sensors with a multiple segmented lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue buildup.
 - b. Ultrasonic:
 - 1) Provide sensors which respond to ultrasonic disturbances within as well as outside the line of sight to detect occupants in the coverage area.
 - 2) Use advanced signal processing technology to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and airflow throughout the controlled space.
 - c. Dual Technology:
 - 1) Sensors use a combination of passive infrared and ultrasonic technologies to detect occupants in coverage area.
 - 2) Provide technology mode selection to allow installer to configure the operation mode between dual technology, passive infrared only, or ultrasonic only functionality.
 - 3) No audio dual technology units will be accepted.
- 3. Sensor Mounting:
 - a. Switch Box:
 - 1) Directional Coverage: 180 degrees.
 - 2) Coverage Area: At desk top level up to 300 square feet and gross motion up to 1,000 square feet.
 - 3) Switch Types:
 - a) Single circuit switches shall control a single switched circuit.
 - b) Bi-level switches shall accommodate up to two switched circuits.

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- 4) Loads:
 - a) Wall box switches shall include an integral power supply.
 - b) Switches shall accommodate loads from 0 watt to 800 watts at 120 volts; 0 watt to 1,200 watts at 277 volts.

2.03 LED SOURCE SYSTEMS

- A. General:
 - 1. Provide IESNA LM 80 test reports.
 - 2. Provide Energy Star compliance for solid state luminaires.
 - 3. Listed To: UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products.
 - 4. Provide RoHS compliant LED light source(s) and driver(s).
 - 5. Rated operating temperature range as indicated on the Luminaire Schedule.
 - 6. Warranty: 5 years minimum.
- B. Electronic Module/Light Engine:
 - 1. Mount all components to a single plate and factory prewired with quick disconnect plugs.
 - 2. Include a driver, thermal control device, thermal protector device, and surge protector device.
 - a. Provide surge protector tested in accordance with IEEE/ANSI C62.41.2 to Category C Low.
 - 3. Provide LEDs mounted to a metal-core circuit board and aluminum heat sink for optimal thermal management and long life.
 - 4. Light Engine Rating per TM 21: 100,000 at 25 degrees C, L70.
 - 5. Correlated Color Temperature (CCT): As indicated on the Luminaire Schedule.
 - 6. Color Rendering Index (CRI): Minimum of 80.
- C. Drivers:
 - 1. Expected life of 60,000 hours at 65 degrees C.
 - 2. Provide drivers mounted in an all metal can.
 - 3. Operating Voltage Range: 50/60 Hz input source, voltage range as indicated on the Luminaire Schedule with sustained variations of plus or minus 10 percent voltage with no damage to the driver.
 - 4. Input Current Total Harmonic Distortion: Less than 20 percent up to 50 percent of full load rating.
 - 5. Power Factor: Greater than 0.90 for primary application up to 50 percent of full load rating.

- 6. Sound rating: Class A.
- 7. Comply with NEMA 410 for inrush current limits.

2.04 EQUIPMENT IDENTIFICATION

- A. Manufacturer's Nameplate: Provide each item of equipment with a nameplate bearing manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; nameplate of distributing agent will not be acceptable.
- B. Provide clear markings located to be readily visible to service personnel.

2.05 FACTORY FINISH

A. Provide electrical equipment with factory-applied painting systems that, at minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.01 LUMINAIRES

- A. General:
 - 1. Install in accordance with manufacturer's recommendations.
 - 2. Provide proper hangers, pendants, and canopies as necessary for complete installation.
 - 3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building required to safely mount.
 - 4. Install plumb and level.
 - 5. Install each luminaire outlet box with galvanized stud.
- B. Mounting:
 - 1. General:
 - a. Coordinate mounting, fastening, and environmental conditions with Section 26 05 02, Basic Electrical Requirements.
 - b. Refer to Fastener Schedule in Section 05 50 00, Metal Fabrications.
 - 2. Wall Mounted: Measure mounting heights from center of mounting plate to finished floor or finished grade, whichever is applicable.
 - 3. Pendant Mounted:
 - a. Provide swivel type hangers and canopies to match luminaires, unless otherwise noted.
 - b. Space single-stem hangers on continuous-row LED luminaires nominally 48 inches apart.
 - c. Provide twin-stem hangers on single luminaires.

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- d. Measure mounting heights from bottom of luminaire to finished floor or finished grade, whichever is applicable.
- C. Swinging Type: Provide, at each support, safety cable capable of supporting four times vertical load from structure to luminaire.
- D. Finished Areas:
 - 1. Install symmetrically with tile pattern.
 - 2. Locate with centerlines either on centerline of tile or on joint between adjacent tile runs.
 - 3. Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and sealing rings.
 - 4. Combustible Low Density Cellulose Fiberboard: Provide spacers and mount luminaires 1-1/2 inches from ceiling surface, or use fixtures suitable for mounting on low density ceilings.
 - 5. Junction Boxes:
 - a. Flush and Recessed Luminaires: Locate minimum 1-foot from luminaire.
 - b. In concealed locations, install junction boxes to be accessible by removing luminaire.
 - 6. Wiring and Conduit:
 - a. Provide wiring of temperature rating required by luminaire.
 - b. Provide flexible steel conduit.
 - 7. Provide plaster frames when required by ceiling construction.
 - 8. Independent Supports:
 - a. Provide each recessed LED luminaire with two safety chains or two No. 12 soft-annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.
 - b. Select chain or wire with tensile strength and method of fastening to structure adequate to support luminaire weight.
 - c. Fasten chain or wire to each end of luminaire.
- E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.
 - 1. Fixture Suspension: Provide 1/4-inch threaded steel hanger rods. Scissor type hangers not permitted.
 - 2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.
- F. Building Exterior: Flush-mounted back box and concealed conduit, unless otherwise indicated.

3.02 EMERGENCY LIGHTING UNIT

- A. Install in accordance with manufacturer's recommendations.
- B. Provide permanent circuit connections with conduit and wire.
- C. Connect to branch circuit feeding normal lighting in area ahead of all local switches.
- D. Provide separate circuit wiring to luminaire.

3.03 FIELD FINISHES

A. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.04 FIELD QUALITY CONTROL

A. Upon completion of installation, verify equipment is properly installed, connected, and adjusted. Conduct an operating test to show equipment operates in accordance with the requirements of this section.

3.05 CLEANING

- A. Remove labels and markings, except UL listing mark.
- B. Wipe luminaires inside and out to remove construction dust.
- C. Clean luminaire plastic lenses with antistatic cleaners only.
- D. Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.
- E. Replace defective lamps at time of Substantial Completion.

END OF SECTION

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SECTION 01 11 00 SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The completed Work will provide Owner with two new buildings at the Roger Scott Pool facility and includes:
 - 1. Demolition of the existing ticketing and administration building.
 - a. Existing utilities shall be temporarily supported, re-routed and installed in the new locations according to the Documents.
 - b. Existing pool sump utilities and equipment are to be protected and not damaged.
 - 2. Construction of a new ticketing building with access ramp.
 - 3. Construction of a new restroom building.
- B. The Work shall be completed following Labor Day 2024 and shall be completed prior to Memorial Day 2025.

1.02 WORK BY OTHERS

- A. The City has procured temporary restroom facilities that will be in place for the 2024 swimming season. Prior to start of Construction, the City will remove the temporary restroom facilities.
- PART 2 PRODUCTS (NOT USED)
- PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00 SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 DEFINITIONS

- A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.
- B. Deferred Submittal: Information submitted by Contractor for portions of design that are to be submitted to permitting agency for approval prior to installation of that portion of the Work, along with Engineer's review documentation that submittal has been found to be in general conformance with Project's design.
- C. Informational Submittal: Information submitted by Contractor that requires Engineer's review and determination that submitted information is in accordance with the Conditions of the Contract.

1.02 PROCEDURES

- A. Direct submittals to Owner, unless specified otherwise.
- B. Electronic Submittals: Submittals shall, unless specifically accepted, be made in electronic format.
 - 1. Each submittal shall be an electronic file in Adobe Acrobat Portable Document Format (PDF). Use the latest version available at time of execution of the Agreement.
 - 2. Electronic files that contain more than 10 pages in PDF format shall contain internal bookmarking from an index page to major sections of the document.
 - 3. PDF files shall be set to open "Bookmarks and Page" view.
 - 4. Add general information to each PDF file, including title, subject, author, and keywords.
 - 5. PDF files shall be set up to print legibly at 8.5-inch by 11-inch, 11-inch by 17-inch, or 22-inch by 34-inch. No other paper sizes will be accepted.
 - 6. Submit new electronic files for each resubmittal.
 - 7. Include a copy of the Transmittal of Contractor's Submittal form, located at end of section, with each electronic file.
 - 8. Provide Engineer with authorization to reproduce and distribute each file as many times as necessary for Project documentation.

- 9. Detailed procedures for handling electronic submittals will be discussed at the preconstruction conference.
- C. Transmittal of Submittal:
 - 1. Contractor shall:
 - a. Review each submittal and check for compliance with Contract Documents.
 - b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
 - Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying submittal has been reviewed, checked, and approved for compliance with Contract Documents.
 - 2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
 - 2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
 - 3. Identify each submittal with the following:
 - a. Numbering and Tracking System:
 - 1) Sequentially number each submittal.
 - 2) Resubmission of submittal shall have original number with sequential alphabetic suffix.
 - b. Specification section and paragraph to which submittal applies.
 - c. Project title and Engineer's project number.
 - d. Date of transmittal.
 - e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.
 - 4. Identify and describe each deviation or variation from Contract Documents.
- D. Format:
 - 1. Do not base Shop Drawings on reproductions of Contract Documents.
 - 2. Package submittal information by individual Specification section. Do not combine different Specification sections together in submittal package, unless otherwise directed in specification.
 - 3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
 - 4. Index with labeled tab dividers in orderly manner.

SUBMITTAL PROCEDURES 01 33 00 - 2

- E. Timeliness: Schedule and submit in accordance Schedule of Submittals and requirements of individual Specification sections.
- F. Processing Time:
 - 1. Time for review shall commence on Engineer's receipt of submittal.
 - 2. Engineer will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
 - 3. Resubmittals will be subject to same review time.
 - 4. No adjustment of Contract Times or Price will be allowed as a result of delays in progress of Work caused by rejection and subsequent resubmittals.
- G. Resubmittals: Clearly identify each correction or change made.
- H. Incomplete Submittals:
 - 1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
 - 2. When any of the following are missing, submittal will be deemed incomplete:
 - a. Contractor's review stamp; completed and signed.
 - b. Transmittal of Contractor's Submittal; completed and signed.
 - c. Insufficient number of copies.
- I. Submittals not required by Contract Documents:
 - 1. Will not be reviewed and will be returned stamped "Not Subject to Review."
 - 2. Engineer will keep one copy and return submittal to Contractor.

1.03 ACTION SUBMITTALS

- A. Prepare and submit Action Submittals required by individual Specification sections.
- B. Shop Drawings:
 - 1. Identify and Indicate:
 - a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
 - b. Equipment and Component Title: Identical to title shown on the Drawings.

- c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
- d. Project-specific information drawn accurately to scale.
- 2. Manufacturer's standard schematic drawings and diagrams as follows:
 - a. Modify to delete information that is not applicable to the Work.
 - b. Supplement standard information to provide information specifically applicable to the Work.
- 3. Product Data: Provide as specified in individual specifications.
- 4. Deferred Submittal: See the Drawings for list of deferred submittals.
 - a. Contractor-design drawings and product data related to permanent construction.
 - 1) Written and graphic information.
 - 2) Drawings.
 - 3) Cut sheets.
 - 4) Data sheets.
 - 5) Action item submittals requested in individual Specification section.
 - b. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit required supporting data and drawings for review and acceptance by Engineer.
- C. Samples:
 - 1. Preparation: Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
 - a. Manufacturer name.
 - b. Model number.
 - c. Material.
 - d. Sample source.
 - 2. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
 - 3. Full-size Samples:
 - a. Size as indicated in individual Specification section.
 - b. Prepared from same materials to be used for the Work.
 - c. Cured and finished in manner specified.
 - d. Physically identical with product proposed for use.

- D. Action Submittal Dispositions: Engineer will review, comment, stamp, and distribute as noted:
 - 1. Approved:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal.
 - b. Distribution: Electronic.
 - 2. Approved as Noted:
 - a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - b. Distribution: Electronic.
 - 3. Partial Approval, Resubmit as Noted:
 - a. Make corrections or obtain missing portions, and resubmit.
 - b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
 - c. Distribution: Electronic.
 - 4. Revise and Resubmit:
 - a. Contractor may not incorporate product(s) or implement Work covered by submittal.
 - b. Distribution: Electronic.

1.04 INFORMATIONAL SUBMITTALS

- A. General:
 - 1. Refer to individual Specification sections for specific submittal requirements.
 - 2. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copy to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copy with review comments to Contractor, and require that submittal be corrected and resubmitted.
- B. Certificates:
 - 1. General:
 - a. Provide notarized statement that includes signature of entity responsible for preparing certification.
 - b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
 - 2. Welding: In accordance with individual Specification sections.

- 3. Installer: Prepare written statements on manufacturer's letterhead certifying installer complies with requirements as specified in individual Specification section.
- 4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
- 5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual Specification sections.
- 6. Manufacturer's Certificate of Compliance: In accordance with Section 01 61 00, Common Product Requirements.
- C. Contractor-design Data (related to temporary construction):
 - 1. Written and graphic information.
 - 2. List of assumptions.
 - 3. List of performance and design criteria.
 - 4. Summary of loads or load diagram, if applicable.
 - 5. Calculations.
 - 6. List of applicable codes and regulations.
 - 7. Name and version of software.
 - 8. Information requested in individual Specification section.
- D. Deferred Submittals: See the Drawings for list of deferred submittals.
 - 1. Contractor-design data related to permanent construction:
 - a. List of assumptions.
 - b. List of performance and design criteria.
 - c. Summary of loads or load diagram, if applicable.
 - d. Calculations.
 - e. List of applicable codes and regulations.
 - f. Name and version of design software.
 - g. Factory test results.
 - h. Informational submittals requested in individual Specification section.
 - 2. Prior to installation of indicated structural or nonstructural element, equipment, distribution system, or component or its anchorage, submit calculations and test results of Contractor-designed components for review by Engineer. Documentation of review and indication of compliance with general design intent and project criteria provided on Engineer's comment form as meets conditions of the Contract, along with completed submittal, shall be filed with permitting agency by Contractor and approved by permitting agency prior to installation.

- E. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual Specification section.
- F. Payment: Application for Payment: In accordance with Owner's Payment Procedures.
- G. Quality Control Documentation: As required in Section 01 45 16.13, Contractor Quality Control.
- H. Schedules:
 - 1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule.
 - a. Show for each, at a minimum, the following:
 - 1) Specification section number.
 - 2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
 - 3) Estimated date of submission to Engineer, including reviewing and processing time.
 - b. On a monthly basis, submit updated Schedule of Submittals to Engineer if changes have occurred or resubmittals are required.
 - 2. Progress Schedules: As requested by the Owner or Engineer.
- I. Special Guarantee: Supplier's written guarantee as required in individual Specification sections.
- J. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.
- K. Submittals Required by Laws, Regulations, and Governing Agencies:
 - 1. Promptly submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
 - 2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.
- L. Test, Evaluation, and Inspection Reports:
 - 1. General: Shall contain signature of person responsible for test or report.

- 2. Factory:
 - a. Identification of product and Specification section, type of inspection or test with referenced standard or code.
 - b. Date of test, Project title and number, and name and signature of authorized person.
 - c. Test results.
 - d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - e. Provide interpretation of test results, when requested by Engineer.
 - f. Other items as identified in individual Specification sections.
- 3. Field:
 - a. As a minimum, include the following:
 - 1) Project title and number.
 - 2) Date and time.
 - 3) Record of temperature and weather conditions.
 - 4) Identification of product and Specification section.
 - 5) Type and location of test, Sample, or inspection, including referenced standard or code.
 - 6) Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
 - 7) If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
 - 8) Provide interpretation of test results, when requested by Engineer.
 - 9) Other items as identified in individual Specification sections.
- M. Testing and Startup Data.

1.05 SUPPLEMENTS

- A. The supplements listed below, following "End of Section", are part of this specification.
 - 1. Forms: Transmittal of Contractor's Submittal.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SUBMITTAL PROCEDURES 01 33 00 - 8

Jacobs TRANSMITTAL OF CONTRACTOR'S SUBMITTAL (ATTACH TO EACH SUBMITTAL)				
TO:	Submittal No.: New Submittal Project: Project No.: Specification Section No.: (Cover only one section with each transmittal) Schedule Date of Submittal:			
SUBMITTAL TYPE: Shop Drawing	Sample Informational			

The following items are hereby submitted:

Number of	Description of Item Submitted	Spec. and	Spec. and Drawing or To Control Contro	Contains V to Contrac	ains Variation	
Copies	(Type, Size, Model Number, Etc.)	Para. No.		No	Yes	

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By:_____

Contractor (Authorized Signature)

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SECTION 01 45 16.13 CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. D3740, Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
 - b. E329, Use in the Evaluation of Testing and Inspection Agencies as Used in Construction.

1.02 DEFINITIONS

A. Contractor Quality Control (CQC): The means by which Contractor ensures that the construction, to include that performed by subcontractors and suppliers, complies with the requirements of the Contract.

1.03 SUBMITTALS

- A. Informational Submittals:
 - 1. CQC Plan: Submit, not later than 30 days after receipt of Notice to Proceed.
 - 2. CQC Report: Submit, weekly, an original and one copy in report form.

1.04 OWNER'S QUALITY ASSURANCE

- A. All Work is subject to Owner's quality assurance inspection and testing at all locations and at all reasonable times before acceptance to ensure strict compliance with the terms of the Contract Documents.
- B. Owner's quality assurance inspections and tests are for the sole benefit of Owner and do not:
 - 1. Relieve Contractor of responsibility for providing adequate quality control measures;
 - 2. Relieve Contractor of responsibility for damage to or loss of the material before acceptance;
 - 3. Constitute or imply acceptance; or
 - 4. Affect the continuing rights of Owner after acceptance of the completed Work.

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- C. The presence or absence of a quality assurance inspector does not relieve Contractor from any Contract requirement.
- D. Promptly furnish all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by Engineer.
- E. Owner may charge Contractor for any additional cost of inspection or test when Work is not ready at the time specified by Contractor for inspection or test, or when prior rejection makes re-inspection or retest necessary. Quality assurance inspections and tests will be performed in a manner that will not unnecessarily delay the Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Maintain an adequate inspection system and perform such inspections as will ensure that the Work conforms to the Contract Documents.
 - B. Maintain complete inspection records and make them available at all times to Owner and Engineer.
 - C. The quality control system shall consist of plans, procedures, and organization necessary to produce an end product that complies with the Contract Documents. The system shall cover all construction and demolition operations, both onsite and offsite, including Work by subcontractors, fabricators, suppliers and purchasing agents, and shall be keyed to the proposed construction sequence.

3.02 COORDINATION MEETING

- A. After the Preconstruction Conference, but before start of construction, and prior to acceptance of the CQC Plan, schedule a meeting with Engineer and Owner to discuss the quality control system.
- B. Develop a mutual understanding of the system details, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite Work, and the interrelationship of Contractor's management and control with the Owner's Quality Assurance.
- C. There may be occasions when subsequent conferences may be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures that may require corrective action by Contractor.

CONTRACTOR QUALITY CONTROL 01 45 16.13 - 2

3.03 QUALITY CONTROL ORGANIZATION

- A. CQC System Manager:
 - 1. Designate an individual within Contractor's organization who will be responsible for overall management of CQC and have the authority to act in CQC matters for the Contractor.
 - 2. CQC System Manager may perform other duties on the Project.
 - 3. CQC System Manager shall be an experienced construction person, with a minimum of 3 years construction experience on similar type Work.
 - 4. CQC System Manager shall report to the Contractor's project manager or someone higher in the organization. Project manager in this context shall mean the individual with responsibility for the overall quality and production management of the Project.
 - 5. CQC System Manager shall be onsite during construction; periods of absence may not exceed 2 weeks at any one time.
 - 6. Identify an alternate for CQC System Manager to serve with full authority during the System Manager's absence. The requirements for the alternate will be the same as for designated CQC System Manager.
- B. CQC Staff:
 - 1. Designate a CQC staff, available at the Site at all times during progress, with complete authority to take any action necessary to ensure compliance with the Contract. CQC staff members shall be subject to acceptance by Engineer.
 - 2. CQC staff shall take direction from CQC System Manager in matters pertaining to QC.
 - 3. CQC staff must be of sufficient size to ensure adequate QC coverage of Work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities.
 - 4. The actual strength of the CQC staff may vary during any specific Work period to cover the needs of the Project. Add additional staff when necessary for a proper CQC organization.
- C. Organizational Changes: Obtain Engineer's acceptance before replacing any member of the CQC staff. Requests for changes shall include name, qualifications, duties, and responsibilities of the proposed replacement.

ROGER SCOTT POOL FACILITIES

3.04 QUALITY CONTROL PHASING

- A. CQC shall include at least three phases of control to be conducted by CQC System Manager for all definable features of Work, as follows:
 - 1. Preparatory Phase:
 - a. Notify Owner at least 48 hours in advance of beginning any of the required action of the preparatory phase.
 - b. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The CQC System Manager shall instruct applicable CQC staff as to the acceptable level of workmanship required in order to meet Contract requirements.
 - c. Document the results of the preparatory phase meeting by separate minutes prepared by the CQC System Manager and attached to the QC report.
 - d. Perform prior to beginning Work on each definable feature of Work:
 - 1) Review applicable Contract Specifications.
 - 2) Review applicable Contract Drawings.
 - 3) Verify that all materials and/or equipment have been tested, submitted, and approved.
 - 4) Verify that provisions have been made to provide required control inspection and testing.
 - 5) Examine the Work area to verify that all required preliminary Work has been completed and is in compliance with the Contract.
 - 6) Perform a physical examination of required materials, equipment, and sample Work to verify that they are on hand, conform to approved Shop Drawing or submitted data, and are properly stored.
 - 7) Review the appropriate activity hazard analysis to verify safety requirements are met.
 - 8) Review procedures for constructing the Work, including repetitive deficiencies.
 - 9) Document construction tolerances and workmanship standards for that phase of the Work.
 - 10) Check to verify that the plan for the Work to be performed, if so required, has been accepted by Engineer.
 - 2. Initial Phase:
 - a. Accomplish at the beginning of a definable feature of Work:
 - 1) Notify Owner at least 48 hours in advance of beginning the initial phase.

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- 2) Perform prior to beginning Work on each definable feature of Work:
 - a) Review minutes of the preparatory meeting.
 - b) Check preliminary Work to verify compliance with Contract requirements.
 - c) Verify required control inspection and testing.
 - d) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Comparison with sample panels is appropriate.
 - e) Resolve all differences.
 - f) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
- Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the QC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
- 4) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.
- 3. Follow-up Phase:
 - a. Perform daily checks to verify continuing compliance with Contract requirements, including control testing, until completion of the particular feature of Work.
 - b. Daily checks shall be made a matter of record in the CQC documentation and shall document specific results of inspections for all features of Work for the day or shift.
 - c. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of Work that will be affected by the deficient Work. Constructing upon or concealing nonconforming Work will not be allowed.
- 4. Additional Preparatory and Initial Phases: Additional preparatory and initial phases may be conducted on the same definable features of Work as determined by Owner if the quality of ongoing Work is unacceptable; or if there are changes in the applicable QC staff or in the onsite production supervision or work crew; or if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

ROGER SCOTT POOL FACILITIES

3.05 CONTRACTOR QUALITY CONTROL PLAN

A. General:

- 1. Plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used.
- 2. An interim plan for the first 30 days of operation will be considered.
- 3. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of Work to be started.
- 4. Work outside of the features of Work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of Work to be started.
- B. Content:
 - 1. Plan shall cover the intended CQC organization for the entire Contract and shall include the following, as a minimum:
 - a. Organization: Description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three-phase control system (see Paragraph QC Phasing) for all aspects of the Work specified.
 - b. CQC Staff: The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a QC function.
 - c. Letters of Authority: A copy of a letter to the CQC System Manager signed by an authorized official of the firm, describing the responsibilities and delegating sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop Work which is not in compliance with the Contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities and responsibilities. Copies of these letters will also be furnished to Owner.
 - d. Submittals: Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers and purchasing agents.
 - e. Testing: Control, verification and acceptance testing procedures for each specific test to include the test name, frequency, specification paragraph containing the test requirements, the personnel and laboratory responsible for each type of test, and an estimate of the number of tests required.

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- f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests, including documentation.
- g. Procedures for tracking deficiencies from identification through acceptable corrective action. These procedures will establish verification that identified deficiencies have been corrected.
- h. Reporting procedures, including proposed reporting formats; include a copy of the CQC report form.
- C. Acceptance of Plans: Acceptance of the Contractor's basic and addendum CQC plans is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. Owner reserves the right to require Contractor to make changes in the CQC plan and operations including removal of personnel, as necessary, to obtain the quality specified.
- D. Notification of Changes: After acceptance of the CQC plan, Contractor shall notify Engineer, in writing, a minimum of 7 calendar days prior to any proposed change. Proposed changes are subject to acceptance by Engineer.

3.06 CONTRACTOR QUALITY CONTROL REPORT

- A. As a minimum, prepare a CQC report for every 7 calendar days. Account for all days throughout the life of the Contract. Reports shall be signed and dated by CQC System Manager. Include copies of test reports and copies of reports prepared by QC staff.
- B. Maintain current records of quality control operations, activities, and tests performed, including the Work of subcontractors and suppliers.
- C. Records shall be on an acceptable form and shall be a complete description of inspections, the results of inspections, daily activities, tests, and other items, including but not limited to the following:
 - 1. Contractor/subcontractor and their areas of responsibility.
 - 2. Operating plant/equipment with hours worked, idle, or down for repair.
 - 3. Work performed today, giving location, description, and by whom. When a network schedule is used, identify each phase of Work performed each day by activity number.
 - 4. Test and/or control activities performed with results and references to specifications/plan requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
 - 5. Material received with statement as to its acceptability and storage.
 - 6. Identify submittals reviewed, with Contract reference, by whom, and action taken.

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- 7. Offsite surveillance activities, including actions taken.
- 8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- 9. List instructions given/received and conflicts in the Drawings and/or Specifications.
- 10. Contractor's verification statement.
- 11. Indicate a description of trades working on the Project; the number of personnel working; weather conditions encountered; and any delays encountered.
- 12. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in file work and workmanship comply with the Contract.

3.07 SUBMITTAL QUALITY CONTROL

A. Submittals shall be as specified in Section 01 33 00, Submittal Procedures. The CQC organization shall be responsible for certifying that all submittals are in compliance with the Contract requirements. Owner will furnish copies of test report forms upon request by Contractor. Contractor may use other forms as approved.

3.08 TESTING QUALITY CONTROL

- A. Testing Procedure:
 - 1. Perform tests specified or required to verify that control measures are adequate to provide a product which conforms to Contract requirements. Procure services of a licensed testing laboratory. Perform the following activities and record the following data:
 - a. Verify testing procedures comply with contract requirements.
 - b. Verify facilities and testing equipment are available and comply with testing standards.
 - c. Check test instrument calibration data against certified standards.
 - d. Verify recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
 - e. Documentation:
 - 1) Record results of all tests taken, both passing and failing, on the CQC report for the date taken.
 - 2) Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test.
 - 3) Actual test reports may be submitted later, if approved by Engineer, with a reference to the test number and date taken.

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- 4) Provide directly to Engineer an information copy of tests performed by an offsite or commercial test facility. Test results shall be signed by an engineer registered in the state where the tests are performed.
- 5) Failure to submit timely test reports, as stated, may result in nonpayment for related Work performed and disapproval of the test facility for this Contract.
- B. Testing Laboratories: Laboratory facilities, including personnel and equipment, utilized for testing soils, concrete, asphalt and steel shall meet criteria detailed in ASTM D3740 and ASTM E329, and be accredited by the American Association of Laboratory Accreditation (AALA), National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), the American Association of State Highway and Transportation Officials (AASHTO), or other approved national accreditation authority. Personnel performing concrete testing shall be certified by the American Concrete Institute (ACI).

3.09 COMPLETION INSPECTION

- A. CQC System Manager shall conduct an inspection of the Work at the completion of all Work or any milestone established by a completion time stated in the Contract.
- B. Punchlist:
 - 1. CQC System Manager shall develop a punchlist of items which do not conform to the Contract requirements.
 - 2. Include punchlist in the CQC report, indicating the estimated date by which the deficiencies will be corrected.
 - 3. CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected and so notify the Owner.
 - 4. These inspections and any deficiency corrections required will be accomplished within the time stated for completion of the entire Work or any particular increment thereof if the Project is divided into increments by separate completion dates.

END OF SECTION

SECTION 01 50 00 TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Association of Nurserymen (AAN): American Standards for Nursery Stock.
 - 2. Federal Emergency Management Agency (FEMA).
 - 3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
 - 4. Telecommunications Industry Association (TIA); Electronic Industries Alliance (EIA): 568B, Commercial Building Telecommunications Cabling Standard.
 - 5. U.S. Department of Agriculture (USDA): Urban Hydrology for Small Watersheds.
 - 6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

A. Informational Submittals: Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.

1.03 MOBILIZATION

- A. Mobilization includes, but is not limited to, these principal items:
 - 1. Obtaining required permits.
 - 2. Moving Contractor's field office and equipment required for first month operations onto Site.
 - 3. Installing temporary construction power, wiring, and lighting facilities.
 - 4. Providing onsite Internet service.
 - 5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
 - 6. Arranging for and erection of Contractor's work and storage yard.
 - 7. Posting OSHA required notices and establishing safety programs and procedures.
 - 8. Having Contractor's superintendent at Site full time.

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1.04 PROTECTION OF WORK AND PROPERTY

- A. Comply with Owner's safety rules while on Owner's property.
- B. Keep Owner informed of serious onsite accidents and related claims.
- 1.05 VEHICULAR TRAFFIC
 - A. Traffic Control and Routing: Contractor shall coordinate with City for all activities that are anticipated to interfere with public traffic or public parking at the Site.

PART 2 PRODUCTS

2.01 PROJECT SIGN

A. Provide and maintain one, 8-foot-wide by 4-foot-high sign constructed of 3/4-inch exterior high density overlaid plywood. Sign shall bear name of Project, Owner, Contractor, Engineer, and other participating agencies.

PART 3 EXECUTION

3.01 TEMPORARY UTILITIES

- A. Power: Coordinate with Owner for temporary electric power.
- B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.
- C. Heating, Cooling, and Ventilating:
 - 1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage because of temperature or humidity. Costs for temporary heat shall be borne by Contractor.
 - 2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.

- 3. Pay costs of installation, maintenance, operation, removal, and fuel consumed.
- 4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
- 5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.
- D. Water: Coordinate with Owner for temporary construction and drinking water at Site.
- E. Sanitary and Personnel Facilities: Provide and maintain facilities for Contractor's employees, Subcontractors, and other onsite employers' employees. Service, clean, and maintain facilities and enclosures.
- F. Telephone Service: Contractor: As required by Contractor, arrange and provide onsite telephone service for use during construction. Pay costs of installation and monthly bills.
- G. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.02 PROTECTION OF WORK AND PROPERTY

- A. General:
 - 1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.
 - 2. No residence or business shall be cut off from vehicular traffic for a period exceeding 4 hours, unless special arrangements have been made.
 - 3. Maintain in continuous service existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.
 - 4. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate activities with owner of said utility and perform work to their satisfaction.
 - 5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.

- 6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
- 7. In areas where Contractor's operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by Contractor.
- 8. Notify property owners and utility offices that may be affected by construction operation at least 2 days in advance: Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.
- 9. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.
- 10. Maintain original Site drainage wherever possible.
- B. Site Security:
 - 1. Erect a temporary security fence. Maintain fence throughout construction period. Obtain Engineer's written permission before removal of temporary security fencing.
 - 2. Provide and maintain additional temporary security fences as necessary to protect the Work and Contractor-furnished products not yet installed.
- C. Trees and Plantings:
 - 1. Protect from damage and preserve trees, shrubs, and other plants outside limits of the Work and within limits of the Work, which are designated on the Drawings to remain undisturbed.
 - a. Where practical, tunnel beneath trees when on or near line of trench.
 - b. Employ hand excavation as necessary to prevent tree injury.
 - c. Do not stockpile materials or permit traffic within drip lines of trees.
 - d. Provide and maintain temporary barricades around trees.
 - e. Water vegetation as necessary to maintain health.
 - f. Cover temporarily exposed roots with wet burlap, and keep burlap moist until soil is replaced around roots.
 - g. No trees, except those specifically shown on the Drawings to be removed, shall be removed without written approval of Engineer.
 - h. Dispose of removed trees in a legal manner off the Site.

TEMPORARY FACILITIES AND CONTROLS 01 50 00 - 4

- Balling and burlapping of trees indicated for replacement shall conform to recommended specifications set forth in the American Standards for Nursery Stock, published by American Association of Nurserymen. Balls shall be firm and intact and made-balls will not be accepted. Handle ball and burlap trees by ball and not by top.
- 3. In event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
- 4. Replace each plant that dies as a result of construction activities.
- D. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.
- E. Waterways: Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.
- F. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

3.03 TEMPORARY CONTROLS

- A. Air Pollution Control:
 - 1. Minimize air pollution from construction operations.
 - 2. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.
 - 3. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

- B. Noise Control:
 - 1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.
 - 2. Noise Control Plan: Propose plan to mitigate construction noise and to comply with noise control ordinances, including method of construction, equipment to be used, and acoustical treatments.
- C. Water Pollution Control:
 - 1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.
 - 2. Prior to commencing excavation and construction, obtain Owner's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and dewatering pump discharges.
 - 3. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.
- D. Erosion, Sediment, and Flood Control: Provide, maintain, and operate temporary facilities to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

3.04 STORAGE YARDS AND BUILDINGS

- A. Coordinate requirements with Section 01 61 00, Common Product Requirements.
- B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.
- C. Temporary Storage Buildings:
 - 1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
 - 2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
 - 3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

3.05 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

3.06 VEHICULAR TRAFFIC

- A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Ensure the least possible obstruction to traffic and normal commercial pursuits.
- B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.
- C. Whenever it is necessary to cross, close, or obstruct roads, driveways, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.
- D. Road Closures: Maintain satisfactory means of exit for persons residing or having occasion to transact business along route of the Work. If it is necessary to close off roadway or alley providing sole vehicular access to property for periods greater than 2 hours, provide written notice to each owner so affected 3 days prior to such closure. In such cases, closings of up to 4 hours may be allowed. Closures of up to 10 hours may be allowed if a week's written notice is given and undue hardship does not result.
- E. Maintenance of traffic is not required if Contractor obtains written permission from Owner and tenant of private property, or from authority having jurisdiction over public property involved, to obstruct traffic at designated point.
- F. In making street crossings, do not block more than one-half the street at a time. Whenever possible, widen shoulder on opposite side to facilitate traffic flow. Provide temporary surfacing on shoulders as necessary.
- G. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.
- H. When flaggers and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange wearing apparel and other regulation traffic control devices.

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- I. Notify fire department and police department before closing street or portion thereof. Notify said departments when streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets, in excess of 300 linear feet, without written permission from fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish Contractor's night emergency telephone numbers to police department.
- J. Coordinate traffic routing with that of others working in same or adjacent areas.

3.07 CLEANING DURING CONSTRUCTION

- A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.
- B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up and dispose of debris.
- C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least weekly, dispose of such waste materials, debris, and rubbish offsite.
- D. At least weekly, brush sweep entry drive, roadways, and other streets and walkways affected by the Work and where adjacent to the Work.

END OF SECTION

SECTION 01 61 00 COMMON PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 DEFINITIONS

- A. Products:
 - 1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
 - 2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
 - 3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

- A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of latest edition of the Florida Building Code.
 - 1. Refer to the Drawings for all loading requirements.

1.03 ENVIRONMENTAL REQUIREMENTS

- A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at the Project Site.
- B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation.

1.04 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

- B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.
- C. Extra Materials, Special Tools, Test Equipment, and Expendables:
 - 1. Furnish as required by individual Specifications.
 - 2. Schedule:
 - a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
 - b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
 - 3. Packaging and Shipment:
 - a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
 - b. Prominently displayed on each package, the following:
 - 1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
 - 2) Applicable equipment description.
 - 3) Quantity of parts in package.
 - 4) Equipment manufacturer.
- D. Deliver materials to Site. Request a minimum 7-day advance notice of shipment from manufacturer.
- E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.05 DELIVERY AND INSPECTION

- A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.
- B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

- C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.
- D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.06 HANDLING, STORAGE, AND PROTECTION

- A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01 50 00, Temporary Facilities and Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.
- B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.
- C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to ensure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.
- D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.
- E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.
- F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.
- G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.
- B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.
- C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.
- D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.
- F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.
- G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.
- H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

- I. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.
- J. Equipment Finish: Provide manufacturer's standard finish and color, except where specific color is indicated.
- K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.
- L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.
- M. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 FABRICATION AND MANUFACTURE

- A. General:
 - 1. Manufacture parts to U.S.A. standard sizes and gauges.
 - 2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
 - 3. Design structural members for anticipated shock and vibratory loads.
 - 4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.

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- 5. Modify standard products as necessary to meet performance Specifications.
- B. Lubrication System:
 - 1. Require no more than weekly attention during continuous operation.
 - 2. Convenient and accessible; oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
 - 3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
 - 4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

- A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.
- B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).
- C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by entity supplying the product, material, or service, and submitted prior to shipment of product or material or execution of the services.

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- B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.
- C. Such form shall certify proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.
- D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 INSTALLATION

- A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.
- B. No shimming between machined surfaces is allowed.
- C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.
- D. Repaint painted surfaces that are damaged prior to equipment acceptance.
- E. Do not cut or notch any structural member or building surface without specific approval of Engineer.
- F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.
- G. For material and equipment specifically indicated or specified to be reused in the Work:
 - 1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
 - 2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.04 FIELD FINISHING

A. In accordance with individual Specification sections.

3.05 ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

3.06 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

3.07 SUPPLEMENTS

- A. The supplement listed below, following "End of Section", is part of this Specification.
 - 1. Form: Manufacturer's Certificate of Compliance.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER:	PRODUCT, MATERIAL, OR SERVICE SUBMITTED:
PROJECT NAME: PROJECT NO:	
I haraby cartify that the above referenced t	product material or service called for by the
Contract for the named Project will be furn requirements. I further certify that the prod specified and conform in all respects with t quantity shown.	nished in accordance with all applicable luct, material, or service are of the quality the Contract requirements, and are in the
Date of Execution:	, 20
Manufacturer:	
Manufacturer's Authorized Representative	e (print):
(Authori	ized Signature)

(Authorized Signature)

SECTION 03 30 10 STRUCTURAL CONCRETE

PART 1 GENERAL

1.01 GENERAL

A. Work shall conform to requirements of ACI 301, Specifications for Structural Concrete, unless otherwise specified.

1.02 REFERENCES

- A. In accordance with ACI 301 and the following:
 - 1. American Concrete Institute (ACI):
 - a. 301, Specifications for Structural Concrete.
 - b. 305.1, Specification for Hot Weather Concreting.
 - c. 306.1, Specification for Cold Weather Concreting.
 - d. 308.1, Specification for Curing Concrete.
 - e. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary.
 - f. SP-66, Detailing Manual.
 - 2. ASTM International (ASTM):
 - a. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
 - b. D1056, Specification for Flexible Cellular Materials—Sponge or Expanded Rubber.
 - 3. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.
 - b. Placing Reinforcing Bars.
 - c. ANSI/CRSI RB 4.1, CRSI Standard for Supports for Reinforcement Used in Concrete.
 - 4. Corps of Engineers (COE): CRD-C-572, Corps of Engineers Specifications for Polyvinylchloride Waterstop.
 - 5. National Ready Mixed Concrete Association (NRMCA).

1.03 DEFINITIONS

A. Cold Weather: When ambient temperature is below 40 degrees F or is approaching 40 degrees F and falling.

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- B. Defective Area: Surface defects that include honeycomb, rock pockets, indentations, and surface voids greater than 3/16-inch deep, surface voids greater than 3/4-inch in diameter, cold joints, cracks in liquid containment structures and below grade habitable spaces that are 0.005-inch wide and wider, and cracks in other structures that are 0.010-inch wide and wider, spalls, chips, embedded debris, sand streaks, mortar leakage from form joints, deviations in formed surface that exceed specified tolerances and include but are not limited to fins, form pop-outs, and other projections. At exposed concrete, defective areas also include texture irregularities, stains, and other color variations that cannot be removed by cleaning.
- C. Exposed Concrete: Concrete surface that can be seen inside or outside of structure regardless of whether concrete is above water, dry at all times, or can be seen when structure is drained.
- D. Hot Weather: As defined in ACI 305.1.
- E. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Formwork and Formwork Accessories: Unless otherwise specified, conform to requirements of ACI 301.
 - b. Reinforcing steel prepared in accordance with CRSI Manual of Standard Practice and ACI SP-66 Detailing Manual:
 - 1) Bending lists.
 - 2) Placing drawings.
 - c. Construction Joints, Expansion Joints, and Control Joints: Layout and location for each type.
 - 2. Mix Design:
 - a. Contain proportions of materials and admixtures to be used on Project, signed by mix designer.
 - b. Documentation of average strength for each proposed mix design in accordance with ACI 301.
 - c. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common product Requirements, for the following:
 - 1) Portland cement.
 - 2) Fly ash.
 - 3) Slag cement.

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- 4) Aggregates, including specified class designation for coarse aggregate.
- 5) Admixtures.
- 6) Concrete producer has verified compatibility of constituent materials in design mix.
- d. Test Reports:
 - 1) Cement: Chemical analysis report.
 - 2) Supplementary Cementitious Materials: Chemical analysis report and report of other specified test analyses.
 - 3) Aggregates:
 - a) Deleterious substances in fine aggregate per ASTM C33/C33M, Table 2.
 - b) Deleterious substances in coarse aggregate per ASTM C33/C33M, Table 4.
 - 4) Water-Soluble Chloride-Ion Content in Hardened Concrete: One of the following:
 - a) Test report in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
 - b) Calculation of water-soluble chloride content based on certified chloride content of each constituent material and proportion of constituent material in concrete mixture.
 - 5) Alkali Aggregate Reactivity: Where required, in accordance with Article Concrete Mix Design. Include documentation of test results per applicable standards.
- e. Product Data:
 - 1) Admixtures: Manufacturer's product data sheets for each admixture used in proposed mix designs.
- 3. Detailed plan for curing and protection of concrete placed and cured in cold weather. Details shall include, but not be limited to, the following:
 - a. Procedures for protecting subgrade from frost and accumulation of ice or snow on reinforcement, other metallic embeds, and forms prior to placement.
 - b. Documentation of embeds that must be at a temperature above freezing prior to placement of concrete.
 - c. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
 - d. Methods for temperature protection during placement.
 - e. Types of covering, insulation, housing, or heating to be provided.
 - f. Curing methods to be used during and following protection period.
 - g. Use of strength accelerating admixtures.
 - h. Methods for verification of in-place strength.

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- i. Procedures for measuring and recording concrete temperatures.
- j. Procedures for preventing drying during dry, windy conditions.
- 4. Detailed plan for hot-weather placements including curing and protection for concrete placed in ambient temperatures over 80 degrees F. Plan shall include, but not be limited to, the following:
 - a. Procedures for measuring and recording temperatures of reinforcement and other embedded items prior to concrete placement.
 - b. Use of retarding admixture.
 - c. Methods for controlling temperature of reinforcement and other embedded items and concrete materials before and during placement.
 - d. Types of shading and wind protection to be provided.
 - e. Curing methods, including use of evaporation retardant.
 - f. Procedures for measuring and recording concrete temperatures.
 - g. Procedures for preventing drying during dry, windy conditions.
- 5. Concrete repair techniques.
- B. Informational Submittals:
 - 1. Preinstallation Conference minutes.
 - 2. Manufacturer's application instructions for bonding agent and bond breaker.
 - 3. Manufacturer's Certificate of Compliance to specified standards:
 - a. Bonding agent.
 - b. Bond breaker.
 - c. Repair materials.
 - 4. Statement of Qualification:
 - a. Batch Plant: Certification as specified herein.
 - b. Mix designer.
 - c. Installer.
 - d. Testing agency.
 - 5. Manufacturer's written instructions for product shipment, storage, handling, installation/application, and repair for:
 - a. Joint filler and primer.
 - b. Preformed control joint.
 - 6. Concrete Delivery Tickets:
 - a. For each batch of concrete before unloading at Site.
 - b. In accordance with ASTM C94/C94M, including Requirement 14.2.1. through Requirement 14.2.10.
 - c. Indicate amount of mixing water withheld and maximum amount that may be permitted to be added at Site.

1.05 QUALITY ASSURANCE

A. Qualifications:

- 1. Batch Plant: NRMCA Program for Certification of Ready-Mixed Concrete Production Facilities or approved equivalent program.
- 2. Mix Designer: Person responsible for developing concrete mixture proportions certified as NRMCA Concrete Technologist Level 2 or DOT certified mix designer in jurisdiction of the Work. Requirement may be waived if individual is Contractor's Licensed Design Engineer.
- 3. Flatwork Finisher: Unless otherwise permitted, at least one person on finishing crew shall be certified as an ACI Flatwork Finisher, or equivalent.
- 4. Testing Agency: Unless otherwise permitted, an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 - a. Where field testing is required of Contractor, personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - b. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician–Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician–Grade II.
- B. Preinstallation Conference:
 - 1. Required Meeting Attendees:
 - a. Contractor, including pumping, placing and finishing, and curing subcontractors.
 - b. Ready-mix producer.
 - c. Admixture representative.
 - d. Testing and sampling personnel.
 - e. Steel Reinforcement Installer
 - f. Owner and/or Owner's designee.
 - 2. Schedule and conduct prior to incorporation of respective products into Project. Notify Owner of location and time.
 - 3. Agenda shall include:
 - a. Admixture types, dosage, performance, and redosing at Site.
 - b. Mix designs, test of mixes, and Submittals.
 - c. Placement methods, techniques, equipment, consolidation, and form pressures.
 - d. Slump or slump flow and placement time to maintain slump and slump flow.

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- e. Finish, curing, and water retention.
- f. Steel reinforcement details.
- g. Protection procedures for weather conditions.
- h. Other specified requirements requiring coordination.
- 4. Conference minutes.

PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise specified, Work must be in accordance with ACI 301.

2.02 FORMWORK

- A. Form Materials:
 - 1. For exposed areas, use hard plastic finished plywood, overlaid waterproof particle board, or steel in new and undamaged condition, of sufficient strength and surface smoothness to produce specified finish.
 - 2. For unexposed areas, use new shiplap or plywood.
 - 3. Earth cuts may be used for forming footings.
- B. Beveled Edge Corner Strips: Nonabsorbent material, compatible with form surface, fully sealed on all sides prohibiting loss of paste or water between the two surfaces.
- C. Form Ties:
 - 1. Material: Steel.
 - 2. Spreader Inserts:
 - a. Conical or spherical type.
 - b. Design to maintain positive contact with forming material.
 - c. Furnish units that will leave no metal closer than 1-1/2 inches to concrete surface when forms, inserts, and tie ends are removed.
 - 3. Wire ties not permitted.

2.03 CONCRETE

- A. Materials:
 - 1. Cementitious Materials:
 - a. Cement:
 - 1) Portland Cement: Unless otherwise specified, conform to requirements of ASTM C150/C150M.

- 2) Blended Hydraulic Cement:
 - a) Unless otherwise specified, excluding Type IS (greater than 70), conforming to ASTM C595/C595M.
 - b) Portland cement used in blended hydraulic cement; conform to requirements of ASTM C150/C150M.
- 3) Furnish from one source.
- b. Supplementary Cementitious Materials (SCM):
 - 1) Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618, except as modified herein:
 - a) ASTM C618, Table 1, Loss on Ignition: Unless permitted otherwise, maximum 3 percent.
 - 2) Slag Cement: In accordance with ASTM C989/C989M, Grade 100 or Grade 120.
 - 3) Silica Fume: In accordance with ASTM C1240.
- 2. Aggregates: Unless otherwise permitted, furnish from one source for each aggregate type used in a mix design.
 - a. Aggregates:
 - 1) In accordance with ASTM C33/C33M, except as modified herein.
 - a) In accordance with ACI 301, except as modified herein.
 - b) Free of materials and aggregate types causing popouts, discoloration, staining, or other defects on surface of concrete.
 - c) Aggregates that are susceptible to alkali-carbonate reactions shall not be used.
 - d) Alkali Silica Reactivity: See Article Concrete Mix Design.
 - 2) Fine Aggregates:
 - a) In accordance with ASTM C33/C33M, except as modified herein.
 - b) In the event manufactured sand is included in the mix design, the material shall be from the same source as the coarse aggregate.
 - c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 2 and as follows:
 - Limit material finer than 75-μm (No. 200) sieve to 3 percent mass of total sample.
 - (2) Limit coal and lignite to 0.5 percent.
 - 3) Coarse Aggregate:
 - a) Crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles as determined by ASTM D4791.

- b) Class designation in accordance with ASTM C33/C33M, Table 3: 4S unless otherwise specified.
- c) Limit deleterious substances in accordance with ASTM C33/C33M, Table 4 for specified class designation.
- 3. Admixtures:
 - a. Characteristics:
 - 1) Compatible with other constituents in mix.
 - 2) Contain at most, only trace amount chlorides in solution.
 - 3) Furnish type of admixture as recommended by manufacturer for anticipated temperature ranges.
 - b. Air-Entraining Admixture: ASTM C260/C260M.
 - c. Water-Reducing Admixture: ASTM C494/C494M, Type A or Type D.
 - d. Retarding Admixture: ASTM C 494/C 494M, Type B.
 - e. Accelerating Admixture: ASTM C 494/C 494M, Type C.
 - f. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F or Type G.
- 4. Water and Ice: Mixing water for concrete and water used to make ice shall be potable water, unless alternative sources of water are permitted.
 - a. Water from alternative sources shall comply with requirements of ASTM C1602/C1602M, and concentration of chemicals in combined mixing water shall be less than:
 - 1) Chloride Content: 1,000 ppm.
 - 2) Sulfate Content as SO₄: 3,000 ppm.
 - 3) Alkalis as $(Na_2O + 0.658 K_2O)$: 600 ppm.
 - 4) Total Solids by Mass: Less than 50,000 ppm.
- B. Concrete Mix Design:
 - 1. General:
 - a. Unless otherwise specified, refer to Supplement at the end of this section for mix design requirements for each class of concrete used on Project.
 - b. Unless otherwise specified, prepare design mixtures for each type and strength of concrete, selecting and proportioning ingredients in accordance with requirements of ACI 301.
 - c. Unless otherwise specified, selection of constituent materials and products in mix design are optional.
 - d. Unless otherwise permitted, use water-reducing admixture or water-reducing admixture and high-range, or water-reducing admixture for the following:
 - 1) Pumped concrete.

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- 2) Concrete with a water-cementitious materials ratio below 0.50.
- 3) Concrete mixtures used in walls.
- 4) When needed to achieve fresh properties that facilitate handling, placing, and consolidating of concrete mixtures, and to achieve specified hardened properties.
- 5) When anticipated high temperatures, low humidity, or other adverse placement conditions can adversely affect fresh properties of concrete.
- e. Unless otherwise specified, desired fresh properties of concrete shall be determined by Contractor, and coordinated with concrete producer. Fresh properties of concrete shall remain stable to satisfaction of Contractor, for duration of placement and consolidation, and shall remain in conformance with requirements of Contract Documents.
- f. Contractor is encouraged to consider using environmentally sustainable concrete mix design technologies such as use of supplementary cementitious materials and aggregate packing, and self-consolidating concrete.
- 2. Proportions:
 - a. Design mix to meet aesthetic, durability, and strength requirements.
 - b. Where fly ash is included in mix, minimum fly ash content shall be a minimum of 15 percent of weight of total cementitious materials.
 - c. Where silica fume is included in mix, minimum silica fume content shall be 5 percent of weight of total cementitious materials.
- 3. Slump:
 - Unless otherwise specified, and prior to submitting mix design, select a target slump at the point of delivery for concrete mixtures used for Work. Selected target slump shall not exceed 9 in. Concrete shall not show visible signs of segregation. The target slump indicated on the submittal shall be used as the basis for acceptance during the project. Determine the slump by ASTM C143/C143M.
 - b. Slump tolerance shall meet requirements of ACI 117.
- 4. Size of Coarse Aggregate:
 - a. Unless otherwise specified, nominal maximum size of coarse aggregate shall not exceed:
 - 1) Three-fourths of minimum clear spacing between reinforcement.
 - 2) One-fifth of narrowest dimension between sides of forms.
 - 3) One-third of thickness of slabs or toppings.
- 5. Temperature Limits:
 - a. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set, plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
 - b. For mass concrete sections, provide documentation that maximum concrete temperature in structure will not exceed 160 degrees F, and maximum temperature differential between center of section and external surfaces of concrete will not exceed 35 degrees F.
 - c. Accelerating admixture may not be used in mass concrete sections unless the thermal control plan specifically addresses the concrete mixtures with the same accelerating admixture, at a dosage equal to or greater than being proposed for the mass concrete.

2.04 REINFORCING STEEL

- A. Deformed Steel Reinforcing Bars: ASTM A615/A615M, Grade 60. Welding of reinforcing bars is not permitted.
- B. Fabrication: Follow CRSI Manual of Standard Practice.

2.05 ANCILLARY MATERIALS

- A. Bonding Agent:
 - 1. Unless otherwise specified, in accordance with the following:
 - a. ASTM C881/C881M, Type V.
 - b. Two-component, moisture-insensitive, 100 percent solids epoxy.
 - c. Consult manufacturer for surface finish, pot life, set time, vertical or horizontal application, and forming restrictions.
 - d. Manufacturers and Products:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject 1500.
 - 2) Euclid Chemical Co., Cleveland, OH; Euco # 352 Epoxy System LV.
 - 3) Prime Resins, Conyers, GA; Prime Bond 3000 to 3900 Series.
 - 4) Sika Chemical Corp., Lyndhurst, NJ; Sikadur 32 Hi-Mod.
- B. Bond Breaker:
 - 1. Nonstaining type, providing positive bond prevention.

- 2. Manufacturers and Products:
 - a. Dayton Superior Corporation, Miamisburg, OH; Sure Lift J6WB.
 - b. Nox-Crete Products Group, Omaha, NE; Silcoseal Select.
- C. Reinforcing Steel Accessories:
 - 1. Plastic Protected Wire Bar Supports: In compliance with ANSI/CRSI RB 4.1 Class 1 Reinforcement Supports.
 - 2. Stainless Steel Protected Wire Bar Supports: In compliance with ANSI/CRSI – RB 4.1 Class 2 Reinforcement Supports, except legs shall be made wholly from stainless steel wire.
 - Precast Concrete Bar Supports: In compliance with ANSI/CRSI RB
 4.1 Cementitious (Precast) Reinforcement Supports.
 - a. Precast concrete bar supports shall have equal or greater strength than the surrounding concrete.
 - b. Precast concrete bar supports shall be four square inches minimum, in plan.
 - c. Precast concrete bar supports shall have tie wires.
- D. Tie Wire:
 - 1. Black, soft-annealed 16-gauge wire.
 - 2. Nylon-coated, epoxy-coated, or plastic-coated wire.
- E. Premolded Joint Filler:
 - 1. Bituminous Type: ASTM D994/D994M or ASTM D1751.
 - 2. Sponge Rubber:
 - a. Neoprene, closed-cell, expanded; ASTM D1056, Type 2C5, with compression deflection, 25 percent deflection (limits), 119 kPa to 168 kPa (17 psi to 24 psi) minimum.
 - b. Manufacturer and Product: Monmouth Rubber and Plastics Corporation, Long Branch, NJ; Durafoam DK515IHD.
- F. Curing Compound:
 - 1. Water-based, high-solids content, nonyellowing, curing compound meeting requirements of ASTM C1315 Type I, Class A.
 - 2. Manufacturers and Products:
 - a. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
 - b. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
 - c. Vexcon Chemical, Inc., Philadelphia, PA; Starseal 1315.
 - d. Dayton Superior; Safe Cure and Seal 1315 EF.

- G. Evaporation Retardant:
 - 1. Optional: Fluorescent fugitive dye color tint that disappears completely upon drying.
 - 2. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterKure ER 50.
 - b. Euclid Chemical Co., Cleveland, OH; Eucobar.
- H. Nonshrink Grout:
 - 1. Nonmetallic, nongas-liberating.
 - 2. Prepackaged natural aggregate grout requiring only the addition of water.
 - 3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
 - 4. Test in accordance with ASTM C1107/C1107M:
 - a. Fluid consistency 20 seconds to 30 seconds in accordance with ASTM C939.
 - b. Temperatures of 40 degrees F, 80 degrees F, and 100 degrees F.
 - 5. Pass fluid grout through flow cone with continuous flow 1 hour after mixing.
 - 6. Minimum Strength of Fluid Grout:
 - a. 3,500 psi at 1 day.
 - b. 4,500 psi at 3 days.
 - c. 7,500 psi at 28 days.
 - 7. Maintain fluid consistency when mixed in 1 yard to 9 yard loads in ready-mix truck.
 - 8. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterFlow 928.
 - b. Five Star Products Inc., Fairfield, CT; Five Star Fluid Grout 100.
 - c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
 - d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
- I. Repair Material:
 - 1. Contain only trace amounts of chlorides and other chemicals that can potentially cause steel to oxidize.
 - 2. Where repairs of exposed concrete are required, prepare mockup using proposed repair materials and methods, for confirmation of appearance compatibility prior to use.
 - 3. Obtain Manufacturer's Certificate of Compliance that products selected are appropriate for specific applications.
 - 4. Repair mortar shall be Site mixed.

- 5. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
- 6. Manufacturers and Products:
 - a. Master Builders Solutions, Shakopee, MN; MasterEmaco S Series products.
 - b. Sika Chemical Corp., Lyndhurst, NJ; SikaTop Series.
- J. Crack Repair:
 - 1. Obtain Letter of Certification from manufacturer's technical representative, that products selected are appropriate for the specific applications.
 - 2. Prepare concrete substrate and mix, place, and cure repair material in accordance with manufacturer's written recommendations.
 - 3. Use part epoxy injection resin for structural crack repairs.
 - a. Manufacturers:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject Series.
 - 2) Euclid Chemical Co., Cleveland, OH.; Euco Series (#452).
 - 3) Sika Chemical Corp., Lyndhurst, NJ.; Sikadur Series.
 - 4. Use hydrophilic polyurethane injection resin for non-structural crack repairs.
 - a. Manufacturers:
 - 1) Master Builders Solutions, Shakopee, MN; MasterInject 1210 IUG.
 - 2) Euclid Chemical Co., Cleveland, OH.; Dural Aqua-Fil.
 - 3) Sika Chemical Corp., Lyndhurst, NJ.; SikaFix HH Hydrophilic.
 - 4) Prime Resins, Inc., Conyers, GA.; Prime Flex 900 XLV.

2.06 SOURCE QUALITY CONTROL

A. Source Quality Control Inspection: Owner shall have access to and have right to inspect batch plants, cement mills, and supply facilities of suppliers, manufacturers, and subcontractors, providing products included in this section.

PART 3 EXECUTION

- 3.01 FORMWORK
 - A. Form Construction:
 - 1. Construct forms and provide smooth-form finish.
 - 2. Form 3/4-inch bevels at concrete edges, unless otherwise shown.

- 3. Make joints tight to prevent escape of mortar and to avoid formation of fins.
- 4. Brace as required to prevent distortion during concrete placement.
- 5. On exposed surfaces, locate form ties in uniform pattern or as shown.
- 6. Construct so ties remain embedded in the member with no metal within 1-inch of concrete surface when forms, inserts, and tie ends are removed.
- B. Form Removal:
 - 1. Nonsupporting forms (walls and similar parts of Work) may be removed after cumulatively curing at not less than 50 degrees F for 24 hours from time of concrete placement if:
 - a. Concrete is sufficiently hard so as not to sustain damage by form removal operations.
 - b. Curing and protection operations are maintained.
 - 2. Remove forms with care to prevent scarring and damaging the surface.
 - 3. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

3.02 PLACING REINFORCING STEEL

- A. Unless otherwise specified, in accordance with ACI 301.
- B. Accessories:
 - 1. Bar Supports in Contact with Ground: Provide precast concrete block supports.
 - a. Do not use brick, broken concrete masonry units, spalls, rocks, construction debris, or similar material for supporting reinforcing steel.
 - 2. Bar Supports in Contact with Forms: Unless otherwise noted, bar supports shall be plastic protected wire bar supports, stainless steel protected wire bar supports, or precast concrete block bar supports.
 - a. Use stainless steel protected wire bar supports or precast concrete block bar supports at formed surfaces that will receive abrasive blasting, hydro-blasting, or grinding.
 - 3. Bar supports shall have sufficient strength and stiffness to carry loads without failure, displacement, or significant deformation. Space bar supports so minimum concrete cover is maintained for reinforcing between supports, and location of reinforcement remains within tolerance throughout work.

- C. Splices and Laps:
 - 1. Lap Splice Reinforcing: Refer to Structural General Notes on the Drawings for additional information.
 - 2. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 CONCRETE PLACEMENT INTO FORMWORK

- A. Inspection: Notify Owner and Special Inspector at least 1 work day in advance before starting to place concrete.
- B. Placement into Formwork:
 - 1. Reinforcement: Secure in position before placing concrete.
 - 2. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 1.5 feet deep, except for slabs that shall be placed full depth. Place and consolidate successive layers prior to initial set of first layer to prevent cold joints.
 - 3. Placement frequency shall be such that lift lines will not be visible in exposed concrete finishes.
 - 4. Use means and methods that prevent segregation.
 - 5. Provide sufficient illumination in the interior of forms so concrete deposition is visible, permitting confirmation of consolidation quality.
 - 6. Joints in Footings and Slabs:
 - a. Ensure space beneath plastic waterstop completely fills with concrete.
 - b. During concrete placement, make visual inspection of entire waterstop area.
 - c. Limit concrete placement to elevation of waterstop in first pass, vibrate concrete under waterstop, lift waterstop to confirm full consolidation without voids, and place remaining concrete to full height of slab.
 - d. Apply procedure to full length of waterstop.
 - 7. Trowel and round off top exposed edges of walls with 1/4-inch radius steel edging tool.
- C. Conveyor Belts and Chutes:
 - 1. Design and arrange ends of chutes, hopper gates, and other points of concrete discharge throughout conveying, hoisting, and placing system for concrete to pass without becoming segregated.
 - 2. Do not use chutes longer than 50 feet.
 - 3. Wipe clean with device that does not allow mortar to adhere to belt.
 - 4. Cover conveyor belts and chutes.

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- D. Retempering: Not permitted for concrete where cement has partially hydrated.
- E. Pumping of Concrete:
 - 1. Provide standby pump, conveyor system, crane and concrete bucket, or other system onsite during pumping, for adequate redundancy to ensure completion of concrete placement without cold joints in case of primary placing equipment breakdown.
 - 2. Minimum Pump Hose (Conduit) Diameter: 4 inches.
 - 3. Replace pumping equipment and hoses (conduits) that are not functioning properly.
- F. Maximum Size of Concrete Placements:
 - 1. Limit size of each placement to allow for strength gain and volume change as a result of shrinkage.
 - 2. Locate expansion, control, and contraction, joints where shown.
 - 3. Construction Joints:
 - a. Unless otherwise shown or permitted, locate construction joints as follows:
 - 1) Locate construction joints as shown on the Drawings or where approved in the joint location submittal.
 - 2) Locate expansion, control, and contraction joints where shown on the Drawings.
 - 3) Provide vertical construction joints at maximum spacing of 40 feet unless shown or approved otherwise.
 - 4) When vertical expansion, contraction, or control joint spacing does not exceed 60 feet, intermediate construction joints are not required.
 - 5) Uniformly space vertical construction joints within straight sections of walls, avoiding penetrations.
 - 4. Consider beams, girders, brackets, column capitals, and haunches as part of floor or roof system and place monolithically with floor or roof system.
- G. Minimum Time between Adjacent Placements:
 - 1. Typical Unless Noted Otherwise: As soon as can safely be done without damaging previously cast concrete or interrupting curing thereof, but not less than 24 hours.
 - 2. Expansion or Contraction Joints: 1 day.

3. If continuous placement of beams, girders, or slabs with columns or walls is indicated in Contract Documents, do not place horizontal elements until the underlying concrete is consolidated and bleed water is not on the surface of the supporting member, unless otherwise specified.

3.04 CONSOLIDATION AND VISUAL OBSERVATION

A. Provide at least one standby vibrator in operable condition at placement site prior to placing concrete.

3.05 COLD WEATHER PLACEMENT

- A. Unless otherwise permitted, shall be in accordance with requirements of ACI 301, ACI 306.1, and as follows:
 - 1. Cold weather requirements shall apply when ambient temperature is below 40 degrees F or approaching 40 degrees F and falling.
 - 2. Do not place concrete over frozen earth or against surfaces with frost or ice present. Frozen earth shall be thawed to acceptance of Owner.
 - 3. Unless otherwise permitted, do not place concrete in contact with surfaces less than 35 degrees F; requirement is applicable to all surfaces including reinforcement and other embedded items.
 - 4. Provide supplemental external heat as needed when other means of thermal protection are unable to maintain minimum surface temperature of concrete as specified in ACI 306.1.
 - 5. Maintain minimum surface temperature of concrete as specified in ACI 306.1 for no less than 3 days during cold weather conditions.
 - 6. Protect concrete from freezing until end of curing period and until concrete has attained a compressive strength of 3,500 psi or design compressive strength if less than 3,500 psi.
- B. Provide maximum and minimum temperature sensors placed on concrete surfaces spaced throughout Work to allow monitoring of concrete surface temperatures representative of Work. Unless otherwise permitted, record surface temperature of concrete at least once every 12 hours during specified curing period.
- C. External Heating Units: Do not exhaust heater flue gases directly into enclosed area as it causes concrete carbonation as a result of concentrated carbon dioxide.
- D. Cure as specified.

ROGER SCOTT POOL FACILITIES

3.06 HOT WEATHER PLACEMENT

- A. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 301, ACI 305.1, and as follows:
 - 1. Maintain concrete temperature below 95 degrees F at time of placement, or furnish test data or other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking as a result of heat of hydration. Cool ingredients before mixing to maintain fresh concrete temperatures as specified or less.
 - 2. Internal concrete temperature in structure shall not exceed 160 degrees F, and maximum temperature differential between center of section and external surfaces of concrete shall not exceed 35 degrees F.
 - 3. Provide for windbreaks, shading, fog spraying, sprinkling, ice, wet cover, or other means as necessary to maintain concrete at or below specified temperature.
 - 4. Cure as specified.

3.07 CONCRETE BONDING

- A. Construction Joints at Existing Concrete:
 - 1. Thoroughly clean and roughen existing concrete surfaces to roughness profile range between CSP 7 to CSP 9 when verified by comparison to PC1-10.
 - 2. Saturate surface with water for 24 hours prior to placing new concrete.

3.08 PREMOLDED JOINT FILLER INSTALLATION

- A. Sufficient in width to completely fill joint space where shown.
- B. Drive nails approximately 1-foot 6 inches on center through filler, prior to installing, to provide anchorage embedment into concrete during concrete placement.
- C. Secure premolded joint filler in forms before concrete is placed.

3.09 FINISHING FORMED SURFACES

A. Provide surface finish 2.0 (SF-2.0) in accordance with ACI 301 and as herein specified.

B. Tie Holes:

- 1. Unless otherwise specified, fill with specified repair material.
 - a. Prepare substrate and mix, place, and cure repair material per manufacturer's written recommendations.
- C. Repair defective areas of concrete.
 - 1. Cut edges perpendicular to surface at least 1/2-inch deep. Do not feather edges. Soak area with water for 24 hours.
 - 2. Patch with specified repair material.
 - 3. Repair concrete surfaces using specified materials. Select system, submit for review, and obtain approval from Owner prior to use.
 - 4. Develop repair techniques with material manufacturer on surface that will not be visible in final construction prior to starting actual repair work and show how finish color will blend with adjacent surfaces. Obtain approval from Owner.
 - 5. Obtain quantities of repair material and manufacturer's detailed instructions for use to provide repair with finish to match adjacent surface or apply sufficient repair material adjacent to repair to blend finish appearance.
 - 6. Repair of concrete shall provide structurally sound surface finish, uniform in appearance or upgrade finish by other means until acceptable to Owner.
- D. Inject cracks that meet the definition of defective area.
 - 1. When crack repair is deemed by Owner as requiring a structural repair, use part epoxy injection resin.
 - 2. When crack repair is deemed by Owner as requiring a nonstructural repair, use hydrophilic polyurethane injection resin.

3.10 FINISHING UNFORMED SURFACES

- A. General:
 - 1. Use manual screeds, vibrating screeds, or roller compacting screeds to place concrete level and smooth.
 - 2. Do not use "jitterbugs" or other special tools designed for purpose of forcing coarse aggregate away from surface and allowing layer of mortar, which will be weak and cause surface cracks or delamination, to accumulate.
 - 3. Do not dust surfaces with dry materials nor add water to surfaces.
 - 4. Cure concrete as specified.

- B. Slab Tolerances:
 - 1. Exposed Slab Surfaces: Comprise of flat planes as required within tolerances specified.
 - 2. Slab Finish Tolerances and Slope Tolerances: Crowns on floor surface not too high as to prevent 10-foot straightedge from resting on end blocks, nor low spots that allow block of twice the tolerance in thickness to pass under supported 10-foot straightedge.
 - 3. Steel gauge block 5/16-inch thick.
 - 4. Finish Slab Elevation: Slope slabs to floor drain and gutter, and shall adequately drain regardless of tolerances.
 - 5. Thickness: Maximum 1/4-inch minus or 1/2-inch plus from thickness shown. Where thickness tolerance will not affect slope, drainage, or slab elevation, thickness tolerance may exceed 1/2-inch plus.
- C. Interior Slab Finish: Provide trowel finish unless specified otherwise.
- D. Exterior Slab Finish:
 - 1. Provide broom finish unless specified otherwise.
 - 2. Finish exposed edges with steel edging tool.
 - 3. Mark sidewalks transversely at 5-foot intervals with jointing tool.

3.11 EXPOSED METAL OBJECTS

- A. Remove metal objects not intended to be exposed in as-built condition of structure including wire, nails, and bolts, by chipping back concrete to depth of 1-inch and then cutting or removing metal object.
- B. Repair area of chipped-out concrete as specified for defective areas.

3.12 BLOCKOUTS AT PIPES OR OTHER PENETRATIONS

A. Where shown, install in accordance with requirements of the Drawings.

3.13 PROTECTION AND CURING

- A. Protect and cure concrete in accordance with requirements of ACI 301, ACI 308.1, and as follows:
 - 1. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
 - 2. Continuously wet cure concrete surfaces of hydraulic structures for a 7-day period. Intermittent wetting is not acceptable.
 - 3. Use curing compound only where approved by Owner.

- 4. Cure formed surfaces with curing compound applied in accordance with manufacturer's written instructions as soon as wet curing and finishing are completed.
- 5. Remove and replace concrete damaged by freezing.
- 6. Repair areas damaged by construction, using specified repair materials and approved repair methods.

3.14 NONSHRINK GROUT

- A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer's written instructions.
- B. Grouting Machinery Foundations:
 - 1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material. Surface roughness in accordance with manufacturer's written instructions.
 - 2. Clean metal surfaces of all paint, oil, grease, loose rust, and other foreign material that will be in contact with grout.
 - 3. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts. Remove wedges after grout is set and pack void with grout.
 - 4. Form with watertight forms at least 2 inches higher than bottom of plate.
 - 5. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's written instructions.

3.15 BACKFILL AGAINST STRUCTURES

- A. Do not backfill against walls until concrete has obtained specified 28-day compressive strength.
- B. Refer to General Structural Notes on the Drawings for additional requirements, including elevated slab and diaphragm completion prior to backfill.
- C. Unless otherwise permitted, place backfill simultaneously on both sides of structure, where such fill is required, to prevent differential pressures.

3.16 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. General:
 - 1. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

- 2. Provide adequate facilities for safe storage and proper curing of concrete test specimens onsite for first 24 hours and for additional time as may be required before transporting to test lab.
- 3. Unless otherwise specified, sample concrete for testing for making test specimens, from point of delivery.
- 4. When concrete is pumped, sample and test air content at point of delivery and at point of placement.
- 5. Evaluation will be in accordance with ACI 301 and Specifications.
- 6. Test specimens shall be made, cured, and tested in accordance with ASTM C31/C31M and ASTM C39/C39M.
- 7. Frequency of testing may be changed at discretion of Owner.
- 8. Pumped Concrete: Take concrete samples for slump, ASTM C143/C143M, and test specimens, ASTM C31/C31M and ASTM C39/C39M.
- 9. If measured air content at delivery is greater than specified limit, check test of air content will be performed immediately on a new sample from delivery unit. If check test fails, concrete has failed to meet requirements of Contract Documents. If measured air content is less than lower specified limit, adjustments will be permitted in accordance with ASTM C94/C94M, unless otherwise specified. If check test of adjusted mixture fails, concrete has failed to meet requirements of Contract Documents. Concrete that has failed to meet requirements of Contract Documents shall be rejected.
- B. Concrete Strength Test:
 - 1. Unless otherwise specified, one specimen at age of 7 days for information, and two 6-inch diameter or when permitted three 4-inch diameter test specimens at age of 28 days for acceptance.
 - 2. If result of 7-day concrete strength test is less than 50 percent of specified 28-day strength, extend period of moist curing by 7 additional days.
 - 3. Provide a minimum of one spare test specimen per sample. Test spare cylinder as directed by Owner.
 - 4. Segregation Test Objective: Concrete shall stay together when slumped. Segregation is assumed to cause mortar to flow out of mix even though aggregate may stay piled enough to meet slump or slump flow test.
 - a. Test Procedure: Make slump or slump flow test and check for excessive slump or slump flow. Observe to see if mortar or moisture flows from slumped concrete.
 - b. Reject concrete if mortar or moisture separates and flows out of mix.

- C. Cold Weather Placement Tests:
 - 1. During cold weather concreting, cast cylinders for field curing as follows. Use method that will produce greater number of specimens:
 - a. Six extra test cylinders from last 100 cubic yards of concrete.
 - b. Minimum three specimens for each 2 hours of placing time or for each 100 cubic yards.
 - 2. These specimens shall be in addition to those cast for lab testing.
 - 3. Protect test cylinders from weather until they can be placed under same protection provided for concrete of structure that they represent.
 - 4. Keep field test cylinders in same protective environment as parts of structure they represent to determine if specified strength has been obtained.
 - 5. Test cylinders in accordance with applicable sections of ASTM C31/C31M and ASTM C39/C39M.
 - 6. Use test results to determine specified strength gain prior to falsework removal.
- D. Slab Finish Tolerances and Slope Tolerances:
 - 1. Support 10-foot-long straightedge at each end with steel gauge blocks of thicknesses equal to specified tolerance.
 - 2. Compliance with designated limits in four of five consecutive measurements is satisfactory, unless defective conditions are observed.

3.17 SUPPLEMENTS

- A. Requirements of concrete mix designs following "End of Section," are a part of this Specification and supplement requirements of Part 1 through Part 3 of this section:
 - 1. Concrete Mix Design, Class 5000F3S1P2C2.

END OF SECTION

CONCRETE MIX DESIGN, CLASS 5000F3S1P2C2

- A. Mix Locations: Typical, unless otherwise specified.
- B. Exposure Categories and Classifications: F3S1P2C2.
- C. Mix Properties:
 - 1. Limit water to cementitious materials ratio (W/Cm) in mix design to maximum value of 0.40.
 - 2. Minimum concrete compressive strength (f'c) shall be 5,000 psi at 28 days.
 - 3. Air-entraining admixtures are prohibited in concrete mixtures and total air content shall not be greater than 3 percent, for the following:
 - a. Slabs to receive hard-troweled finish.
 - b. Slabs to receive dry shake floor hardener.
 - c. Slabs to receive topping placed monolithically as two-course floor on top of plastic concrete.
 - 4. Unless otherwise specified, provide air content based on nominal maximum size of aggregate as follows:

Nominal Maximum Aggregate Size in.‡	Air Content (%)*
3/8	7.5
1/2	7.0
3/4	6.0
1	6.0
1-1/2	5.5
2 [§]	5.0
3§	4.5

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Nominal Maximum Aggregate Size	Air Content
in. [‡]	$(\%)^*$

‡See ASTM C33/C33M for tolerance on oversize for various nominal maximum size designations.

*Tolerance of air content is $\pm 1-1/2$ percent.

§Air contents apply to total mixture. When testing concretes, however, aggregate particles larger than 1-1/2 inches are to be removed by sieving and air content will be measured on sieved fraction (tolerance on air content as delivered applies to this value). Air content of total mixture is computed from value measured on the sieved fraction passing the 1-1/2-inch sieve in accordance with ASTM C231/C231M.

5. Limit supplementary cementitious materials as follows:

Limits on cementitious materials for concrete assigned to Exposure Class F3 [‡] *		
Supplementary cementitious materials	Maximum percent of total cementitious materials by mass	
Fly as or natural pozzolans conforming to ASTM C618	25	
Slag cement conforming to ASTM C989	50	
Silica fume conforming to ASTM C1240	10	
Total of fly ash or natural pozzolans and silica fume	35	
Total of fly ash or natural pozzolans, slag cement, and silica fume	50	
[‡] Supplementary cementitious materials, including fly ash and natural pozzolans, slag cement, and silica fume, used in the manufacture of ASTM C595 and C1157 blended cements shall be included in		

assessing compliance with these limits.

* The individual limits shall apply regardless of the number of cementitious materials in a concrete mixtures.

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- 6. Limit supplementary cementitious materials measured as a percent of weight of total cementitious materials in mix design, as follows:
 - a. Fly Ash and other Pozzolans: 25 percent.
 - b. Slag Cement: 50 percent.
 - c. Silica Fume: 10 percent.
 - d. Total cementitious materials include ASTM C150/C150M and ASTM C595/C595M cement.
 - 1) Fly ash and other pozzolans in Type IP, blended cement, ASTM C595/C595M.
 - 2) Slag used in the manufacture of an IS blended cement, ASTM C595/C595M.
- 7. Provide cementitious materials in accordance with one of the following:
 - a. ASTM C150/C150M Type II; inclusion of supplementary cementitious materials in design mix is optional.
 - b. ASTM C150/C150M types other than Type II, plus supplementary cementitious materials in accordance with one of the following:
 - 1) Tricalcium Aluminate Content of Total Cementitious Materials: Maximum 8 percent by weight.
 - 2) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
 - c. ASTM C595/C595M Type IP or Type IS (less than 70), tested to comply with moderate sulfate resistance option (MS).
 - 1) Provide documentation of test results in accordance with ASTM C1012/C1012M, for combinations of cementitious materials providing sulfate resistance with expansion less than 0.10 percent at 6 months.
- 8. Unless otherwise permitted, minimum cementitious materials content in mix design shall be as follows:
 - a. 515 pounds per cubic yard for concrete with 1-1/2-inch nominal maximum size aggregate.
 - b. 535 pounds per cubic yard for 1-inch nominal maximum size aggregate.
 - c. 560 pounds per cubic yard for 3/4-inch nominal maximum size aggregate.
 - d. 580 pounds per cubic yard for 1/2-inch nominal maximum size aggregate.
 - e. 600 pounds per cubic yard for 3/8-inch nominal maximum size aggregate.
 - f. Unless otherwise permitted, limit cementitious materials content to 100 pounds per cubic yard greater than specified minimum cementitious materials content in mix design.

- 9. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent, unless otherwise specified.
 - a. Limits are stated in terms of chloride ions in percent by weight of cement.
 - b. Unless otherwise permitted, provide documentation from concrete tested in accordance with ASTM C1218/C1218M at an age between 28 days and 42 days.
- D. Refer to PART 1 through PART 3 of this section for additional requirements.

SECTION 04 22 00 CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A82/A82M, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. C33, Standard Specification for Concrete Aggregates.
 - d. C90, Standard Specification for Loadbearing Concrete Masonry Units.
 - e. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - f. C144, Standard Specification for Aggregate for Masonry Mortar.
 - g. C150, Standard Specification for Portland Cement.
 - h. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - i. C270, Standard Specification for Mortar for Unit Masonry.
 - j. C404, Standard Specification for Aggregates for Masonry Grout.
 - k. C476, Standard Specification for Grout for Masonry.
 - 1. C618 12 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - m. C744, Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
 - n. C979, Pigments for Integrally Colored Concrete.
 - o. C989, Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
 - p. C1314, Standard Test Method for Compressive Strength of Masonry Prisms.
 - q. C1403, Standard Test Method for Rate of Water Absorption of Masonry Mortars.
 - r. E514/E514M, Standard Test Method for Water Penetration and Leakage through Masonry.
 - 2. The Masonry Society (TMS):
 - a. TMS 402/ACI 530/ASCE 5; Building Code Requirements for Masonry Structures and Companion Commentaries. (MSJC Code and Commentary).

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- b. TMS 602/ACI530.1/ASCE6; Specification for Masonry Structures.
- c. 602/American Concrete Institute ACI 530.1/ASCE 6, Specification for Masonry Structures and Companion Commentaries. (Masonry Standards Joint Committee Specifications and Commentary).

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings.
 - 2. Data Sheets:
 - a. Horizontal joint reinforcement.
 - b. Preformed control joint materials.
 - c. Water repellant masonry sealer.
 - d. Grout mix design.
 - e. Mortar mix design.
 - f. Grout sand gradation in accordance with ASTM C404.
- B. Informational Submittals:
 - 1. Method and Location of Placing Grout: High lift or low lift.
 - 2. Mix design test results.
 - 3. Certifications:
 - a. Units comply with ASTM C55 and ASTM C90.
 - b. Grout test results conform to ASTM C1019.
 - c. Grout aggregates conform to requirements of ASTM C33, including nonreactivity.
 - d. Mortar sand conform to requirements of ASTM C144.
 - 4. Test results of Project samples from masonry unit manufacturer stating that units comply with ASTM C90. Documentation of material testing shall be one less than 1 year old.
 - 5. Test results of proposed grout mix deign stating that units comply with ASTM C1019. Documentation of material testing shall be 1 year old or less.
 - 6. Test reports stating aggregates for mortar meet requirements of ASTM C144.
 - 7. Test reports or letter of certification stating aggregates for grout meet requirements of ASTM C404.
 - 8. Letter from water repellent admixture manufacturer verifying masonry unit manufacturer's proper use of product.

- 9. Method and materials for removal of efflorescence.
- 10. Field test results to qualify materials.
 - a. Grout tests in accordance with ASTM C1019.

1.03 QUALITY ASSURANCE

- A. Preinstallation Conference:
 - 1. Required Meeting Attendees:
 - a. Masonry subcontractor, including masonry foreman.
 - b. Ready-mix producer.
 - c. Admixture representative.
 - d. Testing and sampling personnel.
 - e. Design Structural Engineer.
 - f. Project Architect for coating system and appearance.
 - 2. Schedule and conduct prior to start of masonry construction.
 - 3. Notify Engineer of location and time.
 - 4. Agenda shall include:
 - a. High lift and low lift procedures.
 - b. Mortar, grout, unit, and reinforcing submittals.
 - c. Types and locations of rebar splices.
 - d. Joint tooling.
 - e. Admixture types, dosage, performance, and redosing at Site.
 - f. Mix designs and test of mix.
 - g. Placement methods, techniques, equipment, consolidation, and reconsolidation.
 - h. Protection procedures for environmental conditions.
 - i. Other specified requirements requiring coordination.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Keep units and mortar/grout cementitious ingredients, including lime, dry.

PART 2 PRODUCTS

2.01 COMPRESSIVE STRENGTH OF MASONRY ASSEMBLAGE

A. Minimum 28-Day Specified Compressive Strength (f'm) of Masonry: 2,500 psi.

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2.02 CONCRETE MASONRY UNITS (CMU)

- A. ASTM C90: Normal weight.
 - 1. Net Area Compressive Strength: 2,800 psi minimum, in accordance with TMS 602, Table 2.
 - a. Water Repellent Admixture:
 - 1) Structural concrete masonry units in weather exposed exterior wall shall be manufactured with integral liquid polymeric admixture to provide resistance to water penetration.
 - 2) Manufacturers and Products:
 - a) W.R. Grace & Co.; Dry-Block Block Admixture.
 - b) BASF Construction Chemicals; Rheopel Plus.
 - 2. Nominal Size: 16 inches long by 8 inches high by thickness shown on the Drawings.
 - 3. Color of Units: See the Drawings.
 - 4. Surface Texture on Exposed Surfaces: As shown on the Drawings.
 - 5. Surface Texture: Smooth on interior, concealed exterior, and surface 1-foot below finished grade.
- B. General Concrete Masonry Unit (CMU) Requirements:
 - 1. Furnish or cut special shapes for corners, jambs, lintels, and other areas shown or required.
 - 2. Special units shall match color and texture of standard units.
 - 3. Where units are placed so end of unit is exposed, such as at a corner or intersection, exposed end of that block shall have surface to match color and texture of sides of other units.
 - 4. Furnish sound, dry, clean units free of cracks, prior to placing in structure.
 - 5. Vertical Cells to be Grouted: Capable of alignment sufficient to maintain clear, unobstructed continuous vertical cell dimensions in accordance with TMS 602, Table 7.
 - 6. Masonry unit size and shape shall allow for all placement patterns. Use vertical grout dams to prevent materials, such as grout, from escaping from cell being filled to adjacent cells where material is not intended to be placed.
- C. Textured Concrete Masonry Units (TCMU):
 - 1. Same type as structural units.
 - 2. Split Face: Scored.
 - 3. Color of Units: See the Drawings.

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2.03 MORTAR MATERIALS

- A. Portland Cement-Lime Mortar:
 - 1. ASTM C270.
 - 2. Cement: ASTM C150, Type II portland cement.
 - 3. Lime: ASTM C207, Type S hydrated.
 - 4. Aggregates:
 - a. Non-reactive in accordance with ASTM C33, Appendix X1.
 - b. Mortar: ASTM C144, sand.
- B. Water: Fresh, clean, and potable.
- C. Water Repellent Admixture:
 - 1. ASTM C1403.
 - 2. Mortar for structural concrete masonry units in weather exposed exterior walls shall include an integral liquid polymeric admixture to provide resistance to water penetration.
 - 3. Manufacturer and Product: BASF Construction Chemicals; Rheopel Plus Mortar Admixture.
- D. Manufacturers and Products:
 - 1. W.R. Grace; DRY-BLOCK.
 - 2. Harris Specialty Chemicals.
 - 3. Axim Italcementi Group; Intrapel.
 - 4. BASF Chemical Co.; Rheopel Admixture.
- E. Mortar Color Admixture:
 - 1. Meet the requirements of ASTM C979.
 - 2. Manufacturer and Product: Davis Colors, Los Angeles, CA; True Tone Mortar Color.
 - 3. Color shall be as shown on the Drawings.

2.04 GROUT MATERIALS

- A. Cement: ASTM C150, Type II portland cement.
- B. Fly Ash: Fly Ash (Pozzolan): Class F fly ash in accordance with ASTM C618.
- C. Slag Cement: In accordance with ASTM C989, Grade 100 or Grade 120.
- D. Lime: ASTM C207, Type S hydrated.

- E. Aggregates:
 - 1. ASTM C404, fine and coarse.
 - 2. Non-reactive in accordance with ASTM C33, Appendix X1.
- F. Water: Fresh, clean, and potable.

2.05 REINFORCEMENT

- A. Reinforcement: Clean and free from loose rust, scale, and coatings that reduce bond.
- B. Deformed Bars: As specified in Section 03 30 10, Structural Concrete.
- C. Horizontal Joint Reinforcement:
 - 1. Two parallel, ASTM A82/A82M, No. 9 wires, galvanized in accordance with ASTM A153/A153M, weld connected to No. 9 perpendicular cross wire at 16 inches, maximum, center.
 - 2. Furnish special manufactured corner and wall intersection pieces.
 - 3. Manufacturer: Dayton Superior/Dur-O-Wal, Dayton, OH.

2.06 PREFORMED CONTROL JOINTS

- A. Solid rubber cross-shape extrusions as manufactured by:
 - 1. Dayton Superior/Dur-O-WalDayton, OH; DA 2001 Control Joint Regular Rubber.
 - 2. Hohmann and Barnard, Inc, Hauppauge, NY; #RS-Standard.

2.07 MORTAR MIXES

- A. In accordance with ASTM C270, Type S and MSJC Specifications.
- B. Mix Method:
 - 1. Property Method: Minimum average mortar 28-day compressive strength 1,800 psi.
- C. Mixing: Machine mix in approved mixers in accordance with ASTM C270.
- D. Where colored masonry units are used, color mortar to match. Inert coloring pigments may be added, but shall not exceed 6 percent by weight of cement.

2.08 GROUT MIXES

- A. Compressive Strength Property: Minimum 2,000 psi at 28 days. Grout strength shall not exceed two times the minimum specified strength.
- B. Mix Design:
 - 1. Proportions: Design mix to meet property/strength requirements.
 - 2. Slump: 8-inch minimum, 11-inch maximum.

C. Mixing:

- 1. Do not use water reducers, air entrainment, plasticizing, high-range water reducers, or other non-specified admixtures in grout mixes.
- 2. Transit-Mixed Grout: Meet requirements of ASTM C476.
- 3. For high lift grouting, add approved grout expansion admixture in accordance with manufacturer's recommendations.
- 4. Fluid consistency suitable for placing without segregation with a slump of 8 inches to 11 inches.

2.09 WATER REPELLENT MASONRY SEALER

- A. Characteristics:
 - 1. Water-based blend of silanes and siloxanes.
 - 2. VOC compliant.
- B. Performance Requirements:
 - 1. Water Absorption: 95 percent reduction in weight gain when tested in accordance with ASTM C140.
 - 2. Water Repellency: 99 percent reduction in weight gain when tested in accordance with ASTM E514.
- C. Manufacturers and Products:
 - 1. W. R. Grace & Co.; Infiniseal DB Sealer.
 - 2. BASF Construction Chemicals; Enviroseal PBT.

PART 3 EXECUTION

- 3.01 GENERAL
 - Meet requirements of Florida Building Code, Chapter 21 and The Masonry Society (TMS) 602/American Concrete Institute (ACI)530.1/ASCE 6, Specification for Masonry Structures and Companion Commentaries (MSJC), Part 3, Execution, except as modified in this section.

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- B. Moisture Protection:
 - 1. Keep units dry while stored on Site.
 - 2. Do not wet units prior to laying.
- C. Provide measures to prevent moisture from entering incomplete walls and open cells.
- D. Cold Weather: Meet requirements of MSJC Specification section "Cold Weather Construction".
- E. Hot Weather: Meet requirements of MSJC Specification section "Hot Weather Construction".
- F. After construction during cold weather, maintain newly constructed masonry temperature above 32 degrees F for a minimum of 24 hours using MSJC or other approved cold weather methods.
- G. After construction and during hot weather, fog spray newly constructed masonry in accordance with MSJC hot weather construction requirements.

3.02 PREPARATION

- A. Concrete Foundations: Meet tolerance requirements of ACI 117 prior to starting any masonry work.
- B. Prepare surface contact area of foundation concrete for initial mortar placement by removing laitance, loose aggregate, and other materials, and anything that would prevent mortar from bonding to foundation.
- C. Patch or grind out-of-tolerance foundation surfaces to receive mortar prior to starting masonry work.
- D. Clean reinforcement dowels and projecting embeds by removing laitance, spillage, or items that will adversely affect grout bond.
- E. Prevent surface damage to foundation concrete that will be exposed to view outside of contact area.

3.03 LAYING MASONRY UNITS

- A. General:
 - 1. Finish Tolerances (Measured on Interior Surfaces): Meet requirements of "Site Tolerance" requirements of Part 3, Execution, of the MSJC Specifications.

- 2. Place units with chipped edges or corners such that chipped area is not exposed to view.
- B. Wall Units:
 - 1. General:
 - a. If necessary to move a unit after once set in-place, remove from wall, clean, and set in fresh mortar.
 - b. Toothing of masonry units is not permitted.
 - 2. Running Bond:
 - a. Unless otherwise shown, lay up walls in straight, level, and uniform courses using a running bond pattern.
 - b. Place units for continuous vertical cells and mortar joints to prevent materials, such as grout and poured insulation, from escaping from cell being filled to adjacent cells where material is not intended to be placed.
 - c. Corners: Lay standard masonry bond for overlapping units and grout solid.
 - d. Intersecting Walls: Half unit appearance shall not extend and be visible on exterior side of intersecting wall. Provide hooked corner bars in bond beam units and joint reinforcement as shown on the Drawings.
 - 3. Glazed Concrete Masonry Units:
 - a. Single-faced units may be installed through wall where walls or partitions are shown to have glazed masonry unit finish on one side only.
 - b. Use facing for dimensional and plane reference in installation.
 - c. Where glazed masonry unit finish is indicated on both sides of a wall or partition, install coved bases of two-unit construction or two-faced units through the wall.
 - d. Install coved bases flush with finished surfaces above, except as otherwise specified.
 - 4. Special Shapes:
 - a. Provide and place such special units as corner block, doorjamb block, lintel block fillers, and similar blocks as may be required.
 - b. Use required shapes and sizes to work to corners and openings, maintaining proper bond throughout wall.

3.04 BUILT-IN ITEMS

- A. Position door frames, windows, vents, louvers, and other items to be built in wall, and construct wall around them.
- B. Install masonry anchors to secure items to wall.

- C. Fill spaces around items with grout except use mortar at mortar joints.
- Do not place electrical, instrumentation, or water conduits in a cell containing parallel reinforcement, unless approved in writing by Engineer. Additionally, pipes, sleeves, and conduits shall meet requirements of TMS 402/ACI 530/ASCE 5, Building Code Requirements for Masonry Structures (MSJC Code) and MSJC specification construction requirements.

3.05 MORTAR JOINTS

- A. General:
 - 1. Meet masonry erection requirements of MSJC, Part 3, Execution, 3.3B.
 - 2. As units are laid, remove excess mortar from grout space of cells to be filled. Final grout space, including any remaining mortar projections, shall be as required by MSJC Table "Grout Space Requirements".
 - 3. Place mortar before initial setting of cement takes place. Retemper only as required for it to remain plastic. Retempering of colored mortar is not allowed.
- B. Exposed Joints:
 - 1. Tool joints exposed to view after final construction, unless otherwise noted or shown.
 - 2. Cut joints flush and as mortar takes its initial set; tool to provide a concave joint.
 - 3. Perform tooling with tool that compacts mortar, pressing excess mortar out.
 - 4. Perform tooling when mortar is partially set, but still sufficiently plastic to bond rather than dragging it out.
 - 5. Rake out joints that are not tight at time of tooling, point, and then tool.
 - 6. Rake and tool joints at split-face surfaces, interior and exterior.
- C. Concealed Joints: Strike flush with no further treatment required.

3.06 CONTROL JOINTS

- A. Preformed Control Joints:
 - 1. Omit mortar from vertical joints.
 - 2. Place in units fabricated to receive rubber control joint material as wall is built.
 - 3. After wall is grouted, cured, and cleaned, install backing rod and sealant as specified in Section 07 92 00, Joint Sealants.
 - 4. Place and tool sealant to match depth of typical joint.

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3.07 REINFORCING

- A. Foundation Dowels:
 - 1. Locate first foundation dowel at end of wall in center of first cell; typically 4 inches from end of wall.
 - 2. Locate at each side of control joints and openings and below beam and joist seats, and then locate at maximum required spacing between these bars.
 - 3. Size, number, and location of foundation dowels shall match all typical and additional vertical wall reinforcing, unless otherwise noted.
 - 4. When foundation dowel does not line up with vertical core, do not slope more than 1 horizontal to 6 vertical to bring it into alignment.
- B. Vertical Reinforcing:
 - 1. Use deformed bars.
 - 2. Hold in position near ends of bars by wire ties to dowels or by reinforcing positioners.
 - 3. Lap reinforcing bars as shown or approved.
 - 4. Wire tie splices together.
 - 5. Minimum Bar Clearance: 1/2-inch from masonry for coarse grout from formed surfaces, and from parallel bars in same grout space.
- C. Horizontal Reinforcing:
 - 1. Use deformed bars.
 - 2. Lay on webs of bond beam units and place as wall is built. Increase web depth to ensure 1/2-inch cover over top of rebar.
 - 3. Lap reinforcing bars where spliced and wire tie together.
 - 4. Minimum Bar Clearance: 1/2-inch from masonry for coarse grout from formed surfaces, and from parallel bars in same grout space.
 - 5. Terminate reinforcing bars 2 inches clear from control joints except horizontal bars at roof and floor courses shall be continuous through joints.
- D. Horizontal Joint Reinforcement: Use where indicated on the Drawings.

3.08 MORTAR PRODUCTION

- A. Mix bulk materials in accordance with MSJC Specification.
- B. Mix prebagged materials with water to produce a workable consistency.
- C. Remix or retemper to maintain workability. Discard mortar that has begun to stiffen or is not used within 2-1/2 hours after initial mixing.

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3.09 GROUT PLACEMENT

- A. Do not mix, convey, or place with equipment constructed of aluminum.
- B. Secure vertical and horizontal reinforcement, ties, bolts, anchors, and other required embedments in place; inspect and verify before placing grout.
- C. Grout beams over openings in one continuous operation.
- D. Maintain vertical alignment in accordance with ACI 530.1, Table 7:
 - 1. Place grout within 1-1/2 hours of addition of water to mix.
 - 2. Use reinforcing positioners to secure vertical reinforcement.
- E. Grouting Requirements:
 - 1. Solid grout all walls.
 - 2. Fully embed horizontal steel with grout in an uninterrupted pour.
 - 3. Do not construct wall more than one course above top of grout pour prior to placing grout.
 - 4. Partial Grouting Requirements:
 - a. Fill cells containing reinforcing steel, anchor bolts, and other embedded items as shown with grout.
 - b. Construct cells to be filled to confine grout within cell.
 - c. Cover tops of unfilled vertical cells under a bond beam with metal lath to confine grout fill to bond beam section.
 - d. Form horizontal construction joints between pours by stopping grout pour 1-1/2 inches below a mortar joint, except at a bond beam; stop pour 1/2-inch below top of masonry unit.
- F. Vibration:
 - 1. Use internal "pencil" type, low energy vibrator to thoroughly consolidate grout and reduce amount of air voids. Do not use concrete vibrators.
 - 2. After initial water loss and settlement has occurred, but before it has taken any set, reconsolidate grout.
 - 3. Waiting period for reconsolidation will vary depending upon weather conditions and block absorption rates, but under "normal" weather conditions with average masonry units the waiting period should be between 30 minutes and 60 minutes.
- G. Cleanouts:
 - 1. Construct in accordance with MSJC Specification.

- 2. Provide for grout pours heights over 5 feet 4 inches in accordance with the IBC.
- 3. Provide of sufficient size to permit cleaning of cell, positioning of reinforcing, and inspection at bottom of every vertical cell containing reinforcing and maximum of 32 inches on center.
- 4. Location: Concealed from view after final construction, unless otherwise approved by Engineer.
- 5. After wall has been inspected and approved and prior to grouting, cap cleanouts in a manner that will seal them from grout leakage and provide a flush finish.

3.10 WATER REPELLENT MASONRY SEALER

- A. Remove efflorescence prior to applying water repellents. Dispose of waste generated.
- B. Apply to exposed exterior concrete masonry walls.
- C. Repoint loose, cracked, or disintegrating mortar at least 7 days prior to application. Ensure joint sealants and caulking are fully cured and wall surfaces are clean, dry, and free of chemical cleaners, efflorescence, dirt, oils, mortar smears, and other surface contaminants.
- D. Follow manufacturer's recommendations for weather conditions during application.
- E. Test a 5-foot by 5-foot wall area to ensure proper coverage, desired water repellency properties, and desired surface appearance when sealer is fully dried.
- F. Apply with spray, brush, or roller following manufacturer's recommendations, at a coverage rate of 50 square feet to 150 square feet per gallon, as determined by testing. Use two-coat application where recommended by manufacturer.

3.11 FIELD QUALITY CONTROL

- A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.
- B. Masonry shall be tested by independent testing agency, retained by Contractor.

- C. Provide adequate facilities for safe storage and proper curing of masonry prisms, mortar samples, and grout samples, as applicable, onsite for first 24 hours, and for additional time as may be required before transporting to test lab.
- D. Masonry Testing:
 - 1. Masonry strength shall be determined using prism testing.
 - 2. Masonry test prisms, when required or desired, shall be constructed onsite with same materials and workmanship to be used for Project and in accordance with ASTM C1314. Method and frequency of prism testing shall be as shown on the Special Inspection and Testing Plan.
- E. Corrective Action: If compressive strength tests made prior to construction of permanent structure fail to meet Specifications, adjustments shall be made to mix designs for mortar, or grout, or both, as needed to produce specified strength.

3.12 CLEANING

- A. Immediately after completion of grouting, clean masonry surfaces of excess mortar, grout spillage, scum, stains, dirt, and other foreign substances using clean water and fiber brushes.
- B. Clean walls not requiring painting or sealing so there are no visible stains.

3.13 PROTECTION OF INSTALLED WORK

- A. Do not allow grout and mortar stains to dry on face of exposed masonry.
- B. Protect tops of walls at all times. Cover tops of walls with waterproof paper when rain or snow is imminent and when the Work is discontinued.
- C. Adequately brace walls until walls and roof are completed.
- D. Provide sufficient bracing to protect walls against damage from elements, including wind and snow.
- E. Protect masonry against freezing for minimum 72 hours after being laid.
- F. Protect masonry from damage until final acceptance of the Work. Damaged units will not be accepted.

END OF SECTION

SECTION 04 22 19 INSULATED CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: The section includes the installation of the following:
 - 1. Insulated concrete masonry units (ICMU).

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Concrete Institute (ACI):
 - a. 315, Details and Detailing of Concrete Reinforcement.
 - b. 530, Building Code Requirements and Specification for Masonry Structures.
 - c. 530/530.1-13, Building Code Requirements and Specification for Masonry Structures and Companion Commentaries.
 - d. ACI 530.1/ASCE 6/TMS 602, Specifications for Masonry Structures.
 - 2. ASTM International Standards (ASTM):
 - a. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - b. A153-B2, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. A580, Standard Specification for Stainless Steel Wire.
 - d. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - e. A641, Standard Specification for Zinc–Coated (Galvanized) Carbon Steel Wire.
 - f. A996, Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement.
 - g. C90, Standard Specification for Loadbearing Concrete Masonry Units.
 - h. C144, Standard Specification for Aggregate for Masonry Mortar.
 - i. C150, Standard Specification for Portland Cement.
 - j. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - k. C404, Standard Specification for Aggregates for Masonry Grout.
 - 1. C494, Standard Specification for Chemical Admixtures for Concrete.

- m. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- n. C979, Standard Specification for Pigments for Integrally Colored Concrete.
- o. C1329, Standard Specification for Mortar Cement.
- p. C1384, Standard Specification for Admixtures for Masonry Mortars.
- q. C1623, Standard Specification for Manufactured Concrete Masonry Lintels.
- r. D2000, Standard Classification System for Rubber Products in Automotive Applications.
- s. D2287, Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- t. D4637, Standard Specification for EPDM Sheet Used In Single-Ply Roof Membrane.
- u. E514/E514M, Standard Test Method for Water Penetration and Leakage Through Masonry.
- 3. ICMU(s): Insulated concrete masonry unit(s).
- 4. Structural CMU: Concrete masonry units (CMU) with open cells complying with ASTM C90, Standard Specification for Loadbearing Concrete Masonry Units, used in either load bearing or non-load bearing conditions.
- 5. National Contract Management Association (NCMA)

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meetings: Conduct Preinstallation Meeting at location selected by Owner.

1.04 ACTION SUBMITTALS

- A. Product Data: Provide Manufacturer's Product Data for the following items:
 - 1. ICMU, including structural CMU and non-structural thin veneer components with insulation as a complete unit, including integral water repellant.
 - 2. Mortar, including integral water repellant.
 - 3. Grout.
 - 4. Prefabricated Flashing.
 - 5. Flashing.
 - 6. Weeps.

- B. Shop Drawings: Provide Shop Drawings indicating installation details, including the following:
 - 1. Provide drawings indicating sizes, configuration, and locations of special shapes.
 - 2. Reinforcing: Provide drawings indicating reinforcing that complies with ACI 315 and includes the following:
 - a. Provide elevations indicating steel reinforcing bar placement.
 - b. Provide details indicating steel reinforcing bar sizes, placement, bends, and laps dimensions.
- C. Samples: Submit samples for each type of product specified.
 - 1. ICMU, including structural CMU and non-structural thin veneer components with insulation as a complete unit.
- D. Samples, Selection Set: Submit complete series of manufacturer's standard colors, textures, and finishes, in manufacturer's standard size, for the following:
 - 1. Structural CMU.
 - 2. Non-Structural Thin Veneer.
 - 3. Colored Mortar with integral water repellant.
- E. Each product color, texture and finish selection to be made by the Owner from the Selection Set of Samples.
- F. Sustainable Design Submittals: For each product, submit the following item to the Project Sustainable Design Coordinator: Environmental Product Declaration (EPD).

1.05 INFORMATIONAL SUBMITTALS

- A. Certificates: For each of the following materials, submit documentation, on product manufacturer's letterhead, stating that materials comply with requirements of the Contract Documents.
 - 1. ICMU, including structural CMU and non-structural thin veneer components with insulation as a complete unit.
 - 2. Mortar with integral water repellant.
 - 3. Grout.
 - 4. Steel reinforcing.
- B. Delegated Design Submittals: Provide engineering design calculations.
- C. Test and Evaluation Reports:
 - 1. Compressive Strength Report: Submit report of the following properties for each combination of masonry unit type and mortar type to be incorporated in the Work calculated according to the standards of ACI 530.1/ASCE 6/TMS 602:
 - a. Average net area compressive strength of masonry units.
 - b. Average net area compressive strength of mortar types.
 - c. Resulting net area compressive strength of masonry construction.

1.06 QUALITY ASSURANCE

- A. Licensed Professionals: Owner to retain an experienced, professional, structural engineer who is legally qualified to practice in the jurisdiction where the Project is located to calculate design of masonry reinforcing requirements and to prepare construction documents for installation of reinforced masonry.
- B. Mockups: Construct mockup of typical exterior wall, as indicated on the Drawings, to exhibit aesthetic effects, to confirm product selections and placement, and to establish construction quality standards.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Deliver CMUs and other cementitious materials neatly stacked on pallets.
- B. Storage and Handling Requirements: Store CMUs and other cementitious materials on elevated platforms in a dry, sheltered location.
 - 1. If sheltered location is not available, completely cover tops and side of stored CMUs and other cementitious materials with a waterproof tarp that is securely restrained from exposing covered materials to precipitation.

1.08 FIELD CONDITIONS

- A. Protection During Construction:
 - 1. Comply with protection recommendations of NCMA TEK 8-4A.
 - 2. At the end of each day's work, cover top of masonry construction with a waterproof tarp that is securely restrained from exposing covered work to precipitation.
 - a. Extend protective covering a minimum of 24 inches down each side of masonry construction.

- 3. Spread protective covering over ground and wall surfaces to protect in place masonry work from mud splatter.
- 4. Protect work adjacent to and below masonry work from grout and mortar droppings, including the following surfaces:
 - a. Sills.
 - b. Ledges.
 - c. Projections.
 - d. Window and door frames.
- 5. Immediately remove grout, mortar, and soil that comes in contact with exposed masonry work.
- B. Weather Conditions:
 - 1. Ambient Conditions: Comply with working recommendations of the International Masonry Industry All Weather Council (IMIAWC) regarding weather conditions.
 - 2. Cold Weather and Hot Weather Construction: Comply with recommendations of ACI 530 and IMIAWC, Recommended Practices and Guide Specifications for Cold Weather and Hot Weather Masonry Construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturer:
 - 1. InsulTech products by Echelon, a member of the Oldcastle Company, "Or-equal," approved.
- B. Source Limitations: Obtain ICMUs from a single manufacturer.

2.02 PERFORMANCE CRITERIA

- A. Structural Performance Requirements: Provide reinforced masonry construction designed to comply with the following requirements:
 - 1. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
 - 2. Design Standards: Comply with the design recommendations of the following:
 - a. ACI 530/530.1-13.
 - b. NCMA TEK 12-4D.
 - c. NCMA TEK 14-19A.
 - d. NCMA TEK 16-3B.
 - 3. Dead Loads: As indicated on the Drawings.
 - 4. Live Loads: As indicated on the Drawings.

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- 5. Wind Loads: As indicated on the Drawings.
- 6. Seismic Loads: As indicated on the Drawings.
- B. Thermal Resistive Performance Requirements:
 - 1. R-Value: R-13.
- C. Fire Resistive Performance Requirements: Determine fire resistant rating according to testing complying with ASTM E 119 testing methods by equivalent concrete masonry thickness or by other means, as acceptable to authorities having jurisdiction.
- D. Water Penetration Resistance: CMU shows no visible water or leaks on back of test specimen after 24 hours when tested according to ASTM E514/E514M.

2.03 CONCRETE MASONRY UNITS, GENERAL

- A. Masonry Standard: Provide concrete masonry complying with ASTM C90.
 - 1. Compressive Strength: Provide ICMUs with a minimum average net area compressive strength of 2,500 psi.
 - 2. Density: Provide ICMU of the following density:
 - a. Lightweight CMU: Less than 105 lb/cu. ft.
 - b. Medium weight CMU: At least 105 lb/cu. ft. but less than 125 lb/cu. ft.
 - c. Normal weight CMU: 125 lb/cu. ft. or more.
- B. Pigments: ASTM C979, inorganic iron oxide pigments.
- C. Integral Water Repellant: Liquid polymeric, admixture that does not reduce flexural bond strength.
 - 1. Integral Water Repellant Product: Subject to compliance with requirements, provide the following:
 - a. RainBloc® Water Repellent Masonry Unit admixture, manufactured by ACM Chemistries, Inc.
- D. Integral Water Repellent. Certified by ICMU manufacturer to have been tested and suitable for use in ICMU.

2.04 INSULATED CONCRETE MASONRY UNITS

- A. ICMU: Preassembled, structural ICMU, consisting of a structural CMU and a thin, non-structural CMU veneer separated by a graphite polystyrene (GPS) molded insulation thermal break and held together as a single unit.
 - 1. Components:
 - a. Structural CMU: unfinished exposed interior face and dovetailed slots on the opposite face.
 - b. Insulation: Nominal 3 inches thick Molded GPS insulation.
 - c. Non-Structural Thin Veneer: Nominal 1-5/8 inches thick CMU with finished exposed exterior face and dovetailed slots on the opposite face.
 - 2. Non-Structural Thin Veneer CMU(CMUV):
 - a. Thin CMU Veneer
 - 1) Color: Integral color to match adjacent building or as selected by Owner.
 - 2) Finish:
 - a) CMUV-1: Textured Split-Faced.
 - b) CMUV-2: Ground.
 - c) CMUV-3: Ground
 - 3) Manufacturer: Echelon, Standard Masonry and Trenwyth Architectural Masonry, "Or-equal," approved.
 - 3. Insulation: Nominal 3 inches thick Molded GPS insulation.
 - 4. Structural CMU Backup:
 - a. Structural CMU
 - 1) Color: As selected by Owner.
 - 2) Finish: Smooth.
 - 3) Nominal Dimensions: 8 inches deep by 8 inches high by 16 inches long.
 - a) Actual Dimensions: 8-1/4 inches deep by 7-5/8 inches high by 15-5/8 inches long.

2.05 INSULATION

- A. Product: Subject to compliance with requirements, provide Neopor® by BASF.
- B. Graphite polystyrene (GPS): Closed cell, GPS insulation complying with ASTM C578, Type II insulation, molded to interlock with the structural CMU and non-structural thin veneer components of ICMU and with male and female connections to interlock with adjacent ICMU units.
 - 1. Density: 1.35 lb/cu. ft.
 - 2. Compressive Strength (Resistance): 15.0 psi.

ROGER SCOTT POOL FACILITIES

2.06 SPECIAL SHAPES

- A. Provide special shapes as required to complete the masonry work as indicated on the Drawings without requiring field cutting, including the following:
 - 1. Left and right hand corners units.
 - 2. Left and right hand corner continuation units.
 - 3. Open end stretcher units.
 - 4. Closed end stretcher units.
 - 5. Double sash units.
 - 6. Left and right hand half sash units.
 - 7. Veneer stretcher units.
 - 8. Veneer left and right hand corners units.
 - 9. Left and right hand 4-inch return jamb block units.

2.07 CONCRETE MASONRY LINTELS

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
- B. Bond Beam Units: Provide closed bottom CMU bond beams matching properties and dimension of ICMU structural CMU component, including color and finish of exposed ICMU faces.
 - 1. Provide Veneer stretcher units where required to match ICMU non-structural thin veneer.

2.08 CONCRETE LINTELS

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
- B. Precast Concrete Lintel: Provide steel reinforced, precast concrete lintels complying with ASTM C1623, with color, texture, and density matching ICMU.

2.09 STEEL LINTELS

- A. Comply with requirements of Sections 04 22 00, Concrete Unit Masonry and 05 50 00, Metal Fabrications.
- B. Provide galvanized steel angles and shapes as indicated on the Drawings.
 - 1. Size steel lintels to support dead loads over openings but not less than sizes indicated on the Drawings.
 - 2. Provide minimum of 8 inches of bearing on each side of opening but not less than required based on masonry's bearing capacity.

2.10 MORTAR AND GROUT MATERIALS

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry
- B. General: Comply with recommendations of the following:
 - 1. NCMA TEK 9-1A.
 - 2. NCMA TEK 9-4A.
- C. Portland Cement: Comply with ASTM C150, using one of the following portland cement Types:
 - 1. Type I, normal.
 - 2. Type II, moderate sulfate resistance.
 - 3. Type III, high early strength, maybe used for cold weather conditions.
- D. Hydrated Lime: Comply with ASTM C207, Type S (special).
- E. Aggregates:
 - 1. Aggregates for Mortar: Comply with ASTM C144.
 - 2. Aggregates for Grout: Comply with ASTM C404.
- F. Packaged Cement Mix: Packaged, factory blended mix of portland cement and hydrated lime with no other components included.
- G. Mortar Cement: Comply with ASTM C1329.
- H. Pigments: Comply with ASTM C979.
 - 1. Comply with quantity limitation specified ASTM C1384, when adding to mortar.
- I. Admixtures: Comply with quantity limitation specified ASTM C1384, when adding to mortar.
 - 1. Cold Weather: Comply with ASTM C494.
 - 2. Integral Water Repellant: Liquid polymeric, admixture that does not reduce flexural bond strength.
 - a. Integral Water Repellant Product: Subject to compliance with requirements, provide one of the following products:
 - 1) RainBloc® Water Repellent Masonry Unit admixture, manufactured by ACM Chemistries, Inc.
- J. Water: Clean and drinkable.

2.11 REINFORCEMENT

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
- B. Reinforcing Bars: Uncoated, deformed, steel reinforcing bars.
 - 1. Grade and Sizes: As indicated on the structural Drawings.
- C. Reinforcing Bar Positioners: Prefabricated wire elements configured to span masonry unit cells and hold reinforcing bars in position when cells are filled with grout. Provide reinforcing bar positioners configured to accommodate the masonry and reinforcing requirements indicated on the Drawings.
 - 1. Wire Material: Provide wire made of one of the following materials:
 - a. Cold-drawn steel wire conforming to ASTM A106.
 - b. Stainless steel wire conforming to ASTM A580 AISI Type 316.
 - 2. Wire Diameter: 0.148-inch minimum.
 - 3. Wire Finish: Galvanized according to one of the following methods:
 - a. Mill Galvanized: ASTM A641, 0.1 ounces per square foot minimum thickness.
 - b. Hot Dipped Galvanized after Fabrication: ASTM A153-B2, 1.5 ounces per square foot minimum thickness.
- D. Joint Reinforcement, Ladder or Truss Type: Prefabricated wire ladder type joint reinforcement consisting of 3 longitudinal rods with cross rods equally spaced, at a maximum of 16 inches on center, to avoid obstructing masonry unit cells.
 - 1. Ladder Width: Depth of structural CMU backup component of ICMU.
 - 2. Wire Material: Provide wire made of one of the following materials:
 - a. Cold-drawn steel wire conforming to ASTM A106,.
 - b. Stainless steel wire conforming to ASTM A580, AISI Type 316.
 - 3. Wire Finish: Galvanized according to one of the following methods:
 - a. Mill Galvanized: ASTM A641, 0.1 ounces per square foot minimum thickness.
 - b. Hot Dipped Galvanized after Fabrication: ASTM A153-B2, 1.5 ounces per square foot minimum thickness.
- E. Joint Reinforcement, Single Wire (Pencil Wire) Type:
 - 1. Wire Material: Provide wire made of one of the following materials:
 - a. Cold-drawn steel wire conforming to ASTM A106,.
 - b. Stainless steel wire conforming to ASTM A580, AISI Type 316.

- 2. Wire Finish: Galvanized according to one of the following methods:
 - a. Mill Galvanized: ASTM A641, 0.1 ounces per square foot minimum thickness.
 - b. Hot Dipped Galvanized after Fabrication: ASTM A153-B2, 1.5 ounces per square foot minimum thickness.

2.12 ACCESSORIES

- A. Field Applied, Water Repellant: Clear, water-based, penetrating water repellent for concrete and masonry.
- B. Prefabricated Flashing and Weeps:
 - 1. Product: Subject to compliance with requirements, provide "BlockFlashTM" as manufactured by Mortar Net SolutionsTM.
 - 2. Flashing Material: Provide prefabricated flashing pans made from recycled polypropylene, chemically stabilized to inhibit degradation by ultraviolet radiation.
 - 3. Flashing Configuration: Embeddable flashing device for exterior CMU construction with built-in slope to direct moisture to integrated weeps and prefabricated flashing manufacturer's attached drainage mats and 1-inch extended insect guards.
 - 4. Coordinate the flashing and weeps specified in the section with other flashing specified in Sections 04 22 00, Concrete Unit Masonry and 07 62 00, Sheet Metal Flashing and Trim.
- C. Flashing: Comply with requirements of Sections 04 22 00, Concrete Unit Masonry and 07 62 00, Sheet Metal Flashing and Trim.
- D. Weeps: Free-draining UV stabilized, open weave, polyester mesh inserts for open head joints of masonry walls.
 - 1. Do not install cotton chord drainage.
 - 2. Color: As indicated on the Drawings As selected by the Architect from the manufacturer's full range of standard colors
- E. Joint Sealants: Non-staining silicone sealant as specified in Section 07 92 00, Joint Sealants.
- F. Sealant Backer Rods: As specified in Section 07 92 00, Joint Sealants.
 - 1. Width and Thickness: As indicated on the Drawings.

- G. Masonry Control Joint Gasket: Provide preformed gasket strips designed to fit standard sash block and to maintain lateral stability in masonry walls, made of one of the following materials:
 - 1. Styrene-butadiene rubber compound, complying with ASTM D2000, Designation M2AA-805.
 - 2. PVC, complying with ASTM D2287, Type PVC-65406.

2.13 MASONRY CLEANER

A. Proprietary Acidic Cleaner: Standard strength cleaner designed to remove mortar and grout stains, efflorescence, and other construction related stains without discoloring and without damaging masonry and mortar surfaces and as approved by ICMU manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Examine in place construction, with mason present, to evaluate and verify the following:
 - 1. That substrates to receive masonry work are within specified dimensional tolerances.
 - 2. That substrates to receive masonry work are clean and have no conditions that would weaken bonding of mortar.
 - 3. That steel reinforcing is the specified size and in the required location.
- B. Correct unacceptable conditions before beginning installation.

3.02 PREPARATION

A. Prepare masonry and set reinforcement prior to grouting according to the recommendations of NCMA TEK 3-2A.

3.03 INSTALLATION OF ICMUS

- A. General:
 - 1. Comply with written recommendation of ICMU manufacturer.
 - 2. Do not install wet ICMUs.
 - 3. Brace walls under construction according to the recommendations of NCMA TEK 3-4B.
- B. Layout: Comply with requirements of NCMA TEK 3-8A.
 - 1. Set first course of ICMU using units with integral water repellant.

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- C. Bond Pattern: Lay ICMUs in a running bond pattern as indicated on the Drawings.
- D. Tolerances: Comply with requirements of NCMA TEK 3-8A.
- E. Setting in Mortar: Comply with recommendations of NCMA TEK 3-1C through TEK 3-14 as applicable to the type of masonry construction and project conditions.
 - 1. ICMU manufacturer's stainless-steel "Bridge tool" is mandatory to install mortar at a uniform 3/4-inch joint thickness with an inside mortar cant to prevent interior mortar roll in during mortar compression as part of the unit installation and to maintain the drainage channels.
 - 2. Take measures to minimize mortar droppings.
- F. Grouting of Cores: Place grout in cells of ICMUs according to the recommendation of NCMA TEK 3-2A.
- G. Control and Expansion Joints: Unless otherwise indicated on the Drawings, locate and install control and expansion joints according to one of the following standards:
 - 1. NCMA TEK 10-2C.
 - 2. NCMA TEK 10-3.
- H. Application of Water Repellant: Apply water repellant according to water repellant manufacturer's written recommendations.

3.04 INSTALLATION OF LINTELS

- A. Comply with requirements of in Section 04 22 00, Concrete Unit Masonry.
- B. Concrete Masonry Lintels: Install CMU lintels where indicated on the Drawings.
 - 1. Provide a minimum of 8 inches of bearing on each side of masonry opening, unless otherwise indicated on the Drawings.
 - 2. Temporary Bracing: Provide temporary bracing until grout has cured sufficiently to support applied loads, but not less than 7 days.
 - 3. Reinforcing: Install reinforcing as indicated on the Drawings, but not less than recommended in NCMA TEK 17-1D.

- C. Steel Angle Lintels: Install steel angle lintels where indicated on the Drawings.
 - 1. Provide a minimum of 8 inches of bearing on each side of masonry opening, unless otherwise indicated on the Drawings.
 - 2. Coordinate with Section 05 50 00, Metal Fabrications.

3.05 INSTALLATION OF FLASHING

- A. Prefabricated Flashing and Weeps: Install prefabricated flashing and weep units at base course, at bond beams, at lintels, and other horizontal locations where ICMU cores are grouted solid.
 - 1. Install prefabricated flashing and weep units according to manufacturer's written instructions.
 - 2. Coordinate installation of prefabricated flashing and weep units with installation of other flashing work.
- B. Comply with requirements of Sections 04 22 00, Concrete Unit Masonry and 07 62 00, Sheet Metal Flashing and Trim.
- C. Flexible Flashing: Locate and install flexible flashing according to the recommendations of the following standards:
 - 1. NCMA TEK 19-4A.
 - 2. NCMA TEK 19-5A.
- D. Weeps: Install weeps at the head joints of the non-structural thin veneer of the ICMUs directly above flashing.
 - 1. Space weeps no more than 16 inches o.c. horizontally.

3.06 REINFORCED ICMUS

- A. Comply with requirements of Section 04 22 00, Concrete Unit Masonry.
- B. Install reinforcing in masonry construction according to the following standards:
 - 1. NCMA TEK 12-1B.
 - 2. NCMA TEK 12-2B.
 - 3. NCMA TEK 12-3C.
 - 4. NCMA TEK 12-4D.
 - 5. NCMA TEK 12-5.
 - 6. NCMA TEK 12-6.
 - 7. NCMA TEK 12-6A.

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- C. Ladder Type Joint Reinforcement: Set within the horizontal joints of the structural CMU components of the ICMU at a minimum of 16 inches on center vertical, unless otherwise indicated.
- D. Single Wire (Pencil Wire) Type Joint Reinforcement: Set within the horizontal joints of the non-structural thin veneer components of the ICMU at a minimum of 16 inches on center vertical, unless otherwise indicated.

3.07 CLEANING

- A. Progress Cleaning: Comply with cleaning during construction recommendations of NCMA TEK 8-4A.
 - 1. Remove mortar droppings which adhere to exposed faces of masonry units with a trowel or chisel after mortar has hardened.
 - 2. Remove remaining mortar with stiff fiber or bristle brush.
 - 3. Remove grout spills immediately by washing and brushing.
- B. Final Cleaning: Perform final cleaning according to ICMU manufacturer's recommendations.

END OF SECTION

SECTION 05 05 19 POST-INSTALLED ANCHORS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.
 - b. 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete.
 - c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
 - 2. American Iron and Steel Institute (AISI): Stainless Steel Type 316.
 - 3. American National Standards Institute (ANSI).
 - 4. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - c. A194/A194M, Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - d. E488/E488M, Standard Test Methods for Strength of Anchors in Concrete Elements.
 - e. F436/F436M, Standard Specification for Hardened Steel Washers.
 - f. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - g. F594, Standard Specification for Stainless Steel Nuts.
 - h. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 - 5. International Association of Plumbing and Mechanical Officials Uniform ES (IAPMO-UES): Evaluation Reports for Concrete and Masonry Anchors.
 - 6. International Code Council Evaluation Service (ICC-ES):
 - a. Evaluation Reports for Concrete and Masonry Anchors.
 - b. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
 - c. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements. Evaluation Reports for Concrete and Masonry Anchors.

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- 7. Specialty Steel Industry of North America (SSINA):
 - a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- B. Exterior Area: Location not protected from weather by a building or other enclosed structure to include buried roof structures.
- C. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or wash down, and where wall or roof slab is not common to a water-holding or earth-retaining structure.
- D. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or wash down, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- E. Submerged: Location at or below top of wall of open water-holding structure, such as a basin or channel, or wall, ceiling, or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Specific instructions for concrete anchor installation, including drilled hole size and depth, preparation, placement, procedures, and instructions for safe handling of anchoring systems.
- B. Informational Submittals:
 - 1. Concrete and Masonry Anchors:
 - a. Manufacturer's product description and installation instructions.
 - b. Current ICC-ES or IAPMO-UES Report for each type of post-installed anchor to be used.
 - 2. Passivation method for stainless steel members.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers of adhesive anchors horizontally or upwardly inclined to support sustained tension loads shall be certified by an applicable certification program. Certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Installer Certification Program or equivalent.
 - 2. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package stainless steel items in a manner to provide protection from carbon impregnation.
- B. Protect hot-dip galvanized finishes from damage because of metal banding and rough handling.

PART 2 PRODUCTS

2.01 GENERAL

A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference				
Stainless Steel:					
Threaded Rods	F593, AISI Type 316, Condition CW				
Nuts*	F594, AISI Type 316, Condition CW				
Carbon Steel:					
Threaded Rods	F1554, Grade 36				
Flat and Beveled Washers (Hardened)	F436/F436M				
Nuts*	A194/A194M, Grade 2H				
Galvanized Steel:					
All	A153/A153M				
*Nuts of other grades and styles having specified proof load stresses greater than specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than minimum tensile strength of specified threaded rod.					

B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, and zinc-plated steel material types as indicated.

2.02 POST-INSTALLED CONCRETE ANCHORS

- A. General:
 - 1. AISI Type 316 stainless, hot-dip galvanized or zinc-plated steel, as shown.
 - 2. Post-installed anchor systems used in concrete shall be approved by ICC Evaluation Services Report or equivalent for use in cracked concrete and for short-term and long-term loads including wind and earthquake.
 - 3. Mechanical Anchors: Comply with the requirements of ICC-ES AC193 or ACI 355.2.
 - 4. Adhesive Anchors: Comply with the requirements of ICC-ES AC308 or ACI 355.4.
- B. Torque-Controlled Expansion Anchors (Wedge Anchors):
 - 1. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; KWIK Bolt-TZ2 Expansion Anchor Safe Set System with hollow drill bit and vacuum and SI-AT-A22 tool with adaptive torque for applicable sizes (ESR-4266).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Power-Stud +SD1, +SD2, +SD4, or +SD6 Anchors (ESR-2502 and ESR-2818).
 - c. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 Anchors (ESR-1771 and ESR-3037).
- C. Self-Tapping Concrete Screw Anchors:
 - 1. Do not use for equipment anchorage unless specifically shown on the Drawings.
 - 2. Manufacturers and Products:
 - a. DeWalt/Powers Fasteners, Brewster, NY; Screw-Bolt+ (ESR-3889).
 - b. DeWalt/Powers Fasteners, Brewster, NY; Hangermate+ Rod Hanger Screw Anchor (ESR-3889).
 - c. DeWalt/Powers Fasteners, Brewster, NY; Snake+ Flush Mount Screw Anchor (ESR-2272).
 - d. Hilti, Inc., Tulsa, OK; Kwik HUS, KH-EZ, KH-EZ CRC, KH-EZ SS316, KH-EZ C, KH-EZ E, KH-EZ I, and KH-EZ P Screw Anchor Safe Set System with hollow drill bit and vacuum (ESR-3027).
 - e. Simpson Strong-Tie Co., Inc., Pleasanton, CA; Titen HD Screw Anchor (ESR-2713 and IAPMO UES-493).

POST-INSTALLED ANCHORS 05 05 19- 4

- D. Adhesive Anchors:
 - 1. Threaded Rod:
 - a. Diameter as shown on the Drawings.
 - b. Length as required to provide minimum depth of embedment indicated and thread projection required.
 - c. Clean and free of grease, oil, or other deleterious material.
 - 2. Adhesive:
 - a. Two-component, insensitive to moisture, designed to be used in adverse freeze/thaw environments.
 - b. Cure Temperature, Pot Life, and Workability: Compatible for intended use and anticipated environmental conditions.
 - 3. Packaging and Storage:
 - a. Disposable, self-contained system capable of dispensing both components in proper mixing ratio and fitting into a manually or pneumatically operated caulking gun.
 - b. Store adhesive on pallets or shelving in a covered storage area.
 - c. Package Markings: Include manufacturer's name, product name, batch number, product expiration date, ANSI hazard
 - classification, and appropriate ANSI handling precautions.
 - d. Dispose of When:
 - 1) Shelf life has expired.
 - 2) Stored other than in accordance with manufacturer's instructions.
 - 4. Manufacturers and Products:
 - a. Hilti, Inc., Tulsa, OK; HIT Doweling Anchor System, HIT-HY 200 V3 Safe Set System with (ESR-4868), HIT RE 500 V3 Safe Set System with HAS threaded rod (ESR-3814), or HIT-RE 500 V3 Safe Set System with Hilti Roughening Tool (HIT RT) with HAS threaded rod (ESR-3814) for diamond cored holes.
 - b. Simpson Strong-Tie Co., Inc., Pleasanton, CA; SET-3G Epoxy Adhesive Anchors. (ESR-4057).
 - c. DeWalt/Powers Fasteners, Brewster NY; Pure 220+ Epoxy adhesive anchor system with Dust X+ System (ESR-5144).
- E. Adhesive Threaded Inserts:
 - 1. Type 316 stainless steel, internally threaded inserts.
 - 2. Manufacturer and Product: Hilti, Inc., Tulsa, OK; HIS-RN Insert with HIT-RE 500-V3 or HIT-HY 200 adhesive.

ROGER SCOTT POOL FACILITIES

2.03 POST-INSTALLED MASONRY ANCHORS

- A. General: AISI Type 316 stainless, hot-dip galvanized, or zinc-plated steel, as shown.
- B. Current ICC Evaluation Report indicating acceptance for anchors at structural applications in masonry.
- C. Manufacturers and Products:
 - Hilti, Inc., Tulsa, OK; HIT-HY 270 Safe Set System with Hilti hollow drill bit and vacuum (ESR-4143) for solid grouted masonry, HIT-HY 200 V3 Safe Set System with Hilti hollow drill bit and vacuum (ESR-4878) for solid grouted masonry, HIT-HY 270 Safe Set System with Hilti hollow drill bit and vacuum (ESR-4144) for unreinforced three-wythe brick.
 - Simpson Strong-Tie Co., Inc., Pleasanton, CA; Strong-Bolt 2 (IAPMO ER 240) for grout filled CMU, Titen-HD (ESR-1056) for grout filled or hollow CMU, AT-XP (IAPMO ER-281) for grout filled CMU.
 - 3. DeWalt/Powers Fasteners, Brewster NY; Power-Stud+ SD1 (ESR-2966) for grout-filled masonry, Screw-Bolt+ (ESR-4042) for grout-filled masonry, AC100+ Gold with Dust X+ System for unreinforced threewythe brick (ESR-2966 2582).

PART 3 EXECUTION

3.01 CONCRETE AND MASONRY ANCHORS

- A. Begin installation only after concrete or masonry to receive anchors is a minimum of 21 days old or has attained design strength whichever requires a longer duration.
- B. Locate existing reinforcing with ground penetrating radar or other method approved by the Engineer prior to drilling. Coordinate with the Engineer to adjust anchor locations where installation would result in hitting reinforcing.
- C. Install in accordance with written manufacturer's instructions.
- D. Provide minimum embedment, edge distance, and spacing as indicated on the Drawings.
- E. Use only drill type, bit type, and diameter recommended by anchor manufacturer. Use rotary hammer drill unless otherwise approved by the Engineer. Core drilling may only be used if specifically allowed by the Engineer.

- F. Clean hole of debris and dust per manufacturer's requirements.
- G. When unidentified embedded steel, rebar, or other obstruction is encountered in drill path, slant drill to clear obstruction. If drill must be slanted more than indicated in manufacturer's installation instructions to clear obstruction, notify the Engineer for direction on how to proceed.
- H. Adhesive Anchors:
 - 1. Unless otherwise approved by the Engineer and adhesive manufacturer:
 - a. Do not install adhesive anchors when temperature of concrete or masonry is below 40 degrees F or above 100 degrees F.
 - b. Do not install prior to concrete attaining an age of 21 days.
 - c. Remove any standing water from hole with oil-free compressed air. Inside surface of hole shall be dry.
 - d. Do not disturb anchor during recommended curing time.
 - e. Do not exceed maximum torque as specified in manufacturer's instructions.
 - 2. For hollow-unit masonry, install screen tube in accordance with manufacturer's instructions.
 - 3. Prestressed Concrete: Do not use drilled-in anchors in prestressed or post-tensioned concrete members without the Engineer's prior approval unless specifically shown on the Drawings.

3.02 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

A. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.03 FASTENER SCHEDULE

A. Unless indicated otherwise on the Drawings, provide fasteners as follows:

Service Use and Location	Product	Remarks					
 Post-Installed Anchors for Metal Components to Cast-in-Place Concrete (such as, Ladders, Handrail Posts, Electrical Panels, Platforms, and Equipment) 							
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).	Verify product acceptability and manufacturer's requirements if anchor installation will occur in an overhead application					

ROGER SCOTT POOL FACILITIES

Service Use and Location	Product	Remarks					
2. Anchors in Grout-Filled Concrete Masonry Units							
Interior Dry Areas	Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment).						
Submerged, Exterior, Interior Wet, and Corrosive Areas	Stainless steel anchors						
3. Anchors in Hollow Concrete Masonry Units							
Interior Dry Areas	r Dry Areas Anchor material type to match material being anchored (for example, stainless steel anchors to anchor stainless steel equipment, zinc-plated anchors to anchor painted equipment, galvanized anchors to anchor galvanized equipment)						
Exterior, Interior Wet, and Corrosive Areas	Stainless steel anchors	Adhesive anchors shall be installed with screen tubes.					
4. All Others							
All service uses and locations	Stainless steel fasteners						

- B. Antiseizing Lubricant: Use on all stainless steel threads.
- C. Do not use adhesive anchors to support fire-resistive construction or where ambient temperature will exceed 120 degrees F.

END OF SECTION

SECTION 05 05 23 WELDING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. BPVC SEC V, Nondestructive Examination.
 - b. BPVC SEC IX, Welding and Brazing Qualifications.
 - 2. American Society of Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
 - 3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
 - 4. American Welding Society (AWS):
 - a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
 - b. A3.0, Standard Welding Terms and Definitions.
 - c. D1.1/D1.1M, Structural Welding Code—Steel.
 - d. D1.8/D1.8M, Structural Welding Code—Seismic Supplement.
 - e. D1.2/D1.2M, Structural Welding Code—Aluminum.
 - f. D1.3/1.3M, Structural Welding Code—Sheet Steel.
 - g. D1.4/D1.4M, Structural Welding Code—Reinforcing Steel.
 - h. D1.6/D1.6M, Structural Welding Code—Stainless Steel.
 - i. QC1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

- A. CJP: Complete Joint Penetration.
- B. CWI: Certified Welding Inspector.
 - 1. Contractor's Welding Inspector: Contractor's CWI acts for, and on behalf of, the Contractor for all inspection and quality matters within the scope of the Contract Documents. Contractor is required to provide a welding inspector to oversee welding operations and be responsible for visual inspection and necessary correction of all deficiencies in materials and workmanship required to meet referenced welding codes. This type of Quality Control Inspection is not classified as Special Inspection.
 - 2. Verification Inspector: This independent inspection is the prerogative of the Owner, who may employ their own, independent CWI, or waive this supplementary, independent CWI inspection.

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- C. MT: Magnetic Particle Testing.
- D. NDE: Nondestructive Examination.
- E. NDT: Nondestructive Testing.
- F. PJP: Partial Joint Penetration.
- G. PQR: Procedure Qualification Record.
- H. PT: Liquid Penetrant Testing.
- I. RT: Radiographic Testing.
- J. UT: Ultrasonic Testing.
- K. VT: Visual Inspection/Testing.
- L. WPQ: Welder/Welding Operator Performance Qualification Record.
- M. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Shop and field WPSs and PQRs.
 - b. NDT procedure specifications prepared in accordance with ASME BPVC SEC V.
 - c. Welding Data (Shop and Field): Submit welding data together with Shop Drawings as a complete package.
 - 1) Show on Shop Drawings, or on a weld map, complete information regarding base metal ASTM specifications, and location, type, size, and length of welds.
 - 2) Identify WPS to be used, and NDE requirements in tail of welding symbol.
 - 3) Clearly distinguish between shop and field welds.
 - 4) Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
 - 5) Welding and NDE Symbols shall be in accordance with AWS A2.4. Welding terms and definitions shall comply with AWS A3.0.

- B. Informational Submittals:
 - 1. WPQs.
 - 2. CWI credentials.
 - 3. Testing agency NDE inspector credentials.
 - 4. CWI visual inspection (VT) reports.
 - 5. Welding Documentation: Submit on forms provided in referenced welding codes.

1.04 QUALIFICATIONS

- A. WPSs: In accordance with AWS D1.1/D1.1M (Annex J Forms) for shop or field welding; or ASME BPVC SEC IX (Forms QW-482 and QW-483) for shop welding only.
- B. WPQs: In accordance with AWS D1.1/D1.1M (Annex J Forms); or ASME BPVC SEC IX (Form QW-484).
- C. CWI: Certified in accordance with AWS QC1 and having prior experience with specified welding codes. Alternate welding inspector qualifications require prior approval by Engineer.
- D. Testing Agency: Personnel performing tests shall be NDT Level II certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

- A. Contractor's CWI shall be present whenever shop welding is performed. CWI shall perform inspection at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
 - 1. Verify conformance of specified job materials and proper storage.
 - 2. Monitor conformance with approved WPSs.
 - 3. Monitor welder performance and conformance with approved WPQs.
 - 4. Inspect weld joint fit-up and perform in-process inspections.
 - 5. Provide 100 percent visual inspection of completed welds.
 - 6. Coordinate with nondestructive testing personnel and review NDE results.

7. Maintain records and prepare reports documenting results of CWI VT and required NDE complies with the Work and referenced welding codes.

PART 3 EXECUTION

3.01 GENERAL

A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

- A. Quality Control Inspection:
 - 1. All Welds: 100 percent VT by Contractor's CWI.
 - 2. Acceptance Criteria:
 - a. All Other Structural Steel: AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.
 - b. Stud Connections: AWS D1.1/D1.1M, Paragraph 9.8.1.
- B. Nondestructive Testing Requirements:
 - 1. NDT frequency shall be as specified below, as required by referenced fabrication or welding codes, or as specified in the attached table. In case there is a conflict, the higher frequency level of NDT shall apply.
 - a. Nontubular Connections:
 - 1) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
 - b. Tubular Connections:
 - 1) Fillet Welds and PJP Groove Welds: 10 percent random PT or MT.
 - 2. NDT Procedures and Acceptance Criteria:
 - a. Nontubular Connections:
 - 1) RT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part E. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.12.1.
 - UT: Perform in accordance with AWS D1.1/D1.1M, Clause 8, Part F. Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.13.1.
 - 3) PT and MT:
 - a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.

- b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 8.9, Visual Inspection, Statically Loaded Nontubular Connections.
- b. Tubular Connections:
 - 1) RT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraph 10.27, and Paragraph 10.28.
 - 2) UT: Comply with requirements for Nontubular Connections and additional requirements of AWS D1.1/D1.1M, Clause 10, Paragraph 10.26, and Paragraph 10.29.
 - 3) PT and MT:
 - a) Perform on fillet and PJP groove welds in accordance with AWS D1.1/D1.1M, Paragraph 8.14.4 and Paragraph 8.14.5.
 - b) Acceptance criteria per AWS D1.1/D1.1M, Paragraph 10.24.

3.03 FIELD QUALITY CONTROL

- A. The Contractor's CWI shall be present whenever field welding is being done and shall perform inspection, at suitable intervals, prior to assembly, during assembly, during welding, and after welding. CWI shall perform inspections as required in AWS D1.1/D1.1M or referenced welding code and as follows:
 - 1. Verify conformance of specified job materials and proper storage.
 - 2. Monitor conformance with approved WPS.
 - 3. Monitor welder performance and conformance with approved WPQs.
 - 4. Inspect weld joint fit-up and perform in-process inspection.
 - 5. Provide 100 percent visual inspection of all welds in accordance with Paragraph Quality Control Inspection.
 - 6. Coordinate with nondestructive testing personnel and review test results.
 - 7. Maintain records and prepare reports confirming results of inspection and testing comply with the Work.

3.04 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal have been deposited in accordance with appropriate welding codes.

3.05 SUPPLEMENT

- A. The supplement listed below, following "End of Section," is a part of this specification.
 - 1. Welding and Nondestructive Testing Table.

END OF SECTION

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Welding and Nondestructive Testing									
Specification Section	Governing Welding Codes or Standards	Submit WPS	Submit WPQ	Onsite CWI Required?	Submit Written NDT Procedure Specification s	NDT Requirements			
05 21 19 Open Web Steel Joists Framing	AWS D1.1/D1.1M, Structural Welding Code—Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 21 19			
05 31 00 Steel Decking	AWS D1.1/D1.1M, Structural Welding Code—Steel or AWS D1.3/D1.3M, Structural Welding Code—Sheet Steel	Yes	Yes	Yes	Yes	100% VT; also see Section 05 31 00			
05 41 00 Structural Metal Stud Framing	AWS D1.1/D1.1M, Structural Welding Code—Steel or AWS D1.3/1.3M, Structural Welding Code—Sheet Steel	No	No	Yes	No	100% VT; also see Section 05 41 00			
05 50 00 Metal Fabrications	AWS D1.1/D1.1M, Structural Welding Code–Steel or AWS D1.2/D1.2M, Structural Welding Code—Aluminum or AWS D1.6/D1.6M, Structural Welding Code—Stainless Steel	Yes	Yes	Yes	No	100% VT; also see Section 05 50 00			

SECTION 05 21 19 OPEN WEB STEEL JOIST FRAMING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Institute of Steel Construction (AISC):
 - a. Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design.
 - b. Allowable Stress Design Specification for Structural Joints using ASTM A325 or A490 Bolts.
 - c. Code of Standard Practice for Steel Buildings and Bridges.
 - 2. American Welding Society (AWS): D1.1, Structural Welding Code Steel.
 - 3. Steel Joist Institute (SJI):
 - a. Standard Specifications and Load Tables:
 - 1) Open-Web Steel Joists, K-Series.
 - Long Span Steel Joists, LH-Series, and Deep Long Span Steel Joists, DLH-Series.
 - 3) Super Longspan Steel Joists, SLH-Series.
 - 4) Joist Girders.
 - b. Recommended Code of Standard Practice for Steel Joists and Joist Girders.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Plan view layout of joists and bridging.
 - 2. Elevation view of each type of joist showing configuration, chord and web member sizes, panel point dimensions, and chord extensions.
 - 3. Connection and bearing details.
 - 4. Special joist reinforcing and connections for supported items, such as monorails and mechanical equipment.
 - 5. Bridging member sizes and connection details.
 - 6. Complete design, including stress and deflection calculations, for joists, joist members, and connections for design load and equipment weight as indicated, plus any construction loads applied by Contractor's operations.
 - 7. Calculations shall include check of joist chord bending stresses for concentrated loads applied between panel points.

- 8. Registered Professional Engineer's stamp, valid in same state as Project, on structural calculations.
- 9. Procedure for handling, erection, and bracing of steel joists.
- B. Informational Submittals:
 - 1. Joist manufacturer's installation requirements.
 - 2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.

1.03 QUALITY ASSURANCE

- A. General: Design and fabricate steel joists and bridging to meet requirements of SJI Standard Specifications and Load Tables.
- B. Certification: SJI Membership, with certification for joist types as indicated on the Drawings.
- C. Qualifications for Field Welding: As specified in Section 05 05 23, Welding.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Protect from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Protect joist paint system from abrasion at steel bands and other joists.
- C. Store joists and bridging off ground on wood sleepers.
- D. Support joists so there is no danger of tipping, sliding, rolling, shifting or material damage.

PART 2 PRODUCTS

2.01 STEEL JOISTS AND BRIDGING

- A. Provide type of joist, chord configuration, and depth as indicated on the Drawings.
- B. Design and Manufacture:
 - 1. In accordance with the applicable SJI Standard Specifications.
 - 2. Chord Members: Rolled double angle sections only.
 - 3. Provide the following where indicated, in accordance with SJI Standard Specifications and Load Tables:
 - a. Bottom chord bracing and end anchorage for uplift design criteria.

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- b. Ceiling extension to within 1-inch of finished wall surface, unless otherwise indicated.
- c. Top chord extension, S type, unless otherwise indicated.
- d. Bottom chord extension and stabilizer plates for joist girders.
- e. Full camber, unless otherwise indicated.

C. Joist Bridging:

- 1. In accordance with applicable SJI Standard Specifications for type of joist.
- 2. Furnish bridging of minimum size and type as indicated.
- 3. Provide anchorage connection to walls and girders at bridging lines as indicated.

2.02 SHOP PRIMER

A. Surface Preparation and Primer: As directed by the Architect.

PART 3 EXECUTION

- 3.01 EXAMINATION
 - A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel joists.

3.02 INSTALLATION

- A. Erection: SJI Standard Specifications and approved Shop Drawings.
- B. Welded Connections: As specified in Section 05 05 23, Welding.

3.03 TOUCHUP PAINTING

- A. Immediately following erection, remove debris from completed installation.
- B. Clean field welds, bolted connections, rust spots, and abraded areas.
- C. Repair damaged painted and galvanized surfaces as specified in accordance with Manufacturer specifications and as directed by the Architect.

3.04 FIELD QUALITY CONTROL

- A. Welding:
 - 1. Visually inspect field welds in accordance with AWS D1.1, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.

2. Repair defective welds as specified in Section 05 05 23, Welding.

END OF SECTION

OPEN WEB STEEL JOIST FRAMING 05 21 19 - 4

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SECTION 05 31 00 STEEL DECKING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Iron and Steel Institute (AISI): Specifications for the Design of Cold Formed Steel Structural Members.
 - 2. American Welding Society (AWS): D1.3, Structural Welding Code Sheet Steel.
 - 3. ASTM International (ASTM):
 - a. A611, Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled.
 - b. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - c. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - d. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - 4. Steel Deck Institute (SDI):
 - a. Design Manual for Composite Decks, Form Decks and Roof Decks.
 - b. Diaphragm Design Manual.
 - 5. Factory Mutual (FM):
 - a. Factory Mutual Approval Guide.
 - b. FM Research Corporation (FMRC): Approval Requirements for Steel Roof Deck Construction.
 - 6. International Code Council Evaluation Service, Inc. (ICC-ES): Evaluation Reports for Deck Fasteners.
 - 7. UL: Fire Resistance Directory.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Plan view layout of decking showing type and section properties of deck panels, reinforcing channels, pans, special jointing, and accessories.
 - 2. Location of openings, deck laps, and deck attachment details.

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- B. Informational Submittals:
 - 1. Decking manufacturer's installation requirements.
 - 2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.
 - 3. Operation manuals for mechanical fastener installation tools.
 - 4. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.

1.03 QUALITY ASSURANCE

- A. General: For metal decking section properties, meet requirements of AISI Specifications for Design of Cold-Formed Steel Structural Members.
- B. Qualifications for Field Welding: As specified in Section 05 05 23, Welding.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
 - B. Store deck bundles on platforms or pallets, with one end elevated to provide drainage.
 - C. Protect bundles against condensation with a ventilated waterproof covering.
 - D. Stack bundles so there is no danger of tipping, sliding, rolling, shifting or material damage.

PART 2 PRODUCTS

- 2.01 METAL DECKING
 - A. Provide metal deck as shown in the Drawings:
 - B. Materials and Finishes:
 - 1. Galvanized Deck:
 - a. Sheet steel for galvanized deck and accessories shall conform to ASTM A653 Structural Quality Grade 33 or higher, as shown in Steel Deck Schedule.
 - b. Galvanizing shall conform to ASTM A924 with coating class of G60 or G90 as defined in ASTM A653 and as shown in Steel Deck Schedule.

- C. Manufacturers:
 - 1. Vulcraft Division of Nucor Co., Brigham City, UT.
 - 2. BHP Steel Building Products, USA, Inc., West Sacramento, CA.
 - 3. Verco Manufacturing, Inc., Phoenix, AZ.
 - 4. United Steel Deck, Inc., Summit, NJ.

2.02 ACCESSORIES

- A. Provide pour stops, column closures, end closures, cover plates, girder fillers, ridge and valley plates, finish strips, reinforcing channels, and other accessories as required for complete installation.
- B. Accessories shall be minimum 22-gauge, except edge forms shall be sized as required by the deck manufacturer, unless shown otherwise on the Drawings.

2.03 MECHANICAL FASTENERS

- A. Self-Drilling Screws:
 - 1. Self-drilling, self-tapping screws with hexagonal washer head and corrosion-resistant finish.
 - 2. Manufacturers and Products:
 - a. ITW Buildex, Itasca, IL; ICH Traxx Self-Drilling Fasteners with Climaseal Coating and Autotraxx Standup Installation Tool.
 - b. Hilti, Inc., Tulsa, OK; Kwik-Pro HWH Self-Drilling Screws with Kwik-Cote Treatment and Kwik-Tapper Screwdriver.
- B. Powder Driven Fasteners:
 - 1. Knurled shank, minimum 1/2-inch diameter steel washer, corrosion-resistant coating.
 - 2. Pin diameter and length to suit deck type and flange thickness of steel support member.
 - 3. Manufacturers and Products:
 - a. ITW Buildex, Itasca, IL; Buildex BX14 pins with yellow dichromate galvanizing and BX900 Installation Tool.
 - b. Hilti, Inc., Tulsa, OK; ENP-series fasteners with electroplated zinc coating and DX-750 Installation Tool.
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PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.02 INSTALLATION

- A. Locate deck bundles to prevent overloading of support framing members.
- B. Install at right angles to supporting members in a three span minimum lay-up, unless shown otherwise, and in accordance with Specification and manufacturer's installation recommendation.
- C. Bearing: 1-1/2 inches, minimum.
- D. Endlaps: Minimum of 2 inches and located over supports.
- E. Do not stretch sidelaps.
- F. Closure Plates:
 - 1. Install closure and cover plate accessories as recommended by the metal deck manufacturer, unless shown otherwise on the Drawings.
 - 2. Floor Deck and Form Deck Closures:
 - a. Fasten column closures, cell closures, and zee closures to deck to provide tight fitting closures at open ends of ribs and sides of decking.
 - b. Fasten cell closures at changes of direction of deck units unless otherwise indicated.
- G. Holes and Openings
 - 1. Cut and fit around roof openings and other work projecting through or adjacent to decking.
 - 2. Locate holes and openings as shown to clear structural framing and bracing members.
 - 3. Reinforcement around openings:
 - a. Roof Deck: For hole sizes of at least 6 inches across, but not more than 12 inches across in roof deck, reinforce with 0.0474-inch design thickness steel plate, painted or galvanized to match deck coating. Extend plate at least 12 inches beyond opening in all directions and attach to top of roof deck with No. 10 self-drilling screws at 6-inch spacing and at all corners. For openings larger than 12 inches across, reinforce roof deck with framing as shown on the Drawings.

- b. Composite Floor Deck and Form Deck: Reinforce openings as indicated on the Drawings.
- H. Protect deck areas from heavy concentrated loads or wheel traffic with planking or other approved means.
- I. Install temporary shoring, if required, to meet strength and deflection limitations, before placing any concrete topping on deck panels.
- J. Completed Deck: Free from buckles and irregularities, and in accordance with FM and UL requirements.

3.03 DECK ATTACHMENT

- A. Fasten panels as shown on the Drawings.
- B. Welded Connections: Weld deck sidelaps, attachment to framing, and accessories in accordance with AWS D1.3 and as specified in Section 05 05 23, Welding.
- C. Mechanical Fasteners:
 - 1. Self-Drilling Screws:
 - a. Install screws in accordance with manufacturer's written instructions and with special installation tool. Do not over-torque.
 - b. Remove and redrive screws at sidelaps where upper sheet is not drawn tightly against lower sheet.
 - 2. Powder Driven Fasteners:
 - a. Install fasteners in accordance with manufacturer's written instructions and with special installation tool.
 - b. Minimum Sidelap Edge Distance: 3/8-inch.
 - c. Minimum End/End Lap Distance: 1-inch.
 - d. Head Projection: As specified by manufacturer for correct penetration into flange of steel support member.

3.04 TOUCHUP PAINTING

- A. Immediately following erection, remove unused deck edge trimmings, screws, fasteners, welding washers, butt ends of welding rods, and debris from completed installation.
- B. Clean field welds, bolted connections, rust spots, and abraded areas.
- C. Repair damaged painted surfaces in accordance with Manufacturer specifications.

- D. Repair damaged galvanized surfaces with zinc-rich spray paint in accordance with ASTM A780; color to match galvanized deck.
- E. Use magnetic gauge to determine that thickness of repair is equal to or greater than base painted or galvanized coating.

3.05 FIELD QUALITY CONTROL

- A. An independent testing agency shall be retained by Contractor and approved by Engineer to perform following inspections.
 - 1. Welded Connections: Visually inspect in accordance with AWS D1.3, Section 7, and as specified in Section 05 05 23, Welding.
 - 2. Mechanical Fasteners: Visually inspect, in accordance with manufacturer's instructions, for each type of fastener.
- B. Repair or replace defective welds and fasteners.

END OF SECTION

SECTION 05 41 00 STRUCTURAL METAL STUD FRAMING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Iron and Steel Institute (AISI):
 - a. Specification for the Design of Cold-Formed Steel Structural Members.
 - b. Cold-Formed Steel Design Manual.
 - c. Design Guide for Cold-Formed Steel Trusses.
 - d. Fasteners for Residential Steel Framing.
 - 2. American Welding Society, Inc. (AWS):
 - a. C1.1, Recommended Practices for Resistance Welding.
 - b. C1.3, Recommended Practices for Resistance Welding Coated Low Carbon Steels.
 - c. D1.3, Structural Welding Code-Sheet Steel.
 - 3. ASTM International (ASTM):
 - a. A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
 - b. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Structural Tubing in Rounds and Shapes.
 - c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - d. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - e. C954, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - f. C955, Standard Specification for Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases.
 - 4. Center for Cold-Formed Steel Structures (CCFSS): Technical Bulletin, Vol. 2, No. 1, February 1993, Screw Connections.
 - 5. International Code Council (ICC): Evaluation Reports for Cold-Formed Steel Framing and Fasteners.

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1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Plan and elevation views of all metal framing systems, including location and framing of all openings.
 - 2. Material specifications, member sizes, and properties.
 - 3. Details of track, web stiffeners, stud bracing, blocking, bridging, and other members as required to provide a complete installation.
 - 4. Details of connections including welding, mechanical fasteners, and accessory items.
 - 5. Installation and erection instructions, including sequence of operations and requirements for temporary bracing and bridging.
- B. Informational Submittals:
 - 1. Manufacturer's installation requirements.
 - 2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05 05 23, Welding.
 - 3. Operation manuals for mechanical fastener installation tools.

1.03 QUALITY ASSURANCE

- A. General: For member section properties, meet requirements of AISI, Specification for the Design of Cold-Formed Steel Structural Members.
- B. Qualifications for Welding: As specified in Section 05 05 23, Welding.
- 1.04 DELIVERY, STORAGE, AND HANDLING
 - A. Deliver to Site in bundles marked with name of manufacturer, section type, thickness, grade of material, and length.
 - B. Store bundles on wood blocking, flat and off ground, to keep clean and to prevent any damage or permanent distortion.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Provide size and type of members as indicated on the Drawings.
 - B. Sheet Steel: ASTM A653/A653M, with G-60 galvanized coating.
 - C. Cold-Formed Members and Accessories: ASTM C955.

D. Dimensions and Properties: Calculate section properties in accordance with AISI Cold-Formed Steel Design Manual.

2.02 STUDS AND JOISTS

- A. Material:
 - 1. ASTM A653/A653M, Structural Steel (SS) Grade 33, or High-Strength Low-Alloy Steel (HSLAS), Type A or B, Grade 50.
 - 2. Section: Type, size, and thickness as indicated on the Drawings.
 - 3. Flanges: Stiffened with return lip.
 - 4. Webs:
 - a. Studs: Punched.
 - b. Joists: Unpunched, unless indicated otherwise on the Drawings.
- B. Accessories:
 - 1. Track: Size as required to fit over studs, same thickness as stud material, unpunched.
 - 2. Blocking, Bridging, and Fire Stops: Same depth as studs or joists, 0.0566-inch minimum design thickness, unpunched.
 - 3. Bracing Straps, Angle Bracing, Clip Angles: Size and thickness as indicated on the Drawings.
 - 4. Mounting Plates: 0.0566-inch minimum design thickness by 8 inches by 18 inches.
 - 5. Accessories shall be from same manufacturer as studs and joists.
- C. Manufacturers and Products:
 - 1. AMS, Los Angeles, CA; Angeles Metal Systems.
 - 2. Clark Steel, Middleton, OH; Steel Framing Systems.
 - 3. Dale Industries; Dearborn, MI; Dale/Incor Steel Framing.
 - 4. Dietrich Industries, Pittsburgh, PA; Lightgauge Metal Framing Products.
 - 5. Knorr Steel Framing Systems, Salem, OR; Light Gauge Steel Framing.
 - 6. Marino/Ware, South Plainfield, NJ; Stud-Rite Lightweight Steel Framing Systems.
 - 7. Unimast Incorporated, Schiller Park, IL; Steel Framing Systems.

2.03 MECHANICAL FASTENERS

- A. Self-Drilling Screws:
 - 1. Self-drilling, self-tapping screws with hexagonal washer head and corrosion-resistant finish.

- 2. Manufacturers and Products:
 - a. ITW Buildex, Itasca, IL; ICH Traxx Self-Drilling Fasteners with Climaseal Coating and Autotraxx Standup Installation Tool.
 - b. Hilti, Inc., Tulsa, OK; Kwik-Pro HWH Self-Drilling Screws with Kwik-Cote Treatment and Kwik-Tapper Screwdriver.
- B. Powder-Driven Fasteners:
 - 1. Knurled shank, minimum 1/2-inch diameter steel washer, corrosion-resistant coating.
 - 2. Pin diameter and length to suit deck type and flange thickness of steel support member.
 - 3. Manufacturers and Products:
 - a. ITW Buildex, Itasca, IL; Buildex BX14 pins with yellow dichromate galvanizing and BX900 Installation Tool.
 - b. Hilti, Inc., Tulsa, OK; ENP-series fasteners with electroplated zinc coating and DX-750 Installation Tool.

2.04 CONCRETE ANCHORS

A. Drilled anchors, size and type as shown on the Drawings and as specified in Section 05 50 00, Metal Fabrications.

2.05 PREFABRICATION

- A. Structural wall framing panels may be prefabricated prior to erection.
- B. Prefabricated assemblies shall be not more than 1/8-inch out of square within length of assembly and shall be braced against racking. Use jig templates for layout and fabrication.
- C. Protect prefabricated panels from damage during handling.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Inspect all prefabricated assemblies and repair any damage.
- B. Examine bearing support surfaces for compliance with requirements for installation tolerances and other conditions affecting performance of metal framing systems.
- C. Provide smooth level bearing surfaces for bottom track of load-bearing walls.
- D. Clean all member and bearing surfaces that will be in contact after assembly.

3.02 INSTALLATION

- A. General:
 - 1. Install framing systems as indicated on the Drawings, complete and in accordance with manufacturer's recommendations.
 - 2. Provide temporary bracing for support of all construction loads until framing system is installed complete with sheathing or decking.
 - 3. Install framing in true line, plumb, level, and in proper alignment.
 - 4. Cut ends of framing members with saw or shear to bear uniformly against abutting members. Flame cutting is not permitted.
 - 5. All structural framing members shall be full-length without splices, unless indicated otherwise.
 - 6. Fasten members together in accordance with AISI, Cold-Formed Steel Design Manual, Part IV, Connections. Wire tying is not permitted.
- B. Stud Bearing Walls:
 - 1. Secure bottom track to floor slab with concrete anchors as indicated on the Drawings.
 - 2. Seat studs squarely and firmly within track before securing with fasteners. Gap between end of stud and track shall be less than 1/16-inch.
 - 3. Install studs with spacing as shown and not more than 2 inches from abutting walls.
 - 4. Provide double studs at jambs of openings wider than stud spacing.
 - 5. Provide triple studs at corners and at jambs of openings wider than 48 inches, unless indicated otherwise.
 - 6. Track shall be continuous. Center splices between studs and splice with stud section full length between studs.
 - 7. Frame wall penetrations for pipes and ducts larger than stud spacing to avoid cutting structural members.
 - 8. Fire stop stud walls and partitions with unpunched blocking full width of stud at midpoint or where required for nailers, in conformance with applicable building code.
 - 9. Provide blocking for support of mechanical items.
 - 10. Do not remove the web knockouts within 10 inches of either end of load-bearing studs.
 - 11. Provide bracing straps with gusset plates and anchor holddown assemblies where indicated on the Drawings.
 - 12. Tolerances:
 - a. Stud Plumbness: 1/8-inch in 10 feet.
 - b. Stud Spacing: Plus or minus 1/8-inch.

- С. Joists:
 - Position joists directly over bearing studs and attach to track. 1.
 - Joists shall be one-piece within a single span. For multiple spans, lap 2. joists and splice as shown on the Drawings.
 - Immediately install bridging and solid blocking to support joists. 3. Maximum spacing of bridging shall be 5 feet.
 - Install web stiffeners where indicated 4.
 - 5. Web Penetrations:
 - Drilled holes for other trades shall be limited to the middle 1/3 of a. the joist depth within the middle 1/3 of the span, unless indicated otherwise. Minimum spacing between drilled holes shall be 1-1/2 times the joist depth. Notching of joist flanges and flame cutting of holes are not permitted.
 - 6. Tolerances:
 - Joist Spacing: Plus or minus 1/8-inch. a.
 - Joist Levelness: Plus or minus 1/8-inch in 10 feet. b.

3.03 **FASTENERS**

- Self-Drilling Screws: A.
 - 1. Install in accordance with manufacturer's written instructions and with special installation tool.
 - Screw type, diameter, and length shall be in accordance with AISI, 2. Fasteners for Residential Steel Framing, minimum two screws per connection unless indicated otherwise.
 - 3. Use clamp to hold members together. Drive screw from lighter to heavier gauge, to allow plies to be pulled together without stripping metal. Do not over torque. A minimum of three exposed threads shall extend through steel.
 - Minimum screw spacing, end distance, and edge distance shall be 4. 3 diameters.
- Β. **Powder-Driven Fasteners:**
 - 1. Use only for connecting cold-formed steel to structural steel members, unless indicated otherwise.
 - Install in accordance with manufacturer's written instructions and with 2. special installation tool.
- C. Welded Connections:
 - 1. Welding shall not be used for material thinner than 0.0451-inch.
 - Weld framing members and accessories in accordance with AWS D1.3. 2.

- 3. Resistance welding for prefabricated framing shall be in accordance with AWS C1.1 and AWS C1.3.
- 4. Repair galvanized surfaces damaged by welding with zinc-rich spray paint in accordance with ASTM A780.
- D. Concrete Anchors: Install in accordance with Section 05 50 00, Metal Fabrications.

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency shall be retained by Contractor and approved by Engineer to perform following inspections.
 - 1. Welded Connections: Visually inspect in accordance with AWS D1.3, Section 7, and as specified in Section 05 05 23, Welding.
 - 2. Mechanical Fasteners: Visually inspect, in accordance with manufacturer's instructions, for each type of fastener.
- B. Repair or replace defective welds and fasteners.

END OF SECTION

SECTION 05 50 00 METAL FABRICATIONS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. The Aluminum Association, Inc. (AA): The Aluminum Design Manual.
 - 2. American Galvanizers Association (AGA):
 - a. Inspection of Hot-Dip Galvanized Steel Products.
 - b. Quality Assurance Manual.
 - 3. American Iron and Steel Institute (AISI): Stainless Steel Types.
 - 4. American Ladder Institute (ALI): A14.3, Ladders Fixed Safety Requirements.
 - 5. American National Standards Institute (ANSI).
 - 6. American Society of Safety Engineers (ASSE): A10.11, Safety Requirements for Personnel and Debris Nets.
 - 7. American Welding Society (AWS):
 - a. D1.1/D1.1M, Structural Welding Code Steel.
 - b. D1.2/D1.2M, Structural Welding Code Aluminum.
 - c. D1.6/D1.6M, Structural Welding Code Stainless Steel.
 - 8. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A48/A48M, Specification for Gray Iron Castings.
 - c. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - d. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - e. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - f. A143/A143M, Standard for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

- j. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
- k. A276, Standard Specification for Stainless Steel Bars and Shapes.
- 1. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
- m. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
- o. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
- p. A384/A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.
- q. A385/A385M, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
- r. A489, Standard Specification for Carbon Steel Lifting Eyes.
- s. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- t. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- u. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- v. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- w. A780/A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- x. A786/A786M, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
- y. A793, Standard Specification for Rolled Floor Plate, Stainless Steel.
- z. A967, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
- aa. A992/A992M, Standard Specification for Structural Steel Shapes.
- bb. A1085, Standard Specification for Cold-Formed Welded Carbon Steel Hollow Structural Sections (HSS).
- cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- dd. B308/B308M, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
- ee. B429/B429M, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.

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- ff. B632/B632M, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
- gg. C881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- hh. D1056, Standard Specification for Flexible Cellular Materials -Sponge or Expanded Rubber.
- ii. F436, Standard Specification for Hardened Steel Washers.
- jj. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
- kk. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- 11. F594, Standard Specification for Stainless Steel Nuts.
- mm. F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.
- nn. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- 9. NSF International (NSF): 61, Drinking Water System Components— Health Effects.
- 10. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.27, Fixed Ladders.
 - b. 29 CFR 1926.105, Safety Nets.
 - c. 29 CFR 1926.502, Fall Protection Systems Criteria and Practices.
- 11. Specialty Steel Industry of North America (SSINA):
 - a. Specifications for Stainless Steel.
 - b. Design Guidelines for the Selection and Use of Stainless Steel.
 - c. Stainless Steel Fabrication.
 - d. Stainless Steel Fasteners.

1.02 DEFINITIONS

- A. Anchor Bolt: Cast-in-place anchor; concrete or masonry.
- B. Corrosive Area: Containment area or area exposed to delivery, storage, transfer, or use of chemicals.
- C. Exterior Area: Location not protected from weather by building or other enclosed structure.
- D. Interior Dry Area: Location inside building or structure where floor is not subject to liquid spills or washdown, nor where wall or roof slab is common to a water-holding or earth-retaining structure.

- E. Interior Wet Area: Location inside building or structure where floor is sloped to floor drains or gutters and is subject to liquid spills or washdown, or where wall, floor, or roof slab is common to a water-holding or earth-retaining structure.
- F. Submerged: Location at or below top of wall of open water-holding structure, such as basin or channel, or wall, ceiling or floor surface inside a covered water-holding structure, or exterior belowgrade wall or roof surface of water-holding structure, open or covered.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Metal fabrications, including welding and fastener information.
 - 2. Samples: Color samples of abrasive stair nosings.

1.04 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Galvanized Coating Applicator: Company specializing in hot-dip galvanizing after fabrication and following procedures of Quality Assurance Manual of the American Galvanizers Association.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Insofar as practical, factory assemble specified items. Package assemblies, which have to be shipped unassembled to protect materials from damage and tag to facilitate identification and field assembly.
- B. Package stainless steel items to provide protection from carbon impregnation.
- C. Protect painted coatings and hot-dip galvanized finishes from damage as a result of metal banding and rough handling. Use padded slings and straps.
- D. Store fabricated items in dry area, not in direct contact with ground.

PART 2 PRODUCTS

2.01 GENERAL

A. For hot-dip galvanized steel that is exposed to view and does not receive paint, limit the combined phosphorus and silicon content to 0.04 percent. For steels that require a minimum of 0.15 percent silicon (such as plates over 1.5 inches thick for ASTM A36/A36M steel), limit maximum silicon content to 0.21 percent and phosphorous content to 0.03 percent.

Item	ASTM Reference
Steel Wide Flange Shapes	A992/992M
Other Steel Shapes and Plates	A36/A36M or A572/A572M, Grade 50 or A992/A992M for other steel shapes
Steel Pipe	A500, Grade B
Hollow Structural Sections (HSS)	A500/A500M, Grade C
Aluminum:	
Aluminum Plates	B209, Alloy y6061-T6
Aluminum Structural Shapes	B308/B308M, Alloy 6061-T6
Stainless Steel:	
Bars and Angles	A276, AISI Type 316 (316L for welded connections)
Shapes	A276, AISI Type 304 (304L for welded connections)
Steel Plate, Sheet, and Strip	A240/A240M, AISI Type 316 (316L for welded connections)
Bolts, Threaded Rods, Anchor Bolts, and Anchor Studs	F593, AISI Type 316, Group 2, Condition SH
Nuts	F594, AISI Type 316, Condition CW
Steel Bolts and Nuts:	
Carbon Steel	A307 bolts, with A563 nuts
High-Strength	A325, Type 1 bolts, with A563 nuts

B. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Anchor Bolts and Rods	F1554, Grade A: 36, with weldability supplement S1.
Eyebolts	A489
Threaded Rods	A36/A36M
Flat Washers (Unhardened)	F844
Flat and Beveled Washers (Hardened)	F436
Thrust Ties for Steel Pipe:	
Threaded Rods	A193/A193M, Grade B7
Nuts	A194/A194M, Grade 2H
Plate	A283/A283M, Grade D
Welded Anchor Studs	A108, Grades C-1010 through C-1020
Aluminum Bolts and Nuts	F468, Alloy 2024-T4
Cast Iron	A48/A48M, Class 35

C. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zincplated steel, and aluminum material types as indicated in Fastener Schedule at end of this section.

2.02 ANCHOR BOLTS AND ANCHOR BOLT SLEEVES

- A. Cast-In-Place Anchor Bolts:
 - 1. Headed type, unless otherwise shown on the Drawings.
 - 2. Material type and protective coating as shown in Fastener Schedule at end of this section.
- B. Anchor Bolt Sleeves:
 - 1. Plastic:
 - a. Single unit construction with corrugated sleeve.
 - b. Top of sleeve shall be self-threading to provide adjustment of threaded anchor bolt projection.
 - c. Material: High-density polyethylene.
 - 2. Fabricated Steel: ASTM A36/A36M.

2.03 POST-INSTALLED CONCRETE AND MASONRY ANCHORS

A. See Section 05 05 19, Post-Installed Anchors.

2.04 STUD SHEAR CONNECTORS

- A. Headed anchor studs (HAS), or threaded anchor studs (TAS), or stud shear connectors, as indicated on the Drawings.
 - Carbon Steel: ASTM A108, Standard Quality Grades 1010 through 1020, inclusive either semikilled or killed aluminum or silicon dioxidation, unless indicated otherwise.
 - 2. Stainless Steel: ASTM F593, AISI Type 316, Condition CW, where indicated.
- B. Manufacturers:
 - 1. Nelson Stud Welding, FabriSteel Co., Elyria, OH.
 - 2. Stud Welding Associates, Inc., Elyria, OH.

2.05 ABRASIVE NOSING FOR STAIRS

- A. Unless otherwise shown on the Drawings, furnish flush type abrasive nosings on stairs.
- B. Nosing Components:
 - 1. Homogeneous epoxy abrasive, with minimum 50 percent aluminum oxide content, formed and cured upon an extruded aluminum base.
 - 2. Epoxy abrasive shall extend over and form curved front edge of nosing.
 - 3. Base of Nosing: Extruded aluminum alloy, 6063-T5, heat-treated.
- C. Anchoring System: Double-set anchors consisting of two rows of integrally extruded anchors.
- D. Size: 3 inches wide by 1/4-inch to 3/8-inch thick by length as shown.
- E. Color: Selected by Engineer from manufacturer's standard color range.
- F. Manufacturers and Products:
 - 1. Wooster Products, Inc., Wooster, OH.
 - 2. American Safety Tread Co., Inc., Helena, AL.

ROGER SCOTT POOL FACILITIES

2.06 FABRICATION

A. General:

- 1. Finish exposed surfaces smooth, sharp, and to well-defined lines.
- 2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in neat, substantial manner.
- 3. Conceal fastenings where practical; where exposed, flush countersink.
- 4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
- 5. Grind cut edges smooth and straight. Round sharp edges to small uniform radius. Grind burrs, jagged edges, and surface defects smooth.
- 6. Fit and assemble in largest practical sections for delivery to Site.
- B. Materials:
 - 1. Use steel shapes, unless otherwise noted.
 - 2. Steel to be hot-dip galvanized: Limit silicon content to less than 0.04 percent or to between 0.15 percent and 0.25 percent.
 - 3. Fabricate aluminum in accordance with AA Specifications for Aluminum Structures–Allowable Stress Design.
- C. Welding:
 - 1. Weld connections and grind exposed welds smooth. When required to be watertight, make welds continuous.
 - 2. Welded fabrications shall be free from twisting or distortion caused by improper welding techniques.
 - 3. Steel: Meet fabrication requirements of AWS D1.1/D1.1M, Section 5.
 - 4. Aluminum: Meet requirements of AWS D1.2/D1.2M.
 - 5. Stainless Steel: Meet requirements of AWS D1.6/D1.6M.
 - 6. Welded Anchor Studs: Prepare surface to be welded and weld with stud welding gun in accordance with AWS D1.1/D1.1M, Section 7, and manufacturer's instructions.
 - 7. Complete welding before applying finish.
- D. Painting:
 - 1. Shop prime with rust-inhibitive primer, unless otherwise indicated.
 - 2. Do not apply protective coating to galvanized steel anchor bolts or galvanized steel welded anchor studs, unless indicated otherwise.

- E. Galvanizing:
 - Fabricate steel to be galvanized in accordance with ASTM A143/A143M, ASTM A384/A384M, and ASTM A385/A385M. Avoid fabrication techniques that could cause distortion or embrittlement of the steel.
 - 2. Provide venting and drain holes for tubular members and fabricated assemblies in accordance with ASTM A385/A385M.
 - 3. Remove welding slag, splatter, burrs, grease, oil, paint, lacquer, and other deleterious material prior to delivery for galvanizing.
 - 4. Remove by blast cleaning or other methods surface contaminants and coatings not removable by normal chemical cleaning process in the galvanizing operation.
 - 5. Hot-dip galvanize steel members, fabrications, and assemblies after fabrication in accordance with ASTM A123/A123M.
 - 6. Hot-dip galvanize bolts, nuts, washers, and hardware components in accordance with ASTM A153/A153M. Oversize holes to allow for zinc alloy growth. Shop assemble bolts and nuts.
 - 7. Galvanized steel sheets in accordance with ASTM A653/A653M.
 - 8. Galvanize components of bolted assemblies separately before assembly. Galvanizing of tapped holes is not required.
- F. Fitting: Where movement of fabrications is required or shown, cut, fit, and align items for smooth operation. Make corners square and opposite sides parallel.
- G. Accessories: Furnish as required for a complete installation. Fasten by welding or with stainless steel bolts or screws.

2.07 SOURCE QUALITY CONTROL

- A. Visually inspect all fabrication welds and correct deficiencies.
 - 1. Steel: AWS D1.1/D1.1M, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.
 - 2. Aluminum: AWS D1.2/D1.2M.
 - 3. Stainless Steel: AWS D1.6/D1.6M.

PART 3 EXECUTION

3.01 INSTALLATION OF METAL FABRICATIONS

- A. General:
 - 1. Install metal fabrications plumb and level, accurately fitted, free from distortion or defects.

ROGER SCOTT POOL FACILITIES

- 2. Install rigid, substantial, and neat in appearance.
- 3. Install manufactured products in accordance with manufacturer's recommendations.
- 4. Obtain Engineer approval prior to field cutting steel members or making adjustments not scheduled.
- B. Aluminum:
 - 1. Do not remove mill markings from concealed surfaces.
 - 2. Remove inked or painted identification marks on exposed surfaces not otherwise coated after installed material has been inspected and approved.
 - 3. Fabrication, mechanical connections, and welded construction shall be in accordance with the AA Aluminum Design Manual.
- C. Pipe Sleeves:
 - 1. Provide where pipes pass through concrete or masonry.
 - 2. Holes drilled with a rotary drill may be provided in lieu of sleeves in existing walls.
 - 3. Provide center flange for water stoppage on sleeves in exterior or waterbearing walls.
 - 4. Provide rubber caulking sealant or a modular mechanical unit to form watertight seal in annular space between pipes and sleeves.
- D. Steel Lintels and Shelf Angles: Provide as required for support of masonry and other construction not attached to structural steel framing, unless otherwise shown on the Drawings.

3.02 CAST-IN-PLACE ANCHOR BOLTS

- A. Locate and hold anchor bolts in place with templates at time concrete is placed.
- B. Use anchor bolt sleeves for location adjustment and provide two nuts and one washer per bolt of same material as bolt.
- C. Minimum Bolt Size: 1/2-inch diameter by 12 inches long, unless otherwise shown.

3.03 ABRASIVE NOSINGS

A. Provide abrasive nosings on concrete steps not being supplied or coated with another type of nosing or nonskid material.

3.04 PAINTING

- A. Repair of Damaged Hot-Dip Galvanized Coating:
 - 1. Conform to ASTM A780/A780M.
 - 2. For minor repairs at abraded areas, use sprayed zinc conforming to ASTM A780/A780M.
 - 3. For flame cut or welded areas, use zinc-based solder, or zinc sticks, conforming to ASTM A780/A780M.
 - 4. Use magnetic gauge to determine thickness is equal to or greater than base galvanized coating.

3.05 FIELD QUALITY ASSURANCE AND QUALITY CONTROL

- A. Contractor-Furnished Quality Control:
 - 1. Inspection and testing required in Section 01 45 16.13, Contractor Quality Control.

END OF SECTION

SECTION 05 52 16 ALUMINUM RAILINGS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Aluminum Association, Incorporated (AA): DAF45, Designation System for Aluminum Finishes.
 - 2. American Concrete Institute (ACI) 318, Building Code Requirements for Structural Concrete.
 - 3. American Iron and Steel Institute (AISI).
 - 4. ASTM International (ASTM):
 - a. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
 - b. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
 - c. E894, Standard Test Method for Anchorage of Permanent Metal Railing Systems and Rails for Buildings.
 - d. E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
 - e. E985, Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
 - 5. International Code Council (ICC): International Building Code (IBC).
 - 6. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Code of Federal Regulations.

1.02 DEFINITIONS

- A. ICC Evaluation Services Report: ICC report on evaluation of manufactured concrete anchor systems.
- B. Railings: This term includes guardrail systems, handrail systems, platform railing systems, ramp-rail systems, and stair-rail systems. Railings may be comprised of a framework of vertical, horizontal, or inclined members, grillwork or panels, accessories, or combination thereof.

- C. Special Inspection: As defined by the FBC (FLORIDA BUILDING CODE), 2023.
- D. Toeboards: Vertical barrier at floor level usually erected on railings along exposed edges of floor or wall openings, platforms, or ramps to prevent miscellaneous items from falling through.

1.03 DESIGN REQUIREMENTS

- A. Structural Performance of Railing Systems: Design, test, fabricate, and install railings to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in railing system components.
 - 1. Railing System: Capable of withstanding the following load cases applied:
 - a. Concentrated load of 200 pounds applied at any point and in any direction in accordance with FBC and OSHA.
 - b. Uniform load of 50 pounds per linear foot applied in any direction in accordance with FBC.
 - c. Concentrated load need not be assumed to act concurrently with uniform loads in accordance with FBC.
 - 2. In-Fill Area of Railing Systems:
 - a. Capable of withstanding a horizontally applied normal load of 50 pounds applied to 1 square foot at any point in system including panels, intermediate rails, balusters, and openings and space between railings.
 - b. Horizontal concentrated load need not be assumed to act concurrently with loads on top rails of railings.
 - 3. Calculated lateral deflection at top of posts shall not exceed 1-inch.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Project-specific scaled plans and elevations of railings and detail drawings. Include railing profiles, sizes, connections, anchorage, size and type of fasteners, and accessories.
 - 2. Samples:
 - a. Rail sections, 6 inches long showing each type of proposed connection, proposed finish, and workmanship.
 - b. Each fitting including wall brackets, castings, toeboard, and rail expansion joints.

- B. Informational Submittals:
 - 1. Manufacturer's assembly and installation instructions.
 - 2. Special Inspection: Manufacturer's instructions for Special Inspection of post-installed anchors.
 - 3. Design Data: Calculations or test data using specified design performance loads and including the following:
 - a. Bending stress in, and deflection of, posts in accordance with ASTM E985 as modified herein.
 - b. Design of post base connection.
 - c. Manufacturer's literature and catalog data of railing and components.
 - 1) Documentation that concrete anchors have been designed in accordance with one of the following:
 - a) ACI 318.
 - b) ICC Evaluation Services Report for selected anchor.
 - 4. Test Reports: Test data may supplement load calculations providing data covers complete railing system, including anchorage:
 - a. Test data for railing and components showing load and deflection as a result of load, in enough detail to prove railing is strong enough and satisfies national, state, local standards, regulations, code requirements, and OSHA 29 CFR 1910, using design loads specified. Include test data for the following:
 - 1) Railing and post connections.
 - 2) Railing wall connections.
 - 3) Railing expansion joint connections.
 - 4) Railing system gate assembly, including latch, gate stop, and hinges. Both gate latch and stop to support required loads applied independent of each other.
 - 5) Railing picket panel clamps and connections.
 - b. Testing of anchorages shall be in accordance with ASTM E894 and ASTM E935 using applied loads in accordance with FBC.
 - c. Deflection Criteria: In accordance with ASTM E985 and design loads specified, except as follows: maximum calculated lateral deflection at top of posts shall not exceed 1-inch.
 - d. Aluminum Rail Piping: Test data showing yield strength of pipe as delivered equals or exceeds specified values.
 - 5. Manufacturer's written recommendations describing procedures for maintaining railings including cleaning materials, application methods, and precautions to be taken in use of cleaning materials.

1.05 QUALITY ASSURANCE

A. Qualifications: Calculations required for design data shall be stamped by a registered civil or structural engineer licensed in state where Project will be constructed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package and wrap railings to prevent scratching and denting during shipment, storage, and installation. Maintain protective wrapping to the extent possible until railing is completely installed.
- B. Delivery:
 - 1. Shop assemble into practical modules of lengths not exceeding 24 feet for shipment.
 - 2. Deliver toeboards loose for field assembly.
 - 3. Deliver clear anodized railing pipe and posts with protective plastic wrap.

1.07 ENVIRONMENTAL REQUIREMENTS

- A. Thermal Movements: Allow for thermal movement resulting from the following maximum range in ambient temperature in design, fabrication, and installation of railings to prevent buckling, opening up of joints, over stressing of components, connections and other detrimental effects. Base design calculation on actual surface temperature of material as a result of both solar heat gain and night time sky heat loss. Temperature change is difference between high or low temperature and installation temperature.
 - 1. Temperature Change Range: 70 degrees F, ambient; 100 degrees F, material surfaces.

PART 2 PRODUCTS

2.01 ALUMINUM RAILINGS

- A. General:
 - 1. Furnish pre-engineered and prefabricated railing systems as shown on the Drawings.
 - 2. Railing systems using pop rivets or glued railing construction are not permitted.
 - 3. Sand cast accessories and components are not permitted.
 - 4. Fasteners shall be AISI Type 316 stainless steel, unless otherwise noted.

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- B. Rails, Posts, and Formed Elbows:
 - 1. Extruded Alloy 6105-T5, 6061-T6, or equivalent.
 - 2. Tensile Strength: 38,000 psi, minimum.
 - 3. Yield Strength: 35,000 psi, minimum.
 - 4. Wall Thickness: 0.145-inch, minimum.
 - 5. Posts and railings shall be nominal 1-1/2-inch diameter (1.90-inch outside diameter).
- C. Accessories:
 - 1. Fittings and Accessories:
 - a. Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements.
 - b. Gauge metal components are not acceptable for load-resisting components.
 - c. Fittings shall match color of pipe in railings.
 - 2. Miscellaneous Extruded Aluminum Parts: Alloys 6063-T6, 6061-T6, or 6105 T5 aluminum, or equivalent, and of adequate strength for all loads.
 - 3. Castings for Railings:
 - a. Cast Al-mag with sufficient strength to meet load and test requirements.
 - b. Anodizable grade finish with excellent resistance to corrosion when subjected to exposure of sodium chloride solution intermittent spray and immersion.
 - 4. Post Anchorages:
 - a. Refer to standard details for types of post anchorages and minimum requirements.
 - b. Bolts at anchorages shall be minimum 1/2-inch diameter.
 - 5. Wall Brackets: Adjustable wall fitting, with provision for minimum three 3/8-inch diameter AISI Type 316 stainless steel bolts or concrete anchors.
 - 6. Rail Terminals (including Wall Returns): Aluminum wall fitting with provision for three 3/8-inch Type 304 fasteners.
 - 7. Railing System Gate:
 - a. Extruded aluminum rail components.
 - b. Hardware Manufacturers and Products:
 - 1) Julius Blum & Co., Inc., Carlstadt, NJ; No. 782/3 gate hinges with springs, and No. 784 gate latch and stop.
 - CraneVeyor Corp., South El Monte, CA; No. C4370b gate hinges with spring, No. C4369 gate latch, and No. C4368 gate stop.
 - Moultrie Manufacturing Co., Moultrie, GA; Part No. W60006.

- 8. Railing Picket Panels and Clamps:
 - a. 1/2-inch Schedule 40 aluminum pipe (picket).
 - b. Extruded aluminum 1-1/2-inch by 7/8-inch by 1/8-inch channel.
 - c. Furnish neoprene plug for each end of picket.
 - d. Fasteners: Stainless steel.
- 9. Toeboards:
 - a. Molded or extruded Alloy 6063-T6 or 6061-T6 aluminum.
 - b. Provide slotted holes for expansion and contraction where required.
- 10. Fasteners: Stainless steel.
- D. Metal Supports Embedded in Concrete: In accordance with Section 05 50 00, Metal Fabrications.
- E. Finishes:
 - 1. Pipe and Post: In accordance with AA DAF45, designation AA-M32-C22-A41.
 - 2. Cast Fittings and Toeboards: In accordance with AA DAF45, designation AA-M10-C22-A41.

2.02 ANCHOR BOLTS, FASTENERS, AND CONCRETE ANCHORS

- A. Locknuts, Washers, and Screws:
 - 1. Elastic Locknuts, Steel Flat Washers, Round Head Machine Screws (RHMS): AISI Type 316 stainless steel.
 - 2. Flat Washers: Molded nylon.
- B. Bolts and Nuts for Bolting Railing to Metal Beams: ASTM A193/A193M and ASTM A194/A194M, Type 316 stainless steel.
- C. Concrete Anchors:
 - 1. Stainless steel, AISI Type 316.
 - 2. Post-installed anchors in accordance with Section 05 50 00, Metal Fabrications, unless otherwise specified herein.
 - 3. Bolt Diameter: 1/2-inch, minimum.

2.03 FABRICATION

- A. Shop Assembly:
 - 1. Post Spacing: Maximum 6-foot horizontal spacing.
 - 2. Railing Posts Bolted to Metal or Concrete:
 - a. In lieu of field cutting, provide approved fitting with sufficient post overlap, containing provisions for vertical adjustment.
 - b. Field fit-up is required.
 - 3. Free of burrs, nicks, and sharp edges when fabrication is complete.
 - 4. Welding is not permitted.
- B. Shop/Factory Finishing:
 - 1. Use same alloy for uniform appearance throughout fabrication for railings.
 - 2. Railing and Post Fittings: Match fittings with color of pipe in railing.
- C. Shop Assembly:
 - 1. Shop assemble rails, posts, and formed elbows with a close tolerance for tight fit.
 - 2. Fit dowels tightly inside posts.
- D. Repair of Defective Work: Remove stains and replace defective Work.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Field fabrication of aluminum railing systems is not permitted.
 - B. Where required, provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on actual structure.
 - C. Install railing with base that provides plus or minus 1/4-inch vertical adjustment inside base fitting. If adjustment is required in field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.
 - D. Modification to supporting structure is not permitted where railing is to be attached.

- E. Mount railings only on completed walls. Do not support railings temporarily by means not satisfying structural performance requirements.
- F. Protection from Entrapped Water:
 - 1. Make provisions in exterior and interior installations subject to high humidity to drain water from railing system.
 - 2. For posts mounted in concrete, bends, and elbows occurring at low points, drill weep holes of 1/4-inch diameter at lowest possible elevations, one hole per post or rail. Drill hole in plane of rail.

3.02 RAILING INSTALLATION

- A. Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.
- B. Expansion Joints:
 - 1. Maximum intervals of 54 feet on center and at structural joints.
 - 2. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
 - 3. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
 - 4. Locate joints within 12 inches of posts. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.
- C. Posts and Rails:
 - 1. Surface Mounted Posts:
 - a. Bolt post baseplate connectors firmly in place.
 - b. Shims, wedges, grout, and similar devices for railing post alignment not permitted.
 - 2. Set posts plumb and aligned to within 1/8-inch in 12 feet.
 - 3. Set rails horizontal or parallel to slope of steps to within 1/8-inch in 12 feet.
 - 4. Install posts and rails in same plane.
 - 5. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail.
 - 6. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.
 - 7. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

- D. Wall Brackets: Support wall rails on brackets spaced maximum 5 feet on centers as measured on the horizontal projection.
- E. Toeboard:
 - 1. Provide at railings, except where 4-inch or higher concrete curbs are installed, at gates, or at stairways unless shown otherwise.
 - 2. Accurately measure in field for correct length; after railing post installation cut and secure to posts.
 - 3. Dimension between bottom of toeboard and walking surface not to exceed 1/4-inch.
 - 4. Install plumb and aligned to within 1/8-inch in 12 feet.
- F. Railing System Gate: Install in accordance with manufacturer's installation instructions.

3.03 FIELD FINISHING

A. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces.

3.04 FIELD QUALITY CONTROL

- A. Post-installed anchors supporting railing systems require special inspection.
- B. Owner-Furnished Quality Assurance, in accordance with ICC IBC Chapter 17 requirements, is provided in the Statement of Special Inspections Plan on the Drawings. Contractor responsibilities and related information are included in the Drawings.
- C. Contractor-Furnished Quality Control: Inspection and testing as required in Section 01 45 16.13, Contractor Quality Control.

3.05 CLEANING

- A. Wash railing system thoroughly using clean water and soap. Rinse with clean water.
- B. Do not use acid solution, steel wool, or other harsh abrasive.
- C. If stain remains after washing, restore in accordance with railing manufacturer's recommendations or replace stained railings.

END OF SECTION

SECTION 06 10 00 ROUGH CARPENTRY

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Wood Preservers' Association (AWPA):
 - a. U1, User Specification for Treated Wood.
 - b. M4, Standard for the Care of Preservative-Treated Wood Products.
 - 2. APA The Engineered Wood Association (APA):
 - a. PRP-108, Performance Standards and Qualification Policy for Structural-Use Panels (Form E445).
 - b. Form B445, APA Quality Assurance Policies for Structural-Use Panels Qualified to PRP-108.
 - 3. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - c. F1667, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
 - 4. International Code Council (ICC): Florida Building Code (FBC).
 - 5. National Fire Protection Association (NFPA): 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - 6. UL: 723, Standard for Safety Test for Surface Burning Characteristics of Building Materials.
 - 7. U.S. Department of Commerce—Product Standards (DOC): PS 1, Structural Plywood.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Construction panels.
 - b. Metal framing anchors.
 - c. Construction adhesives.
 - d. Construction panel thickness where not shown.

- B. Informational Submittals:
 - ICC Evaluation Service Reports, including the following as a minimum:

 Connections and Fasteners.
 - b. Wood Treatment.
 - 2. Wood treatment manufacturer's instructions for handling, storing, installation, and finishing of treated material.
 - 3. Material test reports from testing laboratory showing and interpreting test results in accordance with test methods UL 723, NFPA 255, and ASTM E84, relative to fire-retardant treated wood products.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Immediately upon delivery to Site, place materials in area protected from weather. Do not store seasoned materials in wet or damp areas.
- B. Protect sheet materials from breaking corners and damaging surfaces while unloading.
- C. Store materials a minimum of 6 inches above ground on framework or blocking and cover with waterproof covering, providing for adequate air circulation and ventilation. Store sheet materials flat, not on edge.
- D. Protect fire-retardant materials against high humidity and moisture during storage and erection.
- E. Store materials for which a maximum moisture content is specified in areas where humidity can be controlled.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Each plywood panel identified with designated grade trademark of APA.

2.02 CONSTRUCTION PANELS

- A. Plywood:
 - 1. General:
 - a. Where construction panels are shown on the Drawings for the following concealed types of applications, provide APA Performance-Rated Panels complying with requirements designated under each application for grade designation, span rating, exposure durability classification, edge detail, and thickness.

- b. Construction Panel Standards: Comply with DOC PS 1 for plywood construction panels and for products not manufactured under DOC PS 1 provisions, in accordance with APA PRP-108 and APA Form B445.
- c. Trademark: Each construction panel factory-marked with APA trademark evidencing compliance with grade requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

3.02 GENERAL

- A. Lay out, cut, fit, and install rough carpentry items. Anchor sufficiently to ensure rigidity and permanence.
- B. Install items accurate to dimension, true to line, level, and square unless shown otherwise on the Drawings. Provide for installation and support of other Work.
- C. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.
- D. Make provisions for temporary construction loads and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.

END OF SECTION
SECTION 06 40 00 ARCHITECTURAL MILLWORK

PART 1 GENERAL

1.01 INCLUDED IN THIS SECTION

- A. Ticketing Building:
 - 1. Breakroom kitchenette cabinets.
 - 2. Tickets office wall hung countertop.
- B. Restroom Building: Wall hung sink vanity.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Architectural Woodwork Institute (AWI): Architectural Woodwork Quality Standards.
 - 2. ASTM:
 - a. ASTM D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - b. ASTM D5420, Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
 - c. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - d. ASTM E228, Standard Test Method for Linear Thermal Expansion of Solid Materials with a Push-Rod Dilatometer.
 - 3. Builders Hardware Manufacturers Association (BHMA):
 - a. 201, Cabinet Hardware.
 - b. 156.11, Cabinet Locks.
 - 4. Federal Specifications (FS): MMM-A-130B, Adhesive, Contact.
 - 5. National Electrical Manufacturers' Association (NEMA): LD 3, High-Pressure Decorative Laminates.
 - 6. Product Standards (PS)-U.S. Department of Commerce: 51-71, Hardwood and Decorative Plywood.
 - 7. Woodwork Institute of California (WIC): Manual of Millwork.

1.03 DEFINITIONS

A. Trim: Includes baseboards, chair rails, interior cornices, door frames, and door and window casings and Millwork scribes.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Mandatory.
 - a. Show details and dimensions not controlled by job conditions and required field measurements. Sections through each special function portion of Millwork item.
 - b. Describe and illustrate all features of design showing field measurements, construction details, dimensions, materials, hardware and finish. Use full-size or 1/4-size scale Drawings. Reference Shop Drawings to Contract Document Drawings.
 - c. Furnish manufacturer's descriptive literature of specialty items not manufactured by woodwork manufacturer.
 - 2. Samples:
 - a. Finished Samples of each finish to be applied by woodwork manufacturer.
 - b. Sample casework unit complete with hardware, including locks and accessories, and top. Unit may be incorporated in the Work.
- B. Informational Submittals:
 - 1. Proof of woodwork manufacturer qualifications.
 - 2. Written confirmation of compliance to AWI standard required.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Successful completion of comparable work on similar size project within 2 years before start of construction on this Project.
 - 2. Current member of Architectural Woodwork Institute.
 - 3. Architect reserves right to approve woodwork manufacturer selected to furnish work.
- B. Casework and Paneling: "Quality Standards" of Architectural Woodwork Institute (AWI).
 - 1. Reference to Premium, Custom, or Economy Grade: As defined in AWI "Quality Standards."
 - 2. Provide Custom Grade unless otherwise specified.

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- C. Cabinet Hardware: In accordance with BHMA 201 and BHMA 156.11.
- D. Work in this section shall be accomplished under the Quality Certification Program of the Architectural Woodwork Institute (AWI).

1.06 ENVIRONMENTAL REQUIREMENTS

- A. For a minimum of 72 hours prior to installation, allow woodwork to come to equilibrium onsite in space where it is to be installed.
- B. Humidity: For 24 hours before, during, and after installation, maintain relative humidity between 25 and 55 percent.
- C. Temperature: For 24 hours before, during, and after installation, maintain ambient temperature between 65 and 75 degrees F.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Defer delivery to the Project Site until the installation and storage areas are complete and dry of all wet type construction, and excessive moisture has been out of the building for at least 10 days.
- B. Protect casework and paneling from damage and dampness. Store in weathertight, well-ventilated areas. Do not subject to extreme changes of temperature or humidity.

PART 2 PRODUCTS

2.01 CASEWORK WITH PLASTIC LAMINATE FINISH

- A. Meet the requirements of AWI Quality Standards Section 400 for laminate clad cabinets.
- B. Furnish casework exposed surfaces, including top, edges, front face, and backsplashes, with plastic laminate in colors indicated in Interior Finish Schedule.

2.02 CASEWORK HARDWARE

- Concealed Hinges: Stanley No. 1511 or Knape and Vogt No. 2661; No. 626 finish.
- B. Catches: Stanley No. 46 or McKinney No. 2911; 628 aluminum finish, magnetic.
- C. Pivot Door Slides: Knape and Vogt No. 8085, medium duty.

- D. Pulls/Handles: Solid brass or bronze, Stanley No. 4484, Baldwin No. 4676;
 626 satin chrome finish.
- E. Heavy-Duty Drawer Slides: Knape and Vogt No. 1429 or Grant No. 4930.
- F. Shelf Supports: Knape and Vogt No. 255/256 or Grant No. 120/121, nickel-plated finish.
- G. Shelf and Rod Support: Stanley No. 7046 or Knape and Vogt No. 1194.
- H. Heavy-Duty Pivot Door Slides: HAWA-Turnaway 35/X3, pivot sliding door fitting.

2.03 PLASTIC LAMINATE

- A. Cabinets/Backsplashes/Counter Tops: NEMA LD 3, Grade GP 50; solid color, standard velvet finish. Manufacturer and color as indicated in Interior Finish Schedule.
- B. No unfinished surfaces of casework, cabinets, backsplash, or table are to be exposed.
- C. See Drawings for requirements of the Millwork.

2.04 SOLID SURFACE

- A. Counter tops and backsplashes:
 - 1. Provide non-porous, homogeneous material.
 - 2. Manufacturer:
 - a. Corian
 - b. Wilsonart
 - 3. Adhesive for Bonding to Other Products: One component silicone to ASTM C920.
 - 4. Sealant: A standard mildew-resistant, FDA/UL® and NSF/ANSI 51 compliant in Food Zone area, recognized silicone color matched sealant or clear silicone sealants.
 - 5. See Drawings for requirements of the millwork items.

2.05 ANCILLARY MATERIALS

- A. Adhesives:
 - 1. For Plastic Laminate: Contact cement; Federal Specification MMM-A-130B.
- B. Woodwork Putty: Color to match finish.

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C. Fasteners: Furnish as necessary.

2.06 FABRICATION

- A. Moisture Content: Prior to fabrication, lumber shall be kiln-dried to an average moisture content range as follows:
 - 1. Exterior Work: 9 to 12 percent.
 - 2. Interior Work: 6 to 11 percent.
- B. Casework Construction: AWI Quality Standards Custom Grade, flush overlay.
- C. Casework Fronts: Plastic laminate.
- D. Casework Units: Shop assembled for field installation.
- E. Install concealed hinges on doors.
- F. Drawer Slides: Use side-mounted, heavy-duty type.
- G. Install casework hardware in accordance with manufacturer's instructions.
 - 1. Provide items where indicated and as required for a complete installation.
 - 2. Provide pulls and catches on casework doors unless indicated otherwise.

PART 3 EXECUTION

3.01 PREPARATION

- A. Field verification of field dimensions to be made by millworker prior to commencement of fabrication.
- B. Examine grounds, stripping, and blocking for cabinet attachment.
- C. Do not proceed to install until conditions are acceptable to installer.
- D. Verify that surfaces to receive architectural woodwork items are properly prepared.

3.02 CASEWORK INSTALLATION

- A. Coordinate installation of, and cut openings for mechanical, electrical, and other items that penetrate casework surfaces and tops.
- B. Install all casework in true alignment, level, and plumb.

- C. Secure units with nails or screws to cleats that have been anchored to building structure or wall framing.
- D. Install wall-hung cabinets to rigidly support cabinet weight plus normally expected weight of cabinet contents.
- E. Accurately scribe and closely fit faceplates, filler strips, and trim strips to irregularities of adjacent surfaces.
- F. Adhere plastic laminate as recommended by the laminate manufacturer.
 - 1. Apply with as few cross joints as possible and no longitudinal joints.
 - 2. Scribe neatly to vertical surfaces.
- G. Toe Space at Front of kitchenette cabinets: Provide by installing front face of cabinets 3 inches in front of base face.

3.03 ADJUSTING AND CLEANING

- A. Adjust hardware and leave in smooth working condition.
- B. Adjust doors and drawers to operate without restriction.
- C. Surfaces: Clean and ready for use.

END OF SECTION

SECTION 07 21 01 THERMAL INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - b. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - c. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - d. D4397, Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.
 - e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1.02 DESIGN REQUIREMENTS

- A. Roof Insulation:
 - 1. Coordinate roof insulation with roof system for a complete tested assembly.
 - 2. Wind Uplift Performance: Roof system is designed to withstand wind uplift forces as calculated using the current revision of ASCE-7 10.
 - 3. Thermal Performance: Roof system will achieve an average R-value not less than 30.
 - 4. Building Codes: Roof system will meet the requirements of all bodies having jurisdiction.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Manufacturer's product literature identifying products proposed for use.

1.04 MATERIAL STORAGE

A. Store off ground and keep dry at all times. Protect against weather condensation and damage.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Batt Insulation: ASTM C665, Type III, Class B, fiberglass batts with aluminum foil vapor retarder; R-value on Drawings.
- B. Vapor Retarder: ASTM D4397 plastic sheeting, 6 mils minimum.
- C. Roof Insulation:
 - 1. Formaldehyde-free fiberglass batt or fiberglass blanket complying with ASTM C 991 Type 1 and ASTM E84 with a thermal resistance of R-30.
 - 2. Color: White.
 - 3. Manufacturers and Products:
 - a. Simple Saver System.
 - b. Lamtec Corp.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Batt Insulation:
 - 1. Install in accordance with the manufacturer's instructions.
 - 2. Fasten flanges to the sides of framing members with the vapor retarder facing the warm side. Fit tightly to ensure a continuous seal.
 - 3. Where electrical outlets, ducts, pipes, vents, or other utility items occur, place insulation on the cold weather side of the obstruction.
 - 4. Provide fasteners, adhesive, tape, and sealant as recommended by insulation manufacturer.
- B. Vapor Retarder:
 - 1. Apply to exterior wall and ceiling framing in sheets as large as possible, lapping all joints 6 inches and sealing with sealant and tape recommended by manufacturer.
 - 2. Fit tightly and seal around all penetrations.
 - 3. Replace torn and punctured sheets.
 - 4. Repair minor tears or holes with tape.

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- 5. Repair by replacement major tears or holes that require more than a 6-inch length of tape to repair.
- C. Roof Insulation:
 - 1. Install pre-engineered building insulation system in accordance with manufacturer's installation instructions and the approved Shop Drawings.
 - 2. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
 - 3. Install in exterior spaces without gaps or voids. Do not compress insulation.
 - 4. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
 - 5. Fit insulation tight in spaces and tight to exterior side of the sealed liner.

3.02 CLEANUP AND PROTECTION

- A. Remove from Site all containers, wrappings, and scrap insulation material. Leave floors broom clean.
- B. Protect installed insulation from tears or other damage until covered with finish material. Replace damaged material.

END OF SECTION

SECTION 07 41 13 METAL ROOF PANELS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - b. A792/A792M, Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - c. C1311, Standard Specification for Solvent Release Sealants.
 - d. D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
 - e. E1646, Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference.
 - f. E1680, Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems.
 - 2. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Architectural Sheet Metal Manual.

1.02 SYSTEM DESCRIPTION

- A. Design Requirements: Provide professional engineering services needed to design roof system and assume engineering responsibility.
- B. Performance Requirements:
 - 1. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/square foot of roof area when tested in accordance with ASTM E1680 at the following test pressures:
 - a. Test Pressure:
 - Roof slope greater than 30 degrees: Positive and negative 1.57 lbf/square feet.
 - b. Preload Test-Pressure Difference:
 - 1) Positive: Greater than or equal to 15 lbf/square feet and the greater of 75 percent of building live load or 50 percent of building design positive wind pressure difference.
 - 2) Negative: 50 percent of design wind uplift pressure difference.

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- 2. Water Penetration: No water penetration when tested in accordance to ASTM E1646 at the following test pressures:
 - a. Test Pressure:
 - 1) Roof slope greater than 30 degrees: 20 percent of positive design pressure, but not less than 6.24 lbf/square feet and not more than 12 lbf/square feet.
 - b. Preload Test-Pressure Difference:
 - 1) Positive: Greater than or equal to 15 lbf/square feet and the greater of 75 percent of building live load or 50 percent of building design positive wind pressure difference.
 - 2) Negative: 50 percent of design wind uplift pressure difference.
- 3. Structural Performance:
 - a. Provide metal roof panel assemblies capable of withstanding the design loads specified on the Structural Drawings.
 - b. Deflection Limits: An engineered roof panel assemblies to withstand design loads with vertical deflections no greater than 1/180 of span.
- 4. Thermal Movement: Provide metal roof panel assemblies that allow for thermal movement resulting from temperature change of 120 degrees F (67 degrees C), ambient and 180 degrees F (100 degrees C), material surface.

1.03 SUBMITTALS

- A. Action Submittals:
 - Shop Drawings: Drawings showing thickness and dimensions of parts and accessories, fastening and anchoring methods, details, and locations of seams, joints, and other provisions for thermal movement. Distinguish between factory-assembled and field-assembled work. Include drawings at not less than 1/4-inch to 1-foot scale and details at not less than 3-inch to 1-foot scale.
 - 2. Samples: 12-inch square Samples of specified metal. Samples will be reviewed for color and texture only.
- B. Informational Submittals:
 - 1. Manufacturer's printed installation instructions.
 - 2. A letter from roofing manufacturer stating roofer is approved by manufacturer to apply the roof.
 - 3. Preinstallation Conference meeting minutes.
 - 4. Special guarantee.

5. Certificate of Proper Installation test results or calculations, that assure item's and its anchorage's design criteria meets requirements for loads provided in Section 01 61 00, Common Product Requirements.

1.04 QUALITY ASSURANCE

- A. Applicator's Qualifications: Approved and trained by materials manufacturer.
- B. Preinstallation Conference:
 - 1. Before starting metal roof installation, conduct a conference with Design-Builder, roofing applicator, roofing system materials manufacturer, Subcontractors likely to be on roof, and installers whose work affects metal roof installation.
 - 2. Items to be reviewed and discussed include, but are not limited to, the following items:
 - a. Examine roof deck or substrate conditions for compliance with requirements for flatness and tolerance of structural members.
 - b. Review structural loading limitations of roof deck or purlins and rafters during roofing installation.
 - c. Review flashing details, roof drainage, roof insulation, roof penetrations, roof-mounted mechanical equipment, and other construction and conditions that might affect metal roof panel installation.
 - d. Review governing regulations and requirements for insurance, certificates, and testing and inspecting as applicable.
 - e. Review temporary protection requirements for metal roof panels during and after installation.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver components and metal roof panels so as not to be damaged or deformed. Package for protection during transportation and handling.
- B. Storage and Handling:
 - 1. Protect against damage and discoloration.
 - 2. Handle panels with nonmarring slings.
 - 3. Do not bend panels.
 - 4. Store panels aboveground on pallets or platforms, with one end elevated for drainage.
 - 5. Protect strippable protective covering from exposure to sunlight except as necessary for metal roof installation.
 - 6. Stack panels to prevent twisting, bending, or abrasion, and to provide ventilation.

- 7. Protect panels against standing water and condensation between adjacent surfaces.
- 8. If panels become wet, immediately separate sheets, wipe dry with clean cloth, and separate sheets for air-drying.
- 9. During storage prevent contact with materials that may cause discoloration or staining.

1.06 COORDINATION

- A. Coordinate installation of roof curbs, equipment support, and other roof accessories as specified in Section 07 70 01, Roof Specialties and Accessories.
- B. Coordinate metal roof installation with flashing and trim as specified in Section 07 62 00, Sheet Metal Flashing and Trim.
- C. Coordinate work with construction of decks and other adjoining work.

PART 2 PRODUCTS

- 2.01 ROOFING PANELS
 - A. Material: Steel, galvanized, ASTM A653/A653M, coating designation G90, or ASTM A792/A792M coated steel, 24-gauge minimum metal thickness.
 - B. Surface: Smooth, flat finish.
 - C. Finish:
 - 1. Polyvinylidene Fluoride: Kynar 500.
 - D. Color: As selected by Owner from manufacturer's standard color range.
 - E. Standing Seam, Seamed-Joint:
 - 1. Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically space between vertical ribs designed for sequential field installation by mechanically attaching panels to supports using concealed clips located under one side of panel and engaging opposite edge of adjacent panels and mechanically seaming panels together.
 - 2. Panel Coverage: 16 inches.
 - 3. Panel Height: 2 inches.

- 4. Manufacturers and Products:
 - a. AEP-SPAN; SpanSeam.
 - b. Berridge; Double-Lock Zee-Lock Panel.
 - c. CENTRIA Architectural Systems; SDP200.
 - d. Englert, Inc.; S2500.

2.02 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be fieldassembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fastening in side laps; included accessories for a complete, weathertight installation.
- B. Flush Profile: Solid panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges with flush joint between panels.
 - 1. Material: Aluminum-zinc alloy coated sheet 24 -gauge or Aluminum sheet 0.032-inch minimum metal thickness.
 - 2. Finish: Fluoropolymer.
 - 3. Color: As selected from manufacturer's standard color range.
 - 4. Panel Coverage: 12 inches.
 - 5. Panel Height: 1-inch.
 - 6. Manufacturers and Products:
 - a. AEP Span; Flush Panel.
 - b. PAC-CLAD; Flush Solid.

2.03 ACCESSORIES

- Underlayment: Cold applied, self-adhering, polyethylene-faced sheet, consisting of slip-resisting polyethylene-film reinforcing top surface laminated to SBS-modified asphalt adhesive with release-paper backing, 40-mil minimum thickness meeting ASTM D1970.
- B. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, endwelded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal by means of plastic caps or factory-applied coating.
 - 1. Fasteners for Roof Panels: Self-drilling or self-tapping Type 410 stainless steel or zinc-alloy steel hex washer head with EPDM or PVC washer.
 - 2. Fasteners for Flashing and Trim: Self-drilling screws with hex washer head or blind fastener rivets of high-strength aluminum or stainless steel.

- C. Holddown Clips: System manufacturer's ASTM A792/A792M standard shape steel.
- D. Closures: Manufacturer's standard neoprene blocks shaped to fit roof metal profile.
- E. Sealant:
 - 1. Joint Sealant: Type 5 as specified in Section 07 92 00, Joint Sealants.
 - 2. Silicone Sealant: Type 1 as specified in Section 07 92 00, Joint Sealants.
 - 3. Tape Sealant: Type 13 as specified in Section 07 92 00, Joint Sealants.
 - 4. Butyl Sealant: Butyl-rubber based, solvent-release sealant per ASTM C1311.
- F. Isolation Paint: ASTM D1187, asphalt.

2.04 FABRICATION

- A. Fabricate and finish metal roof panels and accessories at factory to the greatest extent possible.
- B. Provide panel profile, including major ribs and any intermediate stiffening ribs for full panel length.
- C. Panel Length: Roof panels shall be full length from eave to ridge, unless otherwise indicated or limited by shipping limitations.
- D. Where indicated, fabricate metal roof panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact.
- E. Form and fabricate sheets, battens, strips, cleats, valleys, ridges, edge treatments, integral flashings, gutters, downspouts, and other components of specified metal roofing panels to profiles, patterns, and drainage arrangement shown, and as required for permanent leakproof construction, and as recommended by SMACNA's "Architectural Sheet Metal Manual."
- F. Provide for thermal expansion and contraction of Work.
- G. Conceal fasteners and methods of expansion where possible. Do not use exposed fasteners on faces of accessories where exposed to view.

H. Finishes:

- 1. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- 2. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half the range of approved sample. Noticeable variations within same piece are not acceptable. Variations in other component appearances are acceptable if within range of approved samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and conditions for compliance with alignment tolerances required by metal roof panel manufacturer.
- B. Prior to beginning installation, examine rough-in location for items penetrating metal roof panels and coordinate with seam locations.

3.02 PREPARATION

- A. Deck: Firm, dry, free of foreign materials, and smooth. Report immediately to Design -Builder, cracks, breaks, holes, or other unusual irregularities in surface.
- B. Layout Pattern:
 - 1. Lay out to place seams equidistant from corners and aligned with seams on other side of hip or ridge.
 - 2. Coordinate Work of this section with flashing, trim, and other construction to provide a permanently leakproof, secure, and noncorroding installation.

3.03 INSTALLATION

- A. General:
 - 1. Apply roofing only in dry weather and where weather conditions permit.
 - 2. Install in accordance with manufacturer's written instructions and warranty requirements.
 - 3. Comply with recommendations of the SMACNA "Architectural Sheet Metal Manual."
 - 4. Install metal roofing and soffit system consisting of nonstructural sheet metal panels held to substrate with concealed fasteners.

- 5. Conceal expansion joint provisions wherever possible in exposed Work; locate so as to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- 6. Closures and Trim:
 - a. Provide ridges, hips, valleys, eaves, rakes, fascia, coping, gutters, downspouts, and other exposed trim and flashing for a weather-tight roofing and fascia system.
 - b. Provide metal closures at rake edges and each side of ridge and hip caps.
 - c. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of openings. Fasten with self-tapping screws.
- 7. Install ridge and hip caps as the metal roof panel work proceeds.
- 8. Dissimilar Metals:
 - a. Separate from each other where electrolysis might occur.
 - b. Separate metal panels where contact with corrosive substrates may occur.
 - c. Separation is satisfactorily accomplished by coating metals with isolation Paint.
 - d. Comply with various metals producers' recommendations for other forms of protection against contamination from corrosive materials or agents.
- 9. Lap metal flashing over metal roof panels to allow moisture to run over and off the material.
- 10. Cutting and Fitting: Neat, square, and true. Saw cut panels, deburr, and use touchup paint immediately as recommended by roofing panel manufacturer. Torch cutting is prohibited.
- 11. Gutters, Downspouts, and Flashings:
 - a. Straight, weather-tight, exposed surfaces free of dents, scratches, abrasions, stains, and other visible defects.
 - b. Extend gutter lining under metal roofing 6 inches minimum and terminate in 3/4-inch folded edge secured by cleats.
- 12. Valleys:
 - a. Form of sheets not exceeding 10 feet in length. Lap joints 6 inches in direction of drainage.
 - b. Extend valley sheet minimum 6 inches under roofing sheets.
 - c. At valley, double fold valley and roofing sheets, and secure with cleats spaced 18 inches on center.
- B. Underlayment:
 - 1. Install underlayment and slip sheet on roof sheathing, unless otherwise recommended by metal roof panel manufacturer.
 - 2. Apply underlayment single-ply lapped shingle fashion, 3 inches at head and 6 inches at sides.

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- 3. Cover with loose-laid slip sheet similarly lapped and with joints staggered.
- 4. Install no more than can be covered by metal roofing or other approved protection, in same day.
- 5. Use adhesive for temporary anchorage, where possible, to minimize use of mechanical fasteners under metal roof panels.
- C. Standing-Seam Metal Roof:
 - 1. Install as recommended by metal roof panel manufacturer's installation instructions and recommendations.
 - 2. Begin at eaves. Rigidly fasten eave end of metal roof panels and allow ridge end free movement for thermal expansion and contraction.
 - 3. Install clips in panel side joints at location, spacing, and with fasteners as recommended by manufacturer for type of substrate and wind loading specified.
- D. Metal Soffit Panels: Provide full width of soffit. Install perpendicular to support framing. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of openings and joints.

3.04 CLEANING AND PROTECTION

- A. Cleaning:
 - 1. At the end of each day sweep metal clean of foreign materials, especially metal particles and scrap.
 - 2. Peel off strippable film.
 - 3. Where needed, clean metals in conformance with metals industry recommendations or use Basic-H cleaner, Shaklee Corp., Pleasanton, CA.
- B. Protection:
 - 1. Protect material from exposure to chlorides, hydrochloric-based and muriatic acids. If contaminated, wash affected areas immediately with 5 percent soda and water solution and rinse with clear water.
 - 2. Avoid walking on roof after completion.
- C. Final Cleanup:
 - 1. Remove debris, metal clips, nails, and other materials that could prevent adequate drainage or produce corrosion products through electrolysis.
 - 2. Repair and touch up damage.
 - 3. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair.

END OF SECTION

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SECTION 07 62 00 SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C920, Standard Specification for Elastomeric Joint Sealants.
 - c. C1311, Standard Specification for Solvent Release Sealants.
 - d. D1187/D1187M, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - e. D4586/D4586M, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
 - 2. Federal Specifications (FS): QQ-L-201F(2), Lead Sheet.
 - 3. FM Global (FM): Loss Prevention Data Sheet 1-49, Perimeter Flashing.
 - 4. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): 1793, Architectural Sheet Metal Manual.

1.02 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Thermal Movements:
 - 1. Provide sheet metal flashing and trim that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures for preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.
 - a. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.
 - 2. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.
 - 3. Base engineering calculation on surface temperatures of materials as a result of both solar heat gain and nighttime-sky heat loss.
- C. Water Infiltration: Provide sheet metal flashing and trim that does not allow water infiltration to building interior.

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ROGER SCOTT POOL FACILITIES

1.03 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA 1793. Conform to dimensions and profiles shown, unless more stringent requirements are indicated.

1.04 DESIGN REQUIREMENTS

A. Wind Loads: Provide sheet metal and trim assemblies and their anchorage to the building structure that are capable of withstanding the positive and negative wind load pressures shown on the Components and Cladding Wind Surface Pressures table on the Structural Drawings.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Show joints, types and location of fasteners, and special shapes.
 - b. Catalog data for stock manufactured items.
 - 2. Samples: Color Samples for items to be factory finished.
- B. Informational Submittals: Third party testing documentation or manufacturer's literature qualifying sheet metal and trim assemblies and their anchorage to the building structure as meeting the required developed wind pressures for Project as shown on the Components and Cladding Wind Surface Pressures table on the Structural Drawings.

1.06 DELIVERY, HANDLING, AND STORAGE

- A. Inspect for damage, dampness, and wet storage stains upon delivery to Site.
- B. Remove and replace damaged or permanently stained materials that cannot be restored to like-new condition.
- C. Carefully handle to avoid damage to surfaces, edges, and ends.
- D. Do not open packages until ready for use.
- E. Store materials in dry, weathertight, ventilated areas until immediately before installation.

1.07 SPECIAL GUARANTEE

- A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction or, at the option of the Owner, removal and replacement of factory-applied fluoropolymer coating, finish, and accessories found defective during a period of 20 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.
- B. Conditions:
 - 1. Finish: No cracking, blistering, flaking, chipping, checking, chalking, peeling, or fading.
 - 2. All Components: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

- 2.01 METAL
 - A. Prefinished Aluminum Sheet: ASTM B209, alloy and temper as required for application and finish: 0.032-inch thick; mill finish; shop precoated with fluoropolymer coating (Kynar polyvinylidene fluoride resin) coating; color as selected from manufacturer's standard color range.
- 2.02 GUTTERS AND DOWNSPOUTS
 - A. Fabricated from prefinished aluminum sheet specified in this section.

2.03 ANCILLARY MATERIALS

- A. Sealing Tape: Polyisobutylene sealing tape specifically manufactured for setting flanges on bituminous roofing.
- B. Isolation Paint: ASTM D1187/D1187M, asphalt.
- C. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil thick minimum polyester.
- D. Plastic Roof Cement: ASTM D4586/D4586M, Type II.
- E. Elastomeric Sealant: ASTM C920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

- F. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- G. Fasteners:
 - 1. Aluminum Work: Stainless steel or aluminum.
 - 2. Stainless Steelwork: Stainless steel.

2.04 FABRICATION OF FLASHING

- A. Field measure prior to fabrication.
- B. Fabricate in accordance with SMACNA 1793 that applies to design, dimensions, metal, and other characteristics of item indicated.
- C. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- D. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
- E. Seams:
 - 1. Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- F. Reinforcements and Supports: Provide same material as flashing, unless other material is shown. Steel, where shown or required, shall be galvanized or stainless.
- G. Rigid Joints and Seams: Make mechanically strong. Seal aluminum joints with sealant.
- H. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- I. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1-inch deep, filled with butyl sealant concealed within joints.

- J. Fabricate sheet metal in 10-foot maximum lengths, unless otherwise indicated.
- K. Provide watertight closures at exposed ends of counterflashing.
- L. Fabricate corners in one-piece with legs extending 30 inches each way to field joint. Lap, rivet, or solder corner seams watertight. Apply sealant if necessary.
- M. Solvent clean sheet metal. Surfaces to be in contact with roofing or otherwise concealed shall be coated with isolation paint.
- N. Pipe Penetrations through Roof: Flash with lead.
- O. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- P. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
 - 1. Thickness: As recommended by SMACNA 1793 and FM Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

2.05 FABRICATION OF GUTTERS AND DOWNSPOUTS

- A. Form downspouts in maximum lengths as practicable to sizes and shapes indicated on the Drawings:
 - 1. Telescope end joints 1-1/2 inches and lock longitudinal joints of downspouts.
 - 2. Provide elbows at bottom where downspouts empty onto splash blocks.
 - 3. Fit downspouts into cast iron boots or drainpipes where indicated on the Drawings; neatly caulk or cement joints.
- B. Form scuppers and conductor heads to shapes and sizes indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set and cant strips and reglets in place.
- B. Verify nailing strips and blocking are properly located.
- C. Verify membrane termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

- A. Flashing:
 - 1. General:
 - a. Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA 1793.
 - b. Provide concealed fasteners where possible, set units true to line, and level as indicated.
 - c. Install work with laps, joints, and seams that will be permanently watertight.
 - 2. Isolate metal from wood and concrete and from dissimilar metal with isolation tape or two coats of isolation paint.
 - 3. Use only stainless steel fasteners to connect isolated dissimilar metals.
 - 4. Joints: 10-foot maximum spacing and 2-1/2 feet from corners, butted with 3/16-inch space centered over matching 8-inch long backing plate with sealing tape in laps.
 - 5. Set flanges of flashings and roof accessories on continuous sealing tape or in plastic roof cement on top of envelope ply of roofing. Nail flanges through sealing tape and at 3-inch maximum spacing. Touch up isolation paint on flanges.
 - 6. Joints, Fastenings, Reinforcements, and Supports: Sized and located as required to preclude distortion or displacement as a result of thermal expansion and contraction.
 - 7. Provide continuous holddown clips at counterflashing and gravel stops.
 - 8. Conceal fastenings wherever possible.
 - 9. Set flashing and sheet metal to straight, true lines with exposed faces aligned in proper plane without bulges or waves.
- B. Downspouts, Scuppers, and Conductor Heads: Anchor downspouts to wall with straps of same material as downspouts. Install scuppers, and conductor heads as indicated on the Drawings.

3.03 FINISH

A. Exposed Surfaces of Flashing and Sheet Metalwork: Free of dents, scratches, abrasions, or other visible defects, and clean and ready for painting where applicable.

3.04 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.

SHEET METAL FLASHING AND TRIM 07 62 00 - 6

- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 70 01 ROOF SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Movement and Control Association International (AMCA).
 - 2. American Architectural Manufacturers Association (AAMA).
 - 3. ASTM International (ASTM):
 - a. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - b. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
 - 4. FM (Factory Mutual) Global (FM).
 - 5. UL.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings of each item specified showing materials, details, flashing, anchorage, and relation to adjacent structure.
 - 2. Catalog cuts of each item specified item.
- B. Informational Submittals: Manufacturer's Certificate of Compliance or alternately, test results or calculations that assure items and its anchorage's design criteria meets requirements for loads provided in Section 01 61 00, Common Product Requirements.

1.03 SEQUENCING AND SCHEDULING

A. Coordination: Schedule and coordinate work of this section with work of Section 07 41 13, Metal Roofing Panels and Section 07 62 00, Sheet Metal Flashing and Trim.

PART 2 PRODUCTS

- 2.01 VENT PIPE FLASHING
 - A. Prefabricated flashing with elastomeric collar and 0.032-inch aluminum base, sized to fit vent pipe.
 - B. Manufacturer and Product: Oatey; No-Caulk Roof Flashing.

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2.02 ANCILLARY MATERIALS

- A. Isolation Paint: ASTM D1187, asphalt.
- B. Coat aluminum surfaces in contact with concrete or dissimilar metals.
- C. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil-thick minimum polyester.
- D. Fasteners: Stainless steel of type required.

PART 3 EXECUTION

3.01 PREPARATION

- A. Examine surfaces and structures to receive the Work of this section.
- B. Take measurements at Site and fabricate work to suit. No changes shall be made in supporting structure to accommodate this Work.

3.02 INSTALLATION

- A. General:
 - 1. Install roof specialties and accessories as detailed in approved Shop Drawings and in conformance with manufacturer's instructions, recommendations, and standards.
 - 2. Use appropriate vent pipe flashing where pipes penetrate roofing.
 - 3. Use appropriate flashing where ductwork connects to existing roof curbs.
 - 4. Where support curbs are installed on existing roofing provide appropriate flashing in accordance with the existing roofing system manufacturer for a weathertight installation.
 - 5. Factory Finished Units: Place color variations in pieces so no extremes are next to each other.
 - 6. Make Work weathertight and free of expansion and contraction noise.
 - 7. Maintain separation between aluminum surfaces and concrete or dissimilar metals with isolation paint.

END OF SECTION

SECTION 07 92 00 JOINT SEALANTS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. C661, Standard Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer.
 - b. C834, Standard Specification for Latex Sealants.
 - c. C920, Standard Specification for Elastomeric Joint Sealants.
 - d. C1193, Standard Guide for Use of Joint Sealants.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Surface preparation instructions. Indicate where each product is proposed to be used.
 - 2. Samples: Material proposed for use showing color range available.
- B. Informational Submittals:
 - 1. Installation instructions.
 - 2. Documentation showing applicator qualifications.
 - 3. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 4. Special guarantee.

1.03 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum of 5 years' experience installing sealants in projects of similar scope.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 degrees F and 80 degrees F (4 degrees C and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

1.05 SPECIAL GUARANTEE

- A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction or, at the option of the Owner, removal and replacement of Work specified in this section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.
- B. Conditions: No adhesive or cohesive failure of sealant.
- C. Sealed Joints: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

2.01 SEALANT MATERIALS

- A. Characteristics:
 - 1. Uniform, homogeneous.
 - 2. Free from lumps, skins, and coarse particles when mixed.
 - 3. Nonstaining, nonbleeding.
 - 4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
 - 5. Immersible may be substituted for nonimmersible.
- B. Color: Unless specifically noted, match color of the principal wall material adjoining area of application.
- C. Type 1—Silicone, Nonsag, Nonimmersible:
 - 1. Silicone base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
 - 2. Capable of withstanding movement up to 50 percent of joint width.
 - 3. Manufacturers and Products:
 - a. Dow Corning Corp.; No. 790.
 - b. General Electric; Silpruf.
 - c. BASF; Sonneborn, Omniseal-50.
- D. Type 2—Multipart Polyurethane, Self-leveling, Immersible:
 - 1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade P, Class 25.
 - 2. Capable of being continuously immersed in water.

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- 3. Manufacturers and Products:
 - a. BASF; Sonneborn, SL-2.
 - b. Pecora Corp.; Urexspan NR-200.
 - c. Tremco; THC-900/901.
 - d. Sika Chemical Corp.; Sikaflex 2c SL.
- E. Type 3—Multipart Polyurethane, Nonsag, Immersible:
 - 1. Polyurethane base, multicomponent, chemical curing; ASTM C920, Type M, Grade NS, Class 25.
 - 2. Capable of being continuously immersed in water.
 - 3. Manufacturers and Products:
 - a. Pecora; DynaTrol II.
 - b. Tremco; Dymeric 240.
 - c. BASF; Sonneborn NP-2.
 - d. Sika Chemical Corp.; Sikaflex 2c NS.
- F. Type 5—One-part Polyurethane, Immersible:
 - 1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
 - 2. Capable of being continuously immersed in water.
 - 3. Manufacturers and Products for Nonsag:
 - a. Sika Chemical Corp.; Sikaflex-1a.
 - b. Tremco; Vulkem 116.
 - 4. Manufacturers and Products for Self-leveling:
 - a. BASF; Sonneborn, SL-1.
 - b. Tremco; Vulkem 45.
 - c. Sika Chemical Corp.; Sikaflex 1c SL.
- G. Type 8—One-Part Polysulfide, Nonsag, Nonimmersible:
 - 1. Polysulfide base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 12 1/2.
 - 2. Capable of withstanding movement up to 20 percent of joint width.
 - 3. Manufacturer and Product: W. R. Meadows; Deck-O-Seal, one-part.
- H. Type 10—Sanitary Sealant:
 - 1. Silicone sealant similar to Type 1, above, formulated to resist mold growth and repeated exposure to high humidity while retaining adhesion, flexibility, and color.
 - 2. Manufacturers and Products:
 - a. Dow Corning; 786.
 - b. General Electric; Sanitary Sealant SCS1700.

- I. Type 12—One-Part Polycarbonate, Immersible:
 - 1. Polycarbonate base, single-component, moisture curing; ASTM C920, Type S, Grade NS, Class 25.
 - 2. Capable of being continuously immersed in water.
 - 3. Manufacturer and Product: Pro-Seal Products, Inc.; Pro-Seal 34.
- J. Type 13—Tape Sealant:
 - 1. Compressible polyurethane foam impregnated with polybutylene or polymer-modified asphalt.
 - 2. Color: Black.
 - 3. Size: 3/4-inch wide by length required by expanded thickness recommended by manufacturer for particular application.
 - 4. Manufacturers and Products:
 - a. Emseal Joint Systems, Ltd.; AST—High Acrylic.
 - b. Dayton Superior; Polytite Standard.
 - c. PARR Technologies; PARR Sealant EP-7212-T.

2.02 BACKUP MATERIAL

- A. Nongassing, extruded, closed-cell round polyurethane foam or polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.
- B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16-inch wide.
- C. Manufacturers and Products:
 - 1. Sonneborn; Sonolastic Closed-cell Backing Rod.
 - 2. Tremco; Closed-cell Backing Rod.
 - 3. Pecora Corporation; Green Rod.

2.03 ANCILLARY MATERIALS

- A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Primer: Nonstaining type recommended by sealant manufacturer to suit application.

2.04 PREFORMED SEALS

- A. Preformed Compressible Joint Seals:
 - 1. Widths Up to 5 inches:
 - a. BASF, Watson Bowman Acme Div.; Wabo Weatherseal II.
 - b. Emseal Joint Systems Limited; Colorseal.
 - c. LymTal International; Iso-flex Joint System.
 - 2. Other Widths: Series or model recommended by seal manufacturer.

PART 3 EXECUTION

3.01 GENERAL

- A. Use of more than one material for the same joint is not allowed unless approved by sealant manufacturer.
- B. Install joint sealants in accordance with ASTM C1193.
- C. Horizontal and Sloping Joints up to 1 Percent Maximum Slope: Use selfleveling (Grade P) joint sealant.
- D. Steeper Sloped Joints, Vertical Joints, and Overhead Joints: Use nonsag (Grade NS) joint sealant.
- E. Use joint sealant as required for the applicable application and as follows:

Joint Size	Sealant Type
Less than 1"	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, or 12
Less than 2"	1, 2, 3, 4, or 7
Over 2"	Follow manufacturer's recommendation

3.02 PREPARATION

- A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.
- B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.
 - 1. Mask adjacent surfaces where necessary to maintain neat edge.
 - 2. Starting of work will be construed as acceptance of subsurfaces.
 - 3. Apply primer to dry surfaces as recommended by sealant manufacturer.
- C. Verify joint shaping materials and release tapes are compatible with sealant.

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- D. Examine joint dimensions and size materials to achieve required width/depth ratios.
- E. Follow manufacturer's instructions for mixing multi-component products.

3.03 INSTALLATION

- A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.
 - 1. Install backup material as recommended by sealant manufacturer.
 - 2. Where possible, provide full length sections without splices; minimize number of splices.
 - 3. Tape sealant may be used as joint filler if approved by sealant manufacturer.
- B. Use bond breaker where recommended by sealant manufacturer.
- C. Seal joints around window, door and louver frames, expansion joints, control joints, and elsewhere as indicated.
- D. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.
- E. Joints: Tool slightly concave after sealant is installed.
 - 1. When tooling white or light color sealant, use a water wet tool.
 - 2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.
- F. Tape Sealant: Compress to 50 percent of expanded thickness and install in accordance with manufacturer's instructions.

3.04 PREFORMED SEALS

- A. Prepare joint surfaces clean and dry, free from oil, rust, laitance, and other foreign material.
- B. Construct joints straight and parallel to each other and at proper width and depth.
- C. Apply joint sealant manufacturer's approved primer and adhesive in accordance with manufacturer's instructions.
- D. Install seal in accordance with manufacturer's instructions.

3.05 CLEANING

- A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.
- B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

3.06 JOINT SEALANT SCHEDULE

A. This schedule lists the sealant types acceptable for each joint location. Use as few different sealant types as possible to meet the requirements of Project.

Joint Locations	Sealant Type(s)			
Expansion/Contraction and Control Joints At:				
Concrete Floor Slabs (except for water-holding Structures)	2, 5			
Slabs Subject to Vehicle and Pedestrian Traffic	2, 5			
Ceramic Tile Floors	1, 2, 5, 10			
Ceramic Tile Walls	1, 3, 5, 10			
Material Joints At:				
Metal Door, Window, and Louver Frames (Exterior)	1, 5, 6, 8, 12			
Metal Door, Window, and Louver Frames (Interior)	1, 5, 8,			
Wall Penetrations (Exterior)	1, 5, 8, 12			
Wall Penetrations (Interior)	1, 5, 8			
Floor Penetrations	5			
Ceiling Penetrations	1, 3, 5,			
Roof Penetrations	5			
Sheet Metal Flashings	5, 13			
Sheet Metal Roofing and Siding	5, 13			
Precast Concrete Wall Panels	1, 3, 5, 12, 13			
Other Joints:				
Threshold Sealant Bed	5			
Between Counter Tops and Backsplashes	10			

ROGER SCOTT POOL FACILITIES

Joint Locations	Sealant Type(s)
Around Plumbing Fixtures	10
Openings Around Pipes, Conduits, and Ducts Through Fire-Rated Construction	11
Concrete Form Snap-Tie Holes	1, 5

END OF SECTION

SECTION 08 11 16 ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. The Aluminum Association, Incorporated (AA): Designation System for Aluminum Finishes.
 - 2. American Architectural Manufacturers Association (AAMA): 605.2, Voluntary Specification for High Performance Organic Coatings on Architectural Extrusions and Panels.
 - 3. ASTM International (ASTM): B209/B209M, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Applicable information for each type of door and frame, including:
 - a. Frame conditions and complete anchorage details, supplemented by suitable schedules covering doors and frames.
 - b. Glass and louver opening sizes and locations in doors.
 - c. Connections of door frames to structural steel framing concealed in frames.
 - d. Submitted third party testing documentation or signed and sealed engineering of door assemblies to meet required developed positive and negative pressures.
 - e. Location and field splice joints for frames too large to ship in one piece; indicate complete instructions for making field splices.
 - f. Joints required to accommodate expansion joint movement.
 - g. Relate to door numbers used in the Contract Drawings.
 - h. Include all hardware provided and/or installed by door manufacturer.
- B. Informational Submittals: Certificate of Compliance or alternately, test results or calculations, that assure items and its anchorages design criteria meets requirements for loads provided in Section 01 61 00, Common Product Requirements.

ROGER SCOTT POOL FACILITIES

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Properly identify each item with number used in Contract Drawings.
- B. Store doors upright, in protected dry area, at least 1-inch off ground or floor and at least 1/4-inch between individual pieces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers product must be able to meet developed positive and negative door assembly pressures for each exterior door assembly either by testing or engineering by a qualified Florida licensed engineer.
- B. Manufacturers:
 - 1. Cline Aluminum Doors, Inc., Bradenton, FL; Series 100BE.
 - 2. United States Metals and Manufacturing Corp., South Bend, IN; D9 Series.

2.02 MATERIALS

- A. Aluminum Frames:
 - 1. Extruded from 6063-T5 aluminum alloy meeting ASTM B209.
 - 2. Minimum Wall Thickness: 0.125-inch.
 - 3. Mechanically fastened corners.
 - 4. Reinforcements: 6061-T6 aluminum of 1/4-inch minimum thickness.
 - 5. Size and Profile: 5 inches by 1-3/4 inches, with open or closed back and applied stop with integral weatherstripping.
 - 6. Concealed fasteners or welding are preferred to through-the-face fasteners.
- B. Flush Aluminum Doors: 6063-T5 extrusions and 5005-H14, smooth face sheets.
 - 1. Minimum component thicknesses as follows:
 - a. Base Sheets: 0.090-inch.
 - b. Beveled Lock Rail Edge: 0.125-inch.
 - c. Hinge Rail Edge: 0.190-inch.
 - d. Internal Grid Sections: 0.080-inch.

2.03 MISCELLANEOUS ITEMS

- A. Filler or Transom Panels: Furnish of same construction and finish as door.
- B. Furnish manufacturer's standard core filler, anchors, fasteners, and other ancillary items.
- C. Glazing: Accommodate glass of type and thickness indicated and as specified in Section 08 80 00, Glazing.

2.04 FACTORY FINISHING REQUIREMENTS

A. Aluminum Door and Frame Finish: Color as scheduled.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Frames:
 - 1. Installation: Maintain scheduled dimensions, hold head level, and maintain jambs plumb and square.
 - 2. Secure anchorages and connections to adjacent construction.
 - 3. Wherever possible, leave frame spreader bars intact until frames are set perfectly square and plumb and anchors are securely attached.
 - 4. Install following manufacturer's recommendations.

B. Doors:

- 1. Follow manufacturer's recommendations.
- 2. Hardware: In accordance with manufacturer's templates and instructions.
 - a. Adjust operable parts for correct function.
 - b. Remove hardware, with exception of prime coated items, tag, box, and reinstall after finish paint work is completed.

3.02 PROTECTION

A. Protect installed doors and frames against damage from other construction Work.

3.03 SCHEDULES

A. For tabulation of door and frame characteristics, such as size, type, detail, and finish hardware requirements, see Door and Hardware Schedule on the Drawings.

END OF SECTION

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SECTION 08 14 00 WOOD DOORS AND FRAMES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. American National Standards Institute (ANSI):
 - a. A250.8, Recommended Specifications for Standard Steel Doors and Frames.
 - b. A250.11, Recommended Erection Instructions for Steel Frames.
 - c. A117.1 Specifications for making buildings and facilities usable by physically handicapped people.
 - 2. ASTM International (ASTM):
 - a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - b. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 3. Window and Door Manufacturers Association (WDMA):
 - a. Industry Standard I.S.1-A, Architectural Wood Flush Doors.
 - b. Industry Standard I.S.6-A, Architectural Wood Stile and Rail Doors.
 - 4. UL: Building Materials Directory.
 - 5. Warnock Hersey Certification Listings.
 - 6. DHI-Door and Hardware Institute.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Prepare specifically for this Project, indicating location and size of each door, veneer species, type and characteristics, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, factory finishing, if any, glass and glazing, and other pertinent data.
 - a. For factory-premachined doors, also indicate dimensions and locations of cutouts for finish hardware and cutouts for light and louver openings.
 - b. Use same reference numbers for door openings and details as Contract Drawings.

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- 2. Samples-Manufacturers samples of the following door components:
 - a. Door veneer samples.
 - b. Aluminum specialty frame components.
- B. Informational Submittals:
 - 1. Manufacturer's instructions for care and handling.
 - 2. Maintenance instructions for sealing door edges.
 - 3. Certificate of Compliance or alternately, test results or calculations, to document that item and anchorage design criteria meets for loads provided in Section 01 61 00, Common Product Requirements.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Delivery:
 - 1. Deliver doors to jobsite after moisture-producing construction operations are complete and building has reached average prevailing relative humidity of locality.
 - 2. Deliver doors clearly marked with manufacturer's name, brand name, size, thickness, and identifying symbol.
 - 3. Seal edges of doors before delivery to jobsite.
- B. Storage:
 - 1. Store doors in area where there will be no variation greater than plus or minus 5 percent in heat and humidity.
 - 2. Stack flat on wood blocking, laid 12 inches from ends and across center.
 - 3. Under bottom door and over top of stack provide plywood or corrugated cardboard to protect door surface.
- C. Handling:
 - 1. Handle with clean gloves.
 - 2. Do not drag doors across one another or across other surfaces.

1.04 SPECIAL GUARANTEE

- A. Provide as special guarantee, manufacturer's extended guarantee or warranty, with Owner named in writing as beneficiary. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of flush doors specified in this Specification section found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.
- B. Conditions: Free of warp more than 1/4 inch in plane of door and no delamination of veneers.

PART 2 PRODUCTS

2.01 FLUSH WOOD DOORS

- A. Solid Core Wood Doors:
 - 1. Premium grade, five-ply, heavy duty.
 - 2. Staved wood core or particleboard core.
 - 3. Type I glue.
 - 4. Thickness: 1-3/4 inches.
 - 5. Faces: Plastic laminate finished faces High pressure decorative laminate.
 - 6. Doors to be factory finished stain with satin gloss Enviroclad UV finish "Or-equal."
 - 7. Manufacturer: Masonite Architectural "Or-equal," approved.
- B. Glass Stops:
 - 1. Nonfire-Rated Doors: Hardwood to match door face.
 - 2. Fire-Rated Doors: Metal with veneer cover to match door face.

2.02 FABRICATION OF FLUSH WOOD DOORS

- A. Manufacture in accordance with WDMA Industry Standard I.S.1-A.
- B. Moldings: Factory install in configuration indicated.
- C. Prefitting and Premachining of Doors: At Contractor's option.
 - 1. Within tolerances specified herein.
 - 2. Coordinate with Finish Hardware Schedule and door frames.

ROGER SCOTT POOL FACILITIES

2.03 STEEL DOOR FRAMES

- A. Wood doors are to be installed in painted steel frames.
- B. Frames are to be hot-dipped zinc coated steel that complies with ASTM A924, A60, 16 gauge.
- C. Zinc-coated steel conforming to ASTM A 653/A 653M, CS, Type B.
- D. All frames are to have back welded face seams only at the frame corner or intersections. Grind and dress smooth the weld area. Apply a factory baked-on zinc rich primer over the grind area and finish with factory applied pre-finished paint coating.

2.04 SOUND-RESISTANT DOORS

A. Solid core doors with minimum Sound Transmission Class (STC) of 40 decibels or better when tested in accordance with ASTM E90.

PART 3 EXECUTION

- 3.01 INSPECTION
 - A. Verify door frames are of type required for door and are installed as required for proper installation of doors.
 - B. Do not install doors in frames that would hinder operation of doors.

3.02 INSTALLATION

- A. Fit doors for width by planing; for height by sawing.
- B. Tolerances:
 - 1. From Bottom to Floor Covering: 1/2-inch.
 - 2. From Bottom to Top of Threshold: 1/4-inch.
 - 3. Maximum From Top: 1/8-inch.
 - 4. Bevel Lock and Hinge Edges: 1/8-inch in 2 inches.
 - 5. Clearance of Meeting Stiles of Pairs of Doors: 1/8-inch.
- C. Seal Job Site cut surfaces with two coats of door manufacturer's standard sealer before final hanging of doors.

3.03 ADJUST AND CLEAN

A. Replace or rehang doors that are hinge-bound and do not swing or operate freely.

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- B. Replace prefinished doors damaged during installation.
- C. Refinish or replace job-finished doors damaged during installation.

3.04 SCHEDULE

A. For tabulation of door and frame characteristics, such as size, type, detail, and finish hardware requirements, see Section 08 71 00, Door Hardware Schedule on the Drawings.

END OF SECTION

SECTION 08 41 13 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.01 GENERAL

A. Aluminum and glass door and frame located in the following buildings: Ticketing Building

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. The Aluminum Association, Incorporated (AA): Designation System for Aluminum Finishes.
 - 2. American Architectural Manufacturers Association (AAMA): 800, Voluntary Specification and Test Method for Sealants.
 - 3. ASTM International (ASTM):
 - a. C509, Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - b. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - c. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences Across the Specimen.
 - d. E330, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
 - e. E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Provide a thermally isolated aluminum framing system that uses straight-in glazing without projecting stops. Position glass near exterior of frame.
 - 2. System shall have interior flashing to provide continuous flashing to exterior through pressure relieved horizontal weep holes.
 - 3. Face Clip Design:
 - a. Engaged by pushing straight into the clip.
 - b. Easily removed for deglazing.

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- c. Reusable for reglazing.
- 4. Entrances and glass framing shall be compatible in appearance.
- 5. See the Drawings for Door Types and Schedules.
- B. Performance Requirements: Meet requirements of Article Performance Tests.
- C. Provide door assemblies capable of withstanding the design loads specified on the Structural Drawings.
- D. The door and window assemblies shall be impact resistant assemblies designed to safely resist the positive and negative loads as required for the location and type of project designed according to the requirements of the Florida Building Code (FBC).

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Elevations and details of doors, framing, and anchorage to structure.
 - b. Manufacturer's brochures or catalogs, specifications, recommendations, and standard details illustrating and specifying products proposed for use on this Project.
 - c. Show field measurements.
 - d. Anchorage and bracing drawings and/or catalog information, as required for anchorage and bracing and loads provided in Section 01 61 00, Common Product Requirements.
 - 2. Samples: At least 3-inch-long Samples of anodized extruded aluminum, showing probable range of variation in color.
 - 3. Product/Code Certification:
 - a. Provide written verification that submitted door assemblies and installation method meet or exceed Project Performance Requirements, in this section, by one, or more, of the following methods as allowed for by the (FBC):
 - Rational Comparative Analysis: Testing data, calculations and verification documents signed and sealed by a professional engineer registered in the State of Florida.
 - 2) Local product approval by Authority Having Jurisdiction (AHJ).

- B. Informational Submittals:
 - 1. Anchorage and bracing calculations as required for loads provided in Section 01 61 00, Common Product Requirements. Submit with Action Submittal for the same item.
 - 2. Evidence of installer's qualifications.
 - 3. Certified test reports showing compliance with specified performance tests.
 - 4. Manufacturer's Certificate of Compliance: In accordance with Section 01 33 00, Submittal Procedures.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Entity specializing in the installation of aluminum glazing systems, with a minimum of 3 years' experience and approved by the system manufacturer.
- B. Preinstallation Meeting: Conduct to discuss and verify project requirements, substrate conditions, and manufacturer's installation instructions and warranty requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store materials as recommended by manufacturer, in inside designated areas, free of dust and corrosive fumes, as close as possible to point of installation.
- C. Prevent contaminants from contacting aluminum.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Framing systems and entrance doors shall be the products of a single manufacturer.
- B. Materials and products specified in this section shall be products of:
 - 1. Kawneer Co.
 - 2. United States Aluminum Corp.
 - 3. Tublite, Inc.

2.02 BASIC MATERIALS

- A. Basic Aluminum Extrusions: 6063-T5 aluminum not less than 0.094-inch thick; door extrusions not less than 0.125-inch thick.
- B. Framing Members: 4-1/2 to 6 inches in depth with thermal break and face width of 2 to 2-1/2 inches or less unless noted otherwise on the Drawings to resist developed wind pressure.
- C. Swing Entrance Doors:
 - 1. Thickness: 1-3/4 inches.
 - 2. Stile and Rail Construction:
 - a. Medium 3-1/2-inch stiles and top rails, and 6-inch bottom rail.
 - b. Mechanically fastened and welded.
 - c. Hook-in type glazing stops.
 - d. Configuration indicated.
 - 3. Flush Construction:
 - a. Face sheets of plain unpatterned architectural quality 5005 alloy aluminum, 0.050-inch thick, interlocked with stiles and rails.
 - b. Aluminum stiles and rails, mechanically fastened and welded.
 - c. Core of froth-in-place urethane foam, free of chlorofluorocarbon (CFC) blowing agents.
 - d. Aluminum framed vision lights.
 - e. Configuration indicated.
- D. Glazing Gaskets: Framing manufacturer's standard elastomeric extrusion, conforming to ASTM C509.
- E. Glass and Glazing: As specified in Section 08 80 00, Glazing.
- F. Concealed Fastening Devices, Reinforcements, and Other Internal Components: Of aluminum alloy, stainless steel, or corrosion-resistant plated.
- G. Screws: Stainless steel, factory finished color to match aluminum finish.
- H. Hardware: As specified in Section 08 71 00, Door Hardware.
- I. Sealants:
 - 1. AAMA 800, to seal metal to metal, nonworking joints.
 - 2. Color to be compatible with adjacent materials.

- J. Isolation Tape:
 - 1. Manufacturers and Products:
 - a. Tremco; 440.
 - b. 3M; EC1202.
 - c. Presstite; 579.6.

2.03 FINISH

- A. Exposed Framing Members: Free of scratches and other serious surface blemishes.
- B. Treatment and Color:
 - 1. Caustic etch and anodic oxide.
 - 2. Color: To match window frames and flush aluminum doors.
 - 3. Meet requirements of: Clear Anodized Aluminum (Aluminum Association AA M10C22A41) Class I.

2.04 FABRICATION

- A. Methods of Fabrication and Assembly: Manufacturer's discretion, unless otherwise specified.
- B. Reinforcement for Surface Hardware: Manufacturer's standard.
- C. Wind Load: Reinforce mullions as necessary to limit deflection to 1/175 of span when wind load on wall is as stipulated on Door and Hardware Schedule on the Drawings in addition to dead loads.
- D. Assembly: As far as practicable, do fitting and assembly work in shop.

PART 3 EXECUTION

3.01 PREPARATION

- A. Substrate Conditions: Verify acceptability for product installation in accordance with manufacturer's instructions.
- B. Field Measurements: Verify actual opening sizes prior to fabrication.

3.02 INSTALLATION

- A. In accordance with manufacturer's installation instructions.
- B. Set items straight, level, square, plumb, and at proper elevations and in alignment with other work.

- C. Securely anchor units to surrounding structure to resist wind loads and to withstand the normal loads imposed by the operation of the doors.
- D. Fasten framing members in place using screws and backing, anchor plugs, or straps.
 - 1. Accurately cut and fit framing and moldings to result in tightly closed flush, hairline weathertight joints.
 - 2. No visible unfinished aluminum.
 - 3. Provide concealed attachments and fasteners.
- E. Door Operation:
 - 1. Swing freely, and without rattle when closed.
 - 2. Swing Type Doors: Head and jamb clearance of 3/32 inch, plus or minus 1/32-inch.
- F. Coat aluminum surfaces in contact with concrete, cement plaster, or stucco with isolation paint, sealant, or isolation tape cut to neat line.
- G. Seal all joints.
- H. Glazing: As specified in Section 08 80 00, Glazing.

3.03 PERFORMANCE TESTS

- A. Air Leakage Through Assembly: Maximum 0.06 cfm per minute per square foot of wall area at 6.24 psf, as measured in accordance with ASTM E283.
- B. Resistance to Water Infiltration: No leaks in the complete system when tested in accordance with ASTM E331 at test pressure of 8 psf.
- C. Performance Under Uniform Loading:
 - 1. Test in accordance with ASTM E330 for a wind load of 30 psf.
 - 2. Maximum Deflection: Not to exceed 1/175 of member span.
 - 3. When Load is Removed: No permanent deformation or damage.

3.04 MANUFACTURER'S SERVICES

A. Provide manufacturer's representative at Site for preinstallation meeting, installation assistance, inspection and certification of proper installation, and performance testing of specified equipment.

3.05 CLEANING

- A. After erection, protect exposed portions from damage by machines, plaster, lime, paint, acid, cement, or other harmful compounds.
- B. Remove protective materials and clean with plain water, water with soap, or household detergent.

3.06 PROTECTION

A. Protect adjacent areas and finish surfaces from damage during product installation.

3.07 SCHEDULES

A. For tabulation of door and frame characteristics, such as size, type, detail, and finish hardware requirements, see Door and Hardware Schedules on the Drawings.

END OF SECTION

SECTION 08 51 13 ALUMINUM WINDOWS

PART 1 GENERAL

1.01 INCLUDDED IN THIS SECTION

- A. Fixed windows.
- B. Sliding flush-mount transaction window.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. 101, Voluntary Specifications for Aluminum and Poly (Vinyl Chloride) (PVC) Prime Windows and Glass Doors.
 - b. 606.1, Voluntary Guide Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum.
 - c. 701, Combined Voluntary Specification for Pile Weather Strip.
 - d. 800, Voluntary Specification and Test Methods for Sealants.
 - 2. ASTM International (ASTM):
 - a. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. B456, Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
 - c. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - d. C509, Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - e. C864, Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - f. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - g. D3656, Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.
 - h. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - i. E330, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

- j. E331, Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
- k. E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.
- 3. Glass Association of North America (GANA): Glazing Manual.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Large scale details and layout of windows, operators, anchorages, and adjoining construction with all materials indicated accurately to scale.
 - b. Manufacturer's literature including brochures or catalogs, specifications, instructions, and standard details illustrating products proposed for use and other window products available.
 - 2. Samples: Finish on aluminum in sets of two, indicating light and dark extremes, to be used in evaluating products furnished.
- B. Informational Submittals:
 - 1. Manufacturer's Certification of Compliance.
 - 2. Reports of factory quality control tests.
 - 3. Product/Code Certification: Provide written verification that submitted louver assembly and installation method meet or exceed Project Design Requirements, in this section, by one, or more, of the following methods as allowed for by FBC:
 - a. Florida Product Approval for complete window assembly.
 - b. Rational Comparative Analysis: Testing data, calculations, and verification documents signed and sealed by a professional engineer registered in the State of Florida.
 - c. Local product approval by Authority Having Jurisdiction (AHJ).

1.04 QUALITY ASSURANCE

- A. All Units: Meet construction and testing requirements of AAMA 101 and carry the quality certified label of AAMA.
- B. Design Requirements:
 - 1. Provide a thermally isolated aluminum framing system that uses straight-in glazing without projecting stops. Position glass near exterior of frame and provide in-swinging operable vents where shown.

2. Window assemblies shall be impact resistant assemblies designed to safely resist the positive and negative loads as required for the location and type of project designed according to the requirements of the Florida Building Code (FBC).

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store window units in vertical upright position and off the ground on dunnage, preferably inside a building.
- B. Protect units from weather, abuse, defacement, and damage.
- C. Store units inside in areas free of dust and corrosive fumes, as close as possible to point of installation.
- D. Prevent contaminants from contacting aluminum.
- E. Keep water away from stored units and assemblies.
- F. Handle units according to recommendations of AAMA.

1.06 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at option of Owner, removal and replacement of Work specified in this Specification section found defective during period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Fixed window:
 - 1. Kawneer Co.
 - 2. United States Aluminum Corp.
- B. Sliding transaction window: Ready Access, 600 series, "Or-equal," approved.

2.02 MATERIALS

- A. Aluminum: Proper alloy and temper to meet specified requirements.
- B. Hardware: Corrosion-resistant and compatible with aluminum; suitable for intended use and the same as used on the tested units.

- C. Anchors and Fasteners:
 - 1. Exposed: Aluminum, Type 304 stainless steel, or ASTM B456 nickelplated brass.
 - 2. Concealed: Aluminum, cadmium-plated steel, ASTM B633 or ASTM A123 zinc-plated steel, or Type 304 stainless steel.
 - 3. Concealed anchors may be of carbon steel, painted after fabrication with zinc chromate primer.
 - 4. Other Fasteners and Components: Carbon steel or ASTM B456 Nickel plus Chromium plated.
- D. Sealants:
 - 1. AAMA 800 to seal metal to metal, nonworking joints.
 - 2. Color to be compatible with adjacent materials.
- E. Weatherstripping: High-quality materials capable of meeting environmental exposure and performance requirements.
 - 1. Pile Weatherstrip: AAMA 701.
 - 2. Closed Cell Elastomer: ASTM C509.
 - 3. Dense Elastomer: ASTM C864.
- F. Glass and Glazing:
 - 1. Double Pane Insulating Glass (IG-DP):
 - a. ASTM E2190 certified by Insulating Glass Certification Council; with glass elastomer edge seal; purge interpane space with dry hermetic air.
 - b. Total Unit Thickness: 1-inch.
 - c. Outer Pane:
 - 1) Annealed, clear float glass.
 - 2) Minimum Thickness: 1/4-inch.
 - 3) Low E coating on No. 2 surface.
 - d. Inner Pane:
 - 1) Clear laminated glass made up of two liters of clear tempered glass with plastic interlayer.
 - 2) Minimum Total Thickness: 1/4-inch.
 - Plastic Interlayer: Manufacturer's standard, of minimum thickness required to meet FBC impact resistance requirement for Project site.
- G. Service panel:
 - 1. Operation: Manual open/self-closing.
 - 2. One (1) sliding panel.

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- 3. Opening direction: Left to right.
- 4. Security: Self-latching each time panel closes.
- 5. Lock: Mortise thumbturn. Keyed mortise cylinder.
- 6. Handle: Stainless Steel.
- 7. Window sneeze guard: 1/4-inch clear tempered glass protective shield.

2.03 FABRICATION

- A. Fabricate and assemble frame, sash, and ventilator members into windows and window systems in accordance with reviewed Shop Drawings, and as required by AAMA 101.
- B. Mechanical fasteners, welded components, and hardware items shall not bridge thermal barriers unless the window units tested also have thermal bridges.
- C. Sealing Insulating Glass Units: Designed so that water entering space around unit will drain and not remain in contact with edge seal of the glass.
- D. Glazing Beads:
 - 1. Sloped and coped to uniformly tight hairline joints at corners.
 - 2. Material may be prefinished.

2.04 FINISH

- A. Finish components after fabrication, except those that may be prefinished as specified.
- B. Exposed framing members shall be free of scratches and other surface blemishes.
- C. Anodic Coating: Conform to AAMA 606.1, dark bronze.
- D. Frames:
 - 1. Extruded aluminum alloy and chloroprene rubber components.
 - 2. Continuously weld corners of the aluminum.
 - 3. Provide matching aluminum subframes.

2.05 ANCILLARY MATERIALS

- A. Isolation Tape:
 - 1. Manufacturers and Products:
 - a. Tremco; 440.
 - b. 3M; EC1202.

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- c. Presstite; 579.6
- B. Isolation Paint: Bituminous coating conforming to ASTM D1187.
- C. Screens:
 - 1. Furnish rigid metal frame screens to match window frames for operating vents and sash.
 - 2. ASTM D3656, Class 1, 18 by 16 mesh.

2.06 FIXED WINDOWS

- A. Meet requirements of AAMA 101 Designation AW-80 operable and AW-100 fixed.
- B. Provide polyvinyl chloride thermal break separator between inside and outside for all frames.
- C. Ventilators:
 - 1. Project-out type with crank operators and hook or cam type latch.
 - 2. Anderberg stainless steel, adjustable friction, four-arm mechanisms for ventilators operated directly or by pole.
 - 3. Provide pole operator where ventilators are more than 6 feet above floor.

2.07 SOURCE QUALITY CONTROL

- A. Tests:
 - 1. Resistance to Air Infiltration: No greater than 0.06 cfm per square foot of fixed area, as tested in accordance with ASTM E283.
 - 2. Resistance to Water Infiltration: No leakage in frame at test pressure difference of 8 psf, as tested in accordance with ASTM E331.
 - 3. Resistance to Uniform Loading: When tested under load of 20 psf, in accordance with ASTM E330:
 - a. Maximum Deflection: No greater than 1/175 times span for any member.
 - b. When load is removed, no evidence of permanent deformation or damage.

PART 3 EXECUTION

- 3.01 PREPARATION
 - A. Verify dimensions by taking measurements at the Site.

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- B. Verify that openings are within allowable dimensional tolerances, are plumb, level, clean, and provide a solid anchoring surface.
- C. Verify conformance with Shop Drawings and that dimensions and conditions are correct before installing windows.

3.02 INSTALLATION

- A. Window and Window Components:
 - 1. Plumb and align window faces in a single plane for each wall plane.
 - 2. Erect windows and materials square and true and in proper alignment with other work, anchored to maintain position when subjected to normal thermal and building movement and specified wind loads.
 - 3. Install in accordance with manufacturer's instructions.
 - 4. Installation shall be weathertight as specified under Article Source Quality Control.
- B. Coat aluminum surfaces in contact with concrete, cement plaster, or stucco with isolation paint, sealant, or isolation tape cut to neat line.

3.03 GLAZING

- A. Glass may be factory or field installed.
- B. Install in accordance with GANA "Glazing Manual," and glass manufacturer's instructions.

3.04 INSTALLATION OF ACOUSTICAL VISION PANELS

- A. Conform to manufacturer's instructions.
- B. Seal perimeter between frame and structure with permanently nonhardening, synthetic elastomer sealant, as recommended or approved by panel manufacturer.

3.05 ADJUSTING AND CLEANING

- A. Remove protective materials and clean windows with potable water, or water with household soap or detergent.
- B. Inspect and readjust glazed ventilators as necessary for free operation at completion.
- C. Adjust windows for proper operation after installing.
- D. Lubricate hardware and movable units.

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ROGER SCOTT POOL FACILITIES

E. Leave windows in closed position after adjusting and cleaning.

3.06 **PROTECTION**

A. Protect installed window units from materials that could cause damage, such as lime, mortar, runoff from concrete and copper, careless handling of tools, weld splatter, acids, roofing asphalt, solvents, and abrasive cleaners.

3.07 SCHEDULE

A. For window types, sizes, glass, and other requirements, see Window Schedule on the Drawings.

END OF SECTION

SECTION 08 71 00 DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.
 - 1. Door hardware for other doors indicated.
 - 2. Master Keying System and keyed cylinders.
- B. Related Sections:
 - 1. Section 08 11 16, Aluminum Doors and Frames.
 - 2. Section 08 14 00, Wood Doors and Steel Frames.
 - 3. Section 08 41 13, Aluminum-Framed Entrances and Storefronts.
- C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.
 - 1. Builders Hardware Manufacturing Association (BHMA).
 - 2. NFPA 101 Life Safety Code.
 - 3. NFPA 80 Standard for Fire Doors and Other Opening Protectives.
 - 4. ANSI-A156.xx- Various Performance Standards for Finish Hardware.
 - 5. UL10C Positive Pressure Fire Test of Door Assemblies.
 - 6. ANSI-A117.1 Accessible and Usable Buildings and Facilities.
 - 7. DHI /ANSI A115.IG Installation Guide for Doors and Hardware.
 - 8. ICC International Building Code.
 - 9. Florida Building Code, 2017 with amendments.
 - 10. Florida Accessibility Code, 2017 with amendments.
- D. Intent of Hardware Groups:
 - 1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
 - 2. Exterior Doors meet developed wind pressures and applicable third party testing documentation include specific hardware. Hardware sets for exterior doors will be modified as required to match testing requirements.

- 3. Where items of hardware are not definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by Addendum; or, furnish such items in the type and quality established by this Specification, and appropriate to the service intended.
- E. Allowances: Refer to Division 01, General Requirements for allowance amount and procedures.
- F. Alternates: Refer to Division 01, General Requirements for Alternates and procedures.

1.02 SUBSTITUTIONS

A. Comply with Division 01, General Requirements.

1.03 SUBMITTALS

- A. Comply with Division 01, General Requirements.
- B. Special Submittal Requirements: Combine submittals of this section with sections listed under paragraph 1.01B ensure the "design intent" of the system/assembly is understood and can be reviewed together.
- C. Product Data: Manufacturer's specifications and technical data including the following:
- D. Detailed specification of construction and fabrication.
 - 1. Manufacturer's installation instructions.
 - 2. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
 - 3. Submit 6 copies of catalog cuts with hardware schedule.
 - 4. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2.
- E. Shop Drawings Hardware Schedule: Submit six complete reproducible copy of detailed hardware schedule in a vertical format.
 - 1. List groups and suffixes in proper sequence.
 - 2. Completely describe door and list architectural door number as it appears in construction documents.
 - 3. Manufacturer, product name, and catalog number and cut sheets.
 - 4. Function, type, and style.
 - 5. Size and finish of each item.

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- 6. Mounting heights.
- 7. Explanation of abbreviations and symbols used within schedule.
- 8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.
- F. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.
 - 1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.
- G. Samples: (If requested by the Architect):
 - 1. 1 sample of Lever and Rose/Escutcheon design, (pair).
 - 2. 3 samples of metal finishes.
- H. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.
 - 1. Operating and maintenance manuals: Submit three sets containing the following.
 - a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
 - b. Catalog pages for each product.
 - c. Name, Address, and phone number of local representative for each manufacturer.
 - d. Parts list for each product.
 - 2. Copy of final hardware schedule, edited to reflect, "As installed".
 - 3. Copy of final keying schedule.
 - 4. As installed "Wiring Diagrams" for each piece of hardware connected to power, both low voltage and 110 volts.
 - 5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.04 QUALITY ASSURANCE

- A. Comply with Division 01, General Requirements.
 - 1. Statement of qualification for distributor and installers.
 - 2. Statement of compliance with regulatory requirements and single source responsibility.

- 3. Distributor's Qualifications: Firm with 3-years' experience in the distribution of commercial hardware.
 - a. Distributor to utilize full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
 - b. Hardware Schedule shall be prepared and signed by an AHC.
- 4. Installer's Qualifications: Firm with 3-years experienced in installation of similar hardware to that required for this Project, including specific requirements indicated.
- 5. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
 - a. Provide UL listed hardware for labeled and 20-minute openings in conformance with requirements for class of opening scheduled.
 - b. UL requirements have precedence over this specification where conflict exists.
- 6. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.
- B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Comply with Division 01, General Requirements.
 - 1. Deliver products in original unopened packaging with legible manufacturer's identification.
 - 2. Package hardware to prevent damage during transit and storage.
 - 3. Mark hardware to correspond with "reviewed hardware schedule".
 - 4. Deliver hardware to door and frame manufacturer upon request.
- B. Storage and Protection: Comply with manufacturer's recommendations.

1.06 PROJECT CONDITIONS

- A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.
- B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

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1.07 WARRANTY

- A. Refer to Conditions of the Contract.
- B. Manufacturer's Warranty:
 - 1. Closers: Ten years.
 - 2. Exit Devices: Five Years.
 - 3. Locksets and Cylinders: Three years.
 - 4. All other Hardware: Two years.

1.08 OWNER'S INSTRUCTION

A. Instruct Owner's personnel in operation and maintenance of hardware units.

1.09 MAINTENANCE

- A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 01, General Requirements.
 - 1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
 - 2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
 - 3. Delivery, Storage and Protection: Comply with Owner's requirements for delivery, storage and protection of extra service materials.
- B. Maintenance Service: Submit for Owner's consideration maintenance service agreement for electronic products installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1, General Requirements.

<u>Item</u> :	Manufacturer:	Approved:
Hinges	Stanley	Bommer, McKinney
Locksets	Best	
Cylinders	Best	
Exit Devices	Precision Apex	Von Duprin 98/99
Closers	Stanley D4550	Norton 7500

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ROGER SCOTT POOL FACILITIES

Item:	Manufacturer:	<u>Approved</u> :
Protection Plates	Trimco	Burns, Rockwood
Flush Bolts	ABH	Trimco, Burns
Coordinator and	Trimco	ABH, Burns
Brackets		
Threshold and	National Guard	Reese, Zero
Gasketing		

2.02 MATERIALS:

- A. Hinges:
 - 1. Template screw hole locations.
 - 2. Minimum of two permanently lubricated non-detachable bearings.
 - 3. Equip with easily seated, non-rising pins.
 - 4. Sufficient size to allow 180-degree swing of door.
 - 5. Furnish hinges with five knuckles and flush concealed bearings.
 - 6. Provide hinge type as listed in schedule.
 - 7. Furnish 3 hinges per leaf to 7-foot 6-inch height. Add one for each Additional 30 inches in height or fraction thereof.
 - 8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish.
 - 9. UL10C listed for Fire rated doors.
- B. Mortise Type Locks and Latches:
 - 1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C.
 - 2. Furnish UL or recognized independent laboratory certified mechanical operational testing to 4 million cycles minimum.
 - 3. Provide 9001-Quality Management and 14001-Environmental Management.
 - 4. Fit ANSI A115.1 door preparation.
 - 5. Functions and design as indicated in the hardware groups.
 - 6. Solid, one-piece, 3/4-inch (19 mm) throw, anti-friction latchbolt made of self-lubricating stainless steel.
 - 7. Deadbolt functions shall have 1-inch (25 mm) throw bolt made of hardened stainless steel.
 - 8. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8-inch (9.5 mm) when fully extended.
 - 9. Auxiliary deadlatch to be made of one piece stainless steel, permanently lubricated.
 - 10. Provide sufficient curved strike lip to protect door trim.

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- 11. Lever handles must be of forged or cast brass, bronze or stainless steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable.
- 12. Lock shall have self-aligning, thru-bolted trim.
- 13. Levers to operate a roller bearing spindle hub mechanism.
- 14. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
- 15. Spindle to be designed to prevent forced entry from attacking of lever.
- 16. Provide locksets with seven-pin removable and interchangeable core cylinders.
- 17. Each lever to have independent spring mechanism controlling it.
- C. Door Closers shall:
 - 1. Tested and approved by BHMA for ANSI 156.4, Grade 1.
 - 2. UL10C certified.
 - 3. Provide 9001-Quality Management and 14001-Environmental Management.
 - 4. Closer shall have extra-duty arms and knuckles.
 - 5. Conform to ANSI 117.1.
 - 6. Maximum 2-7/16-inch case projection with non-ferrous cover.
 - 7. Separate adjusting valves for closing and latching speed, and backcheck.
 - 8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions.
 - 9. Full rack and pinion type closer with 1-1/2 inches minimum bore.
 - 10. Mount closers on non-public side of door, unless otherwise noted in Specification.
 - 11. Closers shall be non-handed, non-sized and multi-sized.
- D. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1-inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- E. Mop plates: Provide with four beveled edges ANSI J103, 4 inches high by width less 1-inch on single doors and 1-inch on pairs of doors. Furnish oval-head countersunk screws to match finish.
- F. Door Bolts: Flush bolts for wood or metal doors.
 - 1. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
 - 2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
- 3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
- 4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.
- G. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.
 - 1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
 - 2. Provide mounting brackets for soffit applied hardware.
 - 3. Provide hardware preparation (cutouts) for latches as necessary.
- H. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.
 - 1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone).
 - 2. UL10C Positive Pressure rated seal set when required.
- I. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.
 - 1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone).
 - 2. UL10C Positive Pressure rated seal set when required.
- J. Thresholds: Thresholds shall be aluminum beveled type with maximum height of 1/2-inch for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

2.03 FINISH

- A. Designations used in Schedule of Finish Hardware paragraph 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products.
- B. Powder coat door closers to match other hardware, unless otherwise noted.
- C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.04 KEYS AND KEYING

- A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner's permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.
- B. Cylinders, removable and interchangeable core system: Best CORMAXTM Patented seven-pin.
- C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped "Do Not Duplicate."
- D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.
- E. Furnish keys in the following quantities:
 - 1. One each Grand Masterkeys.
 - 2. Four each Masterkeys.
 - 3. Two each Change keys each keyed core.
 - 4. Fifteen each Construction Masterkeys.
 - 5. One each Control keys.
- F. The Owner, or the Owner's agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.
- G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect Owner and hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish three typed copies of keying and programming schedule to Architect.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.
 - 1. Do not proceed until unsatisfactory conditions have been corrected.

3.02 HARDWARE LOCATIONS

- A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.
 - 1. Recommended Locations for Builder's Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
 - 2. Recommended locations for Architectural Hardware for flush wood doors (DHI).
 - 3. WDMA Industry Standard I.S.-1A-04, Industry Standard for Architectural wood flush doors.

3.03 INSTALLATION

- A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- B. Conform to local governing agency security ordinance.
- C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.
 - 1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.
- D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

3.04 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

- A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final Shop Drawings.
 - 1. Check and adjust closers to ensure proper operation.
 - 2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.
 - a. Verify levers are free from binding.
 - b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

DOOR HARDWARE 08 71 00 - 10 PW\JA\CITY OF PENSACOLA\D3754400 JUNE 11, 2024 ©COPYRIGHT 2024 JACOBS 3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.05 SCHEDULE OF FINISH HARDWARE

A. Manufacturer List:

Name
ABH Manufacturing Inc.
Adams Rite
Best Access Systems
National Guard
Precision
Stanley Door Closers
By Others
Stanley
Trimco

B. Finish List:

<u>Code</u>	Description
AL	Aluminum
606	Satin Brass, Clear Coated
625	Bright Chromium Plated
626	Satin Chromium Plated
628	Satin Aluminum, Clear Anodized
630	Satin Stainless Steel
689	Aluminum Painted
626W	Weatherized Satin Chrome
628C	Nylon Silver Coated
GREY	Grey
BLACK	Black
US32D	Stainless Steel, Dull

C. Option List:

Code	Description
CD	Cylinder Dogging
FL	Fire Exit Hardware
M5	Galvanized Steel Chain
WC	Padlock Weather Covers
CSK	Counter Sinking Kick / Mop Plates

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SET #1 – Wood Doors (Privacy Set with key)

BHMA Function # 04 Office with thumb turn and entry lock Doors: 003, 005

3 EA Hinge1 EA Privacy Lockset1 EA Wall Stop3 EA Silencer

SET #2 – Wood Doors (Storage set with key)

BHMA Function # 04 Office with thumb turn and entry lock Doors: 013

3 EA Hinge1 EA Storage Lockset1 EA Wall Stop3 EA Silencer

SET #3 –Aluminum and Glass Entrance Doors

Specification Section 08 41 13, Aluminum-Framed Entrances and Storefronts Exterior-provide testing and impact resistant tested assembly Doors: 001

1 EA Parallel Door Closer with stop
3 EA Hinge
1 EA Entrance Lockset with Lever Handle
Jamb and head door Weather-stripping
1 EA Door Sweep
1 EA Threshold, aluminum anodized serrated
1 EA Pull

SET #4– Aluminum Flush Single Exterior Door

BHMA Function # 04 Storage lock function Exterior-provide testing and impact resistant tested assembly Doors: 004, 011, 012, 014

EA Parallel Door Closer with integral stop
 EA Hinge
 EA Lockset with Lever Handle
 EA Keyed Deadlock on exterior, operated by lever

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- 1 Set jamb and head seals
- 1 EA Rain Drip
- 1 EA Door Sweep
- 1 EA Threshold Clear Aluminum serrated

END OF SECTION

SECTION 08 80 00 GLAZING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI): Z97.1, Safety Glazing Materials Used in Buildings—Safety Performance Specifications and Methods of Test.
 - 2. American Society of Civil Engineers (ASCE): 7, Minimum Design Loads for Buildings and Other Structures.
 - 3. ASTM International (ASTM):
 - a. C509, Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material.
 - b. C864, Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - c. C920, Standard Specification for Elastomeric Joint Sealants.
 - d. C1036, Standard Specification for Flat Glass.
 - e. C1048, Standard Specification for Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
 - f. C1115, Standard Specification for Dense Elastomeric Silicone Rubber Gaskets and Accessories.
 - g. C1172, Standard Specification for Laminated Architectural Flat Glass.
 - h. C1193, Standard Guide for Use of Joint Sealants.
 - i. C1376, Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
 - j. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
 - k. D2843, Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
 - 1. D4802, Standard Specification for Poly(Methyl Methacrylate) Acrylic Plastic Sheet.
 - m. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - n. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - o. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.

- p. E1300, Standard Practice for Determining Load Resistance of Glass in Buildings.
- q. E1425, Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylight, and Glazed Wall Systems.
- r. E1886, Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
- s. E1996, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
- t. E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.
- 4. Consumer Product Safety Commission (CPSC) Code of Federal Regulations (CFR): 16 CFR 1201, Safety Standard for Architectural Glazing Materials.
- 5. Glass Association of North America (GANA):
 - a. Glazing Manual.
 - b. Sealant Manual.
- 6. National Fenestration Rating Council Incorporated (NFRC):
 - a. 100, Procedure for Determining Fenestration Product U-Factors.
 - b. 200, Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence.
 - c. 300, Standard Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems.
- 7. National Fire Protection Association (NFPA):
 - a. 80, Safety Standard for Fire Doors and Other Opening Protectives.
 - b. 252, Safety Standard Methods of Fire Tests of Door Assemblies.
 - c. 257, Safety Standard on Fire Test for Window and Glass Block Assemblies.
- 8. South Coast Air Quality Management District: SCAQMD Rule 1168 Adhesive and Sealant Applications.
- 9. Underwriters Laboratories, Inc. (UL):
 - a. 752, Standard for Bullet-Resisting Equipment.
 - b. Building Materials Directory.
 - c. 10C, Standard for Safety for Positive Pressure Fire Tests of Door Assemblies.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Complete schedule of glass and glazing material to be used for each purpose.

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- b. Indicate sizes, layout, thicknesses, and loading conditions for glass.
- 2. Product Data:
 - a. Catalog cuts of glazing materials with inclusion of glass edge cutting procedures.
 - b. Glass: Provide structural, physical, and thermal and solar optical performance characteristics, size limitations, special handling or installation requirements.
 - c. Glazing Sealants, Compounds, and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors where exposed.
- 3. Samples:
 - a. Glass: Two samples 12 by 12 inches in size of each type of glass, illustrating each glass units, coloration and design properly labeled.
- B. Notice of Acceptance (NOA):
 - 1. Impact-Resistant Glazing Units and Insulated Impact-Resistant Glazing Units: Provide Miami-Dade NOA number and test documentation for glazing assembly units showing manufacturer's name, missile impact ratings, anchoring, materials and minimum and maximum design pressures clearly identified for each required assembly type. Provide NOA with valid expiration date.
 - 2. NOA Labeling: Each unit assembly shall bear a permanent label with the manufacturer's name and logo, city, state, and the following statement, "Miami-Dade County Product Control Approved", unless otherwise noted.
- C. Informational Submittals:
 - 1. Design calculations for glass thicknesses. Signed and sealed by professional engineer registered in Florida.
 - 2. Manufacturer's Certificate of Compliance for each type of glazing, in accordance with Section 01 61 00, Common Product Requirements.
 - 3. Details and methods of glazing for each type of glazing condition; include manufacturer's recommendations for setting, sealing materials, and installing each type of glazing.
 - 4. Documentation declaring compatibility and adhesion test reports from sealant manufacturer indicating that glazing materials were tested for compatibility and adhesion with glazing sealants and other glazing materials.
 - 5. Documentation of glazer's previous experience and manufacturer's approval.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing Work of this section with minimum 3 years' documented experience approved by manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Storage:
 - 1. Support cases on both sides when stored vertically.
 - 2. After unpacking, place interleaving protection between lites.
 - 3. Keep glass and interleaving dry by storing inside where temperatures are above dewpoint, or if outside storage is necessary, cover glass interleaving with opaque tarpaulins or plastic and inspect periodically. Wet interleaving can stain glass.
 - 4. Avoid exposing stored glass to direct sunlight.
- B. Handling:
 - 1. Stack individual lites on edge and lean them against sturdy uprights at a slope of 5 degrees to 7 degrees from vertical.
 - 2. Cushion bottom edges with soft, firm pads free of dirt, grit, glass chips, or other foreign material.
 - 3. Do not rotate or cartwheel insulating glass units over their corners. Use turning device such as a rolling block if units must be rotated.

1.05 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction, or at option of Owner, removal and replacement of Work specified in this Specification section found defective during a period of 10 years for vertical application insulating glass after date of Substantial Completion. Guarantee to cover deterioration because of normal conditions of use and not because of handling installing and cleaning practices performed contrary to glass manufacturer's published instructions. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Single Source Fabrication Responsibility: Fabrication processes including Low-E and reflective coatings, insulating, laminating, silkscreen, and tempering, shall be fabricated by a single fabricator.

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- B. Performance/Design Criteria:
 - 1. Provide glass and glazing materials for continuity of building enclosure vapor retarder and air barrier:
 - a. In conjunction with vapor retarder and air barrier materials described in section.
 - b. To utilize inner pane of multiple pane sealed units for continuity of air barrier and vapor retarder seal.
 - c. To maintain continuous air barrier and vapor retarder throughout glazed assembly from glass pane to heel bead of glazing sealant.
 - 2. Glass Thickness: Select minimum thickness in accordance with ASTM E1300 to resist specified design loads with the following maximum probability of breakage:
 - a. Vertical Glass: Eight lites per 1,000 for wind loads with 60 seconds maximum load duration.
 - b. Minimum Thickness: 1/4-inch for exterior glass.
- C. Structural Design: Design in accordance with Florida Building Code for most critical combination of wind, snow, seismic, and dead loads.
- D. Wind Loads: Design and size glass to withstand positive and negative wind loads acting normal to plane of wall, including increased loads at building corners.
 - 1. Design Wind pressures for components and cladding as shown on the Structural Drawings.
 - 2. Wind-Borne Debris Loads: Design and size glass located less than 60 feet (18.288 m) abovegrade to withstand the following loads:
 - a. Glass Within 30 Feet (9.144 m) of Grade: ASTM E1886 and ASTM E1996; large missile impact test.
 - b. Glass Greater than 30 Feet (9.144 m) Abovegrade: ASTM E1886 and ASTM E1996; small missile impact test.
 - 3. Exterior Glass Deflection: Maximum of 1/175 of glass edge length or 3/4 inch (19 mm), whichever is less with full recovery of glazing materials.
 - 4. Interior Glass Deflection: Maximum differential deflection for two adjacent unsupported edges when 50 plf (730 N/m) force is applied to one panel at any point up to 42 inches (1067 mm) above finished floor less than thickness of glass.
 - 5. Thermal and Solar Optical Performance: Measured or calculated in accordance with the following:
 - a. U-Values: NFRC 100.
 - b. Solar Heat Gain Coefficients: NFRC 200.
 - c. Solar Optical Properties: NFRC 300.

- E. Recycled Content Materials: Furnish materials with recycled content including post-consumer and pre-consumer recycled content.
 - 1. Regional Materials: Furnish materials extracted, processed, and manufactured within 500 miles (800 km) of Project Site.

2.02 FLOAT GLASS PRODUCTS

- A. Clear Glass:
 - 1. Heat strengthened (FG-CH) or Tempered (FC-CT) float glass as specified; Class 1 clear.
 - 2. Minimum Thickness: 1/4-inch.
- B. Low E Glass:
 - 1. Heat strengthened, tinted (FG-ETH) or tempered float glass as specified; Class 2 tinted.
 - 2. Minimum Thickness: 1/4-inch.
 - 3. Tint: Gray.
 - 4. Coating: ASTM C1376; pyrolytic.
 - C. Manufacturers:
 - 1. Viracon.
 - 2. ACH Glass Operations
 - 3. AFG Industries, Inc.
 - 4. Oldcastle Glass.

2.03 INSULATING GLASS PRODUCTS

- A. Laminated Insulating Glass:
 - 1. ASTM E2190 certified by Insulating Glass Certification Council and Insulating Glass Manufacturers Alliance; with glass elastomer edge seal; place reflective film within unit; purge interpane space with dry hermetic air.
 - 2. Total Unit Thickness: 1-5/16-inch unless otherwise indicated.
 - 3. Insulating Glass Unit Edge Seal Construction: Stainless steel, thermally broken, bent and soldered corners.
 - 4. StormGuard by Viracon "Or-equal," approved.

2.04 GLAZING SEALANTS

- A. Elastomeric Glazing Sealants: Materials compatible with adjacent materials including glass, insulating glass seals, and glazing channels.
 - 1. Silicone Glazing Sealant: ASTM C920, Type S, Grade NS, Class and Use suitable for glazing application indicated; single component curing; capable of water immersion without loss of properties; nonbleeding, nonstaining, cured Shore A Hardness Range 15 to 25.
- B. Dense Gaskets:
 - 1. Resilient extruded shape to suit glazing channel retaining slot; black.
 - 2. Neoprene: ASTM C864.
 - 3. EPDM: ASTM C864.
 - 4. Silicone: ASTM C1115.
- C. Soft Gaskets:
 - 1. ASTM C509 Type II; resilient extruded shape to suit glazing channel retaining slot; black.
 - 2. Neoprene.
 - 3. EPDM.
 - 4. Silicone.
- D. Preformed Glazing Tape:
 - 1. Size to suit application.
 - 2. Preformed butyl compound with integral resilient tube spacing device; 10 to 15 Shore A durometer hardness; coiled on release paper; black color.
 - 3. Butyl Corner Sealant: ASTM C920 single component nonskinning butyl compatible with glazing tape; color to match tape.

2.05 GLAZING ACCESSORIES

- A. Setting Blocks: Elastomeric material recommended by glass manufacturer, 80 to 90 Shore A durometer hardness, length of 0.1 inch for each square foot (25 mm for each square meter) of glazing or minimum 4 inch (100 mm) by width of glazing rabbet space minus 1/16 inch (1.5 mm) by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Elastomeric material recommended by glass manufacturer, 50 to 60 Shore A durometer hardness, minimum 3-inch (75-mm) long by one half the height of glazing stop by thickness to suit application self-adhesive on one face.

C. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings for glazing are correctly sized and within acceptable tolerance.
- B. Verify surfaces of glazing channels or recesses are clean, free of obstructions impeding moisture movement, weeps are clear and ready to receive glazing.

3.02 PREPARATION

- A. Do not perform glazing work in damp, foggy, or rainy weather, or when temperatures are not within range recommended by GANA "Glazing Manual".
- B. Surfaces:
 - 1. Smooth, even, sound, dry, and clean.
 - 2. Clean contact surfaces with solvent and wipe dry.
- C. Priming:
 - 1. Complete and cured.
 - 2. Prime surfaces scheduled to receive sealant.
- D. Measure size of frames to receive glass and compute actual glass size allowing for edge clearances.
- E. Verify functioning weep system is present.
- F. Do not proceed with glazing until unsatisfactory conditions have been corrected.

3.03 GLAZING INSTALLATION

- A. General: Follow recommendations of glass manufacturer GANA "Sealant Manual, GANA "Glazing Manual" and the following:
 - 1. Glazing Sealants: Comply with ASTM C1193.
 - 2. Fire Rated Openings: Comply with NFPA 80.

- B. Exterior Wet/Dry Method (Preformed Tape and Sealant) Installation:
 - Cut glazing tape to length and set against permanent stops, 3/16-inch (5 mm) below sight line. Seal corners by butting tape and dabbing with compatible butyl sealant.
 - 2. Apply heel bead of butyl sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapor seal.
 - 3. Place setting blocks at 1/4 points with edge block no more than 6 inches (150 mm) from corners.
 - 4. Rest glazing on setting blocks and push against tape and heel bead of sealant with sufficient pressure to attain full contact at perimeter of pane or glass unit.
 - 5. Fill gap between glazing and stop with elastomeric glazing sealant to depth equal to bite of frame on glazing, but not more than 3/8 inch (9 mm) below sight line.
 - 6. Apply cap bead of elastomeric glazing sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
- C. Interior Dry Method (Tape and Tape) Installation:
 - 1. Cut glazing tape to length and set against permanent stops, projecting 1/16-inch (1.6 mm) above sight line.
 - 2. Place setting blocks at 1/4 points with edge block no more than 6 inches (150 mm) from corners.
 - 3. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
 - 4. Place glazing tape on free perimeter of glazing in same manner described above.
 - 5. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
 - 6. Knife trim protruding tape.

3.04 FIELD QUALITY CONTROL

- A. Hose Test:
 - 1. Use 3/4-inch minimum hose without nozzle. With full stream, flood glazing from bottom to top.
 - 2. Correct leaks disclosed by hose test by reglazing and retesting until eliminated.

ROGER SCOTT POOL FACILITIES

3.05 MANUFACTURER'S FIELD SERVICES

A. Provide manufacturer's representative at Site for installation assistance and inspection.

3.06 CLEANING

- A. Leave glass and glazing in undamaged condition and ready for final cleaning.
- B. Remove excess glazing compound from installed glass.
- C. Remove labels from glass surface at time of final cleaning.
- D. Wash and polish both faces of glass.
- E. Clean adjacent surfaces of glass.

3.07 PROTECTION OF COMPLETED WORK

- A. Protection:
 - 1. Keep glass free from contamination by materials capable of staining glass.
 - 2. Install tape across lights secured to frames or structure.
 - 3. No tape or marking allowed on glass.
- B. Replacements and Repairs: Prior to Substantial Completion, replace broken, defective, or scratched glass and repair damaged compounds.

END OF SECTION

SECTION 08 90 00 LOUVERS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Movement and Control Association (AMCA): 500-L, Laboratory Methods of Testing Louvers for Rating.
 - 2. The Aluminum Association, Incorporated (AA): Designation System for Aluminum Finishes.
 - 3. ASTM International (ASTM):
 - a. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
 - b. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 4. UL: Building Materials Directory.

1.02 DESIGN REQUIREMENTS

A. Wind Loads: Provide louver assemblies and their anchorage to the wall structure that are capable of withstanding the positive and negative wind load pressures shown on the Components and Cladding Wind Surface Pressures table on the Structural Drawings.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Large scale details of louvers, anchorage, and relationship to adjoining construction.
 - a. Manufacturer's Literature: Descriptive and performance data of louvers, including standard drawings and louver-free area.
 - 2. Samples: Manufacturer's standard finishes and colors.
 - 3. Product/Code Certification: Provide written verification that submitted louver assembly and installation method meet or exceed Project Design Requirements, in this section, by one, or more, of the following methods as allowed for by FBC:
 - a. Florida Product Approval for complete louver assembly.
 - b. Rational Comparative Analysis: Testing data, calculations, and verification documents signed and sealed by a professional engineer registered in the State of Florida.
 - c. Local product approval by Authority Having Jurisdiction (AHJ).

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ROGER SCOTT POOL FACILITIES

- B. Informational Submittals:
 - 1. Factory test data.
 - 2. Certificates of AMCA ratings.
 - 3. Installation instructions.
 - 4. Parts list, if applicable.
 - 5. Maintenance procedures.
 - 6. Special Guarantee.
 - 7. Third party testing documentation or manufacturer's literature qualifying louver assembly as meeting required developed wind pressures for Project as shown on the Components and Cladding Wind Surface Pressures table on the Structural Drawings.

1.04 SPECIAL GUARANTEE

A. Manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction, or at option of Owner, removal and replacement of special fluorocarbon or baked-on finish found defective during a period of 20 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

PART 2 PRODUCTS

2.01 GENERAL

- A. Hurricane-rated louver sizes are based on 46 percent free area and 500 fpm maximum velocity through free area.
- B. Water Penetration Rate: No greater than 0.02 ounce per square foot.
- C. Louvers: Rated and tested in accordance with AMCA 500-L.
- D. Furnish louvers with interior duct collars.

2.02 FIXED STORMPROOF LOUVERS (TYPE SP)

- A. Frame: Extruded aluminum channel, 0.081-inch thick, 6 inches deep, with concealed mullions.
- B. Blades: Extruded aluminum, 0.081-inch thick, Z-shaped, 35-degree to 45-degree pitch angle, spaced 3 inches to 4.25 inches on center.
- C. Pressure Loss: AMCA certified rating of no greater than 0.10-inch WC.

- D. Sizes: As shown on the Drawings.
- E. Screen: Inside mounted, painted aluminum, 1/2-inch mesh.
- F. Finish: Kynar 500 fluorocarbon coating.
- G. Manufacturers and Products:
 - 1. Ruskin; Model ELF6375DXD 6-inch Deep Horizontal Drainable Hurricane Louver "Or-equal," approved.

2.03 ACCESSORIES

- A. Anchors and Fasteners: Stainless steel.
- B. Flashings: Match louver frame.
- C. Isolation Tape: Tremco 440, 3M EC1202, or Presstite 579.6.
- D. Isolation Paint: ASTM D1187, bituminous coating.

2.04 SOURCE QUALITY CONTROL

- A. Factory Performance Tests:
 - 1. Airflow versus pressure loss.
 - 2. Rain penetration data.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Check openings to ensure dimensions conform to the Drawings.
- B. Ensure openings are free of irregularities that would interfere with installation.
- C. Do not install louvers until defects have been corrected.

3.02 INSTALLATION

- A. Install louvers as shown on reviewed Shop Drawings. Coordinate with heating or ventilation ductwork to be connected.
- B. Follow procedures in manufacturer's recommended installation instructions.
- C. Separate aluminum from other metals with isolation tape or paint.

3.03 CLEANING

- A. After erection, protect exposed portions from damage by machines, paint, lime, acid, cement, or other harmful compounds.
- B. Remove protective materials and clean with plain water, water with soap, or household detergents.

END OF SECTION

SECTION 09 29 00 GYPSUM BOARD

PART 1 GENERAL

1.01 GENERAL:

- A. Section includes:
 - 1. Gypsum Board.
 - 2. Non-Structural Framing.
- B. Related sections:
 - 1. Section 07 21 01, Thermal Insulation.
 - 2. Section 09 90 05 Architectural Painting.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI): A118.9, Test Methods and Specifications for Cementitious Backer Units.
 - 2. ASTM International (ASTM):
 - a. A641/A641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - b. C208, Standard Specification for Cellulosic Fiber Insulating Board.
 - c. C475/C475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
 - d. C514, Standard Specification for Nails for the Application of Gypsum Board.
 - e. C645, Standard Specification for Nonstructural Steel Framing Members.
 - f. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - g. C754, Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - h. C840, Standard Specification for Application and Finishing of Gypsum Board.
 - i. C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

- j. C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- k. C1177/C1177M, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- 1. C1178/C1178M, Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel.
- m. C1396/C1396M, Standard Specification for Gypsum Board.
- n. D4977, Standard Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion.
- o. D5420, Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
- p. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- q. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- r. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
- s. E413, Classification for Rating Sound Insulation.
- t. E695, Standard Test Method of Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading.
- 3. Gypsum Association (GA):
 - a. 214, Recommended Levels of Gypsum Board Finish.
 - b. 216, Application and Finishing of Gypsum Panel Products.
- 4. UL: UL Fire Resistance Directory.

1.03 SUBMITTALS

- A. Submittals:
 - 1. Control joint pattern proposed for gypsum board.
 - 2. Control joint pattern proposed for gypsum soffit.
 - 3. Manufacturer's list of items and materials proposed for use, with descriptive literature for each system used.
 - 4. Manufacturer's product data for adhesives and sealants including printed statement of VOC content and material safety data sheets.

1.04 QUALITY ASSURANCE

A. General: Regardless of the minimum specifications herein, utilize materials and applications recommended by manufacturer.

- B. Applicator's Qualifications: Use only workers regularly employed in this type of work who can show experience in application of similar materials and specific systems specified.
- C. Single Source Responsibility: Use gypsum board and related joint treatment materials from a single manufacturer for each type used.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver fire-rated materials bearing testing agency label and required fire classification numbers.
- B. Storage:
 - 1. Store materials inside, under cover, stacked flat, off floor.
 - 2. Stack gypsum board so that long lengths are not over short lengths.
 - 3. Avoid overloading floor system of storage area.
 - 4. Store adhesives and finishing compounds in dry areas; protect against freezing at all times.

1.06 ENVIRONMENTAL CONDITIONS

- A. Temperature: In areas receiving gypsum board installation, maintain minimum temperature of 40 degrees F for 48 hours before, during, and after gypsum board application. Maintain minimum temperature of 50 degrees F for 48 hours before, during, and after application of adhesive methods of attachment and finishing compounds until drying is complete.
- B. Ventilation:
 - 1. Provide ventilation during and following adhesives and joint treatment applications.
 - 2. Use temporary air circulators in enclosed areas lacking natural ventilation.
 - 3. Under slow drying conditions, allow additional drying time between coats of joint treatment.
 - 4. Protect installed materials from drafts of ambient air during hot, dry weather.
 - 5. Protect materials from drying too rapidly during hot and dry weather.

PART 2 PRODUCTS

2.01 GYPSUM BOARD

A. Regular Board (GWB): ASTM C1396/C1396M, 5/8-inch thick with tapered edges.

- B. Abuse Resistant Board (ARWB): ASTM C1396/C1396M, Type X, 5/8-inch thick as manufactured by:
 - 1. National Gypsum Company; Gold Bond Hi-Abuse Wallboard.
 - 2. United States Gypsum Co.; SHEETROCK Brand Abuse-Resistant Gypsum Panels.

2.02 TILE BACKING PANELS

- A. Cementitious Backer Board (CBB):
 - 1. Aggregated portland cement panel reinforced with vinyl-coated, woven fiberglass mesh embedded in both surfaces meeting ANSI A118.9.
 - 2. Thickness: 1/2-inch.
 - 3. Manufacturers and Products:
 - a. Custom Building Products; Wonderboard.
 - b. United States Gypsum; Durock.

2.03 FASTENERS

- A. Gypsum Board:
 - 1. Annular Ring Nail: ASTM C514, GWB-54, 1-1/4 inches long for 1/2-inch gypsum board, and 1-3/8 inches long for 5/8-inch gypsum board.
 - 2. Smooth Shank Nail: ASTM C514, 1-3/8 inches long for 1/2-inch gypsum board, and 1-1/2 inches long for 5/8-inch gypsum board.
 - 3. Screws: ASTM C1002, self-drilling, self-tapping, bugle head, for use with power-driven tool.
 - a. Type S, 1-inch long for gypsum board to sheet metal.
 - b. Type W, 1-1/4 inches long for gypsum board to wood.
- B. Glass Mesh Mortar Units/Cementitious Backer Board:
 - 1. Screws: ASTM C1002, self-drilling, self-tapping, bugle head, for use with power-driven tool.
 - a. Type S, 1-1/4-inch, Hi-Lo for wood or 22-gauge to 25-gauge steel framing.
 - b. Type S-12, 1-1/4-inch, for 14-gauge to 20-gauge steel framing; 1-15/16 inch.
 - c. Type S-12, Pilot Point for steel joists.
 - 2. Nails: 1-1/4-inch galvanized roofing nail with 7/16-inch diameter head for wood framing.

2.04 JOINT TREATMENT MATERIALS

- A. Tape:
 - 1. General Interior Applications: ASTM C475/C475M, perforated paper tape.
 - 2. Soffit Board, Glass Mesh Mortar Units, and Cementitious Backer Board: 2-inch wide 10 by 10 open weave glass mesh tape as recommended by manufacturer.
- B. Compound:
 - 1. General Interior Applications: ASTM C475/C475M, all-purpose, ready-mixed compound.
 - 2. Water-Resistant GWB and Soffit Boards: Chemically curing, polyindurate type material as recommended by manufacturer.

2.05 ANCILLARY MATERIALS

- A. Adhesives: As recommended by gypsum board manufacturer for intended use.
- B. Sound Attenuation Blankets: ASTM C665, Type I (no facing), 3 inches thick.
- C. Acoustical Sealant:
 - 1. Nonsetting and nonstaining with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Manufacturers:
 - a. DAP.
 - b. United States Gypsum.
 - c. Tremco.
 - d. Ohio Sealants, Inc.

2.06 TRIM ACCESSORIES

- A. ASTM C1047, Zinc-Coated Metal.
- B. Manufacturers and Products:
 - 1. Corner Bead:
 - a. 1-1/4 inches by 1-1/4 inches:
 - 1) United States Gypsum; Dur-A-Bead.
 - 2) Gold Bond; standard corner beads.
 - 2. Edge Trim:
 - a. United States Gypsum; 200B metal trim.
 - b. Gold Bond; No. 200 casing bead.

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- 3. Metal Control Joint:
 - a. United States Gypsum; No. 093.
 - b. Gold Bond; E-Z strip control joint.

2.07 NONSTRUCTURAL METAL FRAMING MEMBERS

- A. ASTM C645, galvanized C-studs with 1-5/8-inch flanges and C-H studs with J-runners.
- B. Sizes and Gauge: As noted on the Drawings.
- C. Manufacturers:
 - 1. United States Gypsum.
 - 2. Dale/Incor.
 - 3. Gold Bond.
 - 4. Unimast, Inc.

2.08 LIGHT-GAUGE METAL FRAMING ACCESSORIES

- A. Cold-Rolled Carrying Channel: Cold-rolled steel, 16-gauge metal with minimum 1/2-inch wide flange, galvanized 1-1/2 inches deep.
- B. Cold-Rolled Bridging Channel: Cold-rolled steel, 16-gauge metal with minimum 1/2-inch wide flange galvanized 1-1/2 inches deep.
- C. Cold-Rolled Furring Channel: Cold-rolled steel, 25-gauge metal with minimum 1/2-inch wide flange, galvanized 3/4 inches deep.
- D. Z-Furring: Galvanized 25-gauge, 2-1/2 inch(es) deep.
- E. Hat-Shaped Furring Channels: Roll-formed hat shaped section of 25-gauge galvanized steel with a face width of 1-1/4 inches and a depth of 7/8 inch.
- F. Resilient Furring Channels: Roll-formed section of 25-gauge galvanized steel with face width of 1-1/2 inches designed for resilient attachment of gypsum board to framing.
- G. Hanger Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
- H. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.625-inch diameter or double strand of 0.0475-inch diameter wire.

2.09 DRY WALL CEILING SUSPENSION SYSTEM

A. Use system of main runners, cross tees, and furring channels.

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- B. Manufacturers:
 - 1. Armstrong World Industries, Inc.; Furring Systems/Drywall.
 - 2. Chicago Metallic Corporation.
 - 3. USG Interiors, Inc.; Drywall Suspension System.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect surfaces to receive gypsum board and related materials before beginning work and report to Engineer any defects in such work which will adversely affect the quality of work specified herein.

3.02 PREPARATION

- A. General: Provide, install, and maintain necessary scaffold, staging, trestles, planking, and temporary heating, lighting, and ventilation as necessary for duration of gypsum board work.
- B. Protection: Protect work of other trades.
- C. Coordination:
 - 1. Coordinate work with that of other trades. Check Specifications and Drawings of other trades to determine parts of work requiring coordination.
 - 2. Cut and repair gypsum board systems for installation of omitted work.
- D. Surface Preparation: Repair defective surfaces prior to starting work. Prepare as specified for application of specific materials.

3.03 ERECTION OF SUSPENDED CEILING

- A. General:
 - 1. Securely brace all ceiling areas against sway as required by code for seismic control.
 - 2. Prevent runner and furring channels from contacting masonry walls.
 - 3. Provide 1-1/2-inch channels around recessed lighting fixture openings to support fixtures.
- B. Hangers:
 - 1. Space not over 4 feet on center (OC) in direction of runners and within 6 inches of ends of runners.

- 2. Securely attach to structure above and provide for full saddle tie to main runner at indicated height.
- 3. Install additional hangers at ends of each suspension member and at light fixtures, 6 inches from vertical surfaces.
- 4. Do not splay wires more than 5 inches in a 4-foot vertical drop.
- 5. Provide four-way wire splays at 45 degrees from main runner to support structure for every 144 square feet of ceiling area to prevent sway.
- 6. Wrap wire minimum three times horizontally, turning ends upward.
- 7. Where hanger wires cannot be hung vertically from structure above because of ducts, pipes, cable trays, or other interferences, provide trapezes of steel channels (minimum 2-inch deep, 16-gauge cold-rolled carrying channels) hung on steel rods or 8-gauge wire from structural members above. Hang ceiling wires from trapezes or similar members supporting ducts or pipes. Do not hang directly from ducts or pipes.
- C. Main Runner Channels:
 - 1. Run main runner channels spaced not more than 4 feet OC, and 6 inches from parallel walls, at right angles to the length of joists.
 - 2. Overlap splices in main runners 12 inches minimum, interlock flanges, and securely tie near each end of splice with double loops of tie wire.
- D. Furring Channels:
 - 1. Attach furring channels to main runners at right angles, space at 16 inches OC.
 - 2. Securely saddle tie furring to the main runners at each crossing or equivalent clips or attachments.
 - 3. Splices in Cross-Furring: Lap 8 inches minimum, interlock flanges, and securely tie near each end of splice with two loops of tie wire.

3.04 ERECTION OF DRY WALL CEILING SUSPENSION SYSTEM

- A. Follow manufacturer's printed instructions.
- B. Hangers:
 - 1. Space not over 4 feet OC in direction of runners and within 6 inches of ends of runners.
 - 2. Securely attach to structure above and provide for full saddle tie to main runner at indicated height.
 - 3. Connections shall develop full strength of hanger wire.
- C. Bracing:
 - 1. Securely brace ceiling areas against sway.

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- 2. Where required by code, install for seismic control.
- 3. Prevent runner and furring channels from contacting masonry walls.
- D. Where ducts interfere with normal spacing of hangers and carrying channels, install additional hangers and channels to properly suspend ceiling.

3.05 ERECTION OF LIGHT-GAUGE NONSTRUCTURAL METAL FRAMING

- A. Layout: Align partitions as shown on the Drawings.
- B. Tracks:
 - 1. Attach metal runner tracks to floor slabs with suitable fasteners located 2 inches from each end and spaced not more than 24 inches OC.
 - 2. Where partitions terminate at suspended or framed ceilings attach top tracks to suspended ceiling with toggle or molly bolts spaced 24 inches OC.
 - 3. Where partitions terminate above suspended ceilings provide diagonal bracing from top of partitions to structure above. Bracing shall be 3-5/8-inch metal studs staggered at 48 inches OC.
 - 4. Where partitions terminate at underside of concrete or metal decking attach deflection channels to substrate with suitable fasteners located 2 inches from each end and spaced not more than 24 inches OC. Locate partition top tracks within deflection channels with a minimum top clearance of 1-inch. Do not attach track to channel.
- C. Studs:
 - 1. ASTM C754.
 - 2. Following manufacturer's printed instructions, position studs vertically, engaging floor and ceiling tracks and spaced as noted on the Drawings.
 - 3. Splice: When necessary, use 8-inch nested lap and one positive attachment per stud flange.
 - 4. Place in direct contact with doorframe jambs, abutting partitions, and partition corners. Provide for anchorage of doorframes to studs.
 - 5. Anchor studs for shelf-walls and those adjacent to window and doorframes, partition intersections, and corners to ceiling and floor runner flanges. Securely anchor studs to jamb and head anchor clips of door or borrowed-light frames by bolt or screw attachment.
 - 6. Over metal door and borrowed-light frames, place horizontally a cut-tolength section of runner, with a web-flanged bend at each end, and secure with one positive attachment per flange. Position a cut-to-length stud (extending to ceiling runner) at vertical panel joints over doorframe header.
 - 7. Locate studs at abutting construction, partition intersections, and partition corners.

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- 8. Spacing: At 16 inches OC, unless otherwise required by manufacturer.
- 9. At Doorframes and Cased Openings:
 - a. Full height double studs, No. 20 gauge minimum, secured to jamb anchors by bolts, screws, or welds.
 - b. Header Track: Secure to frame head anchors and double studs.
 - c. Provide double channel stiffeners through studs above frame and extend at least one stud space beyond each jamb.
- 10. Windows: Similar framing to door openings with stiffeners both above and below.
- 11. Wall Mounting Accessories: Provide channels, horizontal studding, No. 16 gauge sheet 8 inches by 2 inches greater than stud spacing, or other members within walls as required to provide secure and adequate support.
- D. Furring:
 - 1. Space furring channels the same as studs or as shown.
 - 2. Around columns and beams construct furring as shown using metal studs and furring channels securely tied together and anchored in-place.
 - 3. Attach resilient furring channels to wood framing with screws.

3.06 APPLICATION OF GYPSUM BOARD

- A. Inspection and Preparation:
 - 1. Check framing for accurate spacing and alignment.
 - 2. Verify spacing of installed framing does not exceed maximum allowable for thickness of gypsum board to be used.
 - 3. Verify frames are set for thickness of gypsum board to be used.
 - 4. Do not proceed with installation of gypsum board until deficiencies are corrected and surfaces to receive gypsum board are acceptable.
 - 5. Repair protrusions of framing, twisted framing members, or unaligned members before installation of gypsum board is started.
- B. General:
 - 1. Meet requirements of ASTM C840 and GA 216.
 - 2. Joints: Use gypsum board of maximum lengths to minimize end joints. Stagger end joints when they occur. Locate end joints as far as possible from center of wall or ceiling. Abut gypsum board without forcing. Neatly fit ends and edges of gypsum board. Do not place butt ends against tapered edges.
 - 3. Support ends and edges of gypsum board panels on framing or furring members except for face layer of double layer and where ends are back blocked and floated.

- 4. Use metal edge trim where gypsum board abuts another material, at corners, and where shown or noted on the Drawings.
- 5. Use cementitious backer board in toilet, shower, and janitor room walls behind ceramic tile and elsewhere as indicated on the Drawings.
- 6. Follow manufacturer's recommendation of good practice.
- C. Over Framing:
 - 1. Apply gypsum board first to ceiling and then to walls for single layer horizontal application.
 - 2. Use vertical application for fire-rated walls.
 - 3. Fasten gypsum board securely to framing using double nailing, screw, or adhesive method.
- D. Sound-Rated Partitions:
 - 1. Fabricate and erect in accordance with manufacturer's printed instructions for required rating.
 - 2. Install sound-deadening board and attenuation blankets as detailed.
 - 3. Seal with acoustical sealant perimeter edges of gypsum board, joints around penetrations, and other joints as noted.

3.07 INSTALLATION OF CEMENTITIOUS BACKER BOARD (CBB)

- A. Follow manufacturer's printed instructions for erection, cutting, attachments, and joint treatment.
- B. Verify framing is installed at maximum 16 inches OC, and necessary blocking to support fixtures and accessories has been installed. Where backing plates or straps are used, space out from framing to ensure a smooth finish application. Do not proceed until defects are corrected and are acceptable.
- C. Precut boards to required sizes and make necessary cutouts. Fasten with appropriate fasteners. Space fasteners 6 inches OC maximum or as directed by manufacturer. Fit ends closely but not forced together. Maintain 1/4-inch spacing between edge of board and fixture. Caulk all joints and corners that are to receive tiles. Apply 2-inch glass fiber tape over joints and corners embedded with tile setting mortar.

3.08 JOINT SYSTEM FOR GYPSUM WALLBOARD

- A. Interior Gypsum Board: Conform to ASTM C840.
- B. Required: On exposed gypsum board, under ceramic tile and wall covering, and behind casework.

- C. Prefill: Fill V-grooves formed by abutting rounded edges of gypsum board with prefill joint compound. Fill V-joint flush and remove excess compound beyond groove. Leave clear depression to receive tape. Permit prefill joint compound to harden prior to application of tape.
- D. Taping and Finishing Joints:
 - 1. Taping or Embedding Coat: Apply compound in thin, uniform layer to joints and angles to be reinforced. Apply reinforcing tape immediately. Center tape over joint and seat tape into compound. Leave approximately 1/64-inch to 1/32-inch compound under tape to provide bond. Apply skim coat immediately following tape embedment but not to function as fill or second coat. Fold tape and embed in angles to provide true angle. Dry embedding coat prior to application of fill coat.
 - 2. Filling Coat: Apply joint compound over embedding coat. Fill taper flush with surface. Apply fill coat to cover tape. Feather out fill coat beyond tape and previous joint compound line. For joints with no taper, feather out at least 4 inches on either side of tape. Do not apply fill coat on interior angles. Allow fill coat to dry prior to application of finish coat.
 - 3. Finishing Coat: Spread joint compound evenly over and beyond fill coat on joints. Feather to smooth uniform finish. Apply finish coat to taped angles to cover tape and taping compound. Sand final application of compound to provide surface ready for decoration.
 - 4. Filling and Finishing Depressions: Apply joint compound as first coat to fastener depressions. Apply at least two additional coats of compound after first coat is dry. Leave filled and finished depressions level with plane of surface.
- E. Finishing Beads and Trim:
 - 1. First Fill Coat: Apply joint compound to bead and trim. Feather out from ground to plane of the surface. Dry compound prior to application of second fill coat.
 - 2. Second Fill Coat: Apply joint compound in same manner as first fill coat. Extend beyond first coat onto face of gypsum board. Dry compound prior to application of finish coat.
 - 3. Finish Coat: Apply joint compound to bead and trim. Extend beyond second fill coat. Feather finish coat from ground to plane of surface. Sand finish coat to provide flat surface ready for decoration.

3.09 FINAL FINISHES FOR GYPSUM WALLBOARD

A. Levels of Finish: Conform to GA 214.

- B. Level 1:
 - 1. Taping or embedding coat only.
 - 2. Use in concealed areas, and where indicated, unless a higher level is required for fire-resistive or sound-rated assemblies.
- C. Level 2:
 - 1. Taping, filling, and finishing coats.
 - 2. Use on water-resistant gypsum backing board.
- D. Level 3:
 - 1. Taping, filling, and finishing coats.
 - 2. Use on surfaces indicated to have spray texture or ceramic tile.
- E. Level 4:
 - 1. Taping, filling, and finishing coats plus two separate coats applied over joints, angles, fastener heads, and trim accessories.
 - 2. Sand between coats and after last coat.
 - 3. Use on surfaces indicated to receive wall coverings.
- F. Level 5:
 - 1. Same as Level 4, plus a thin, smooth, uniform skim coat of joint compound, or product specially formulated for this purpose, over entire surface.
 - 2. Produce surfaces free of tool marks and ridges, ready for decoration.
 - 3. Use on surfaces not indicated otherwise, those indicated to receive gloss, semi-gloss, and nontextured flat paints, and where indicated.

3.10 SPRAY TEXTURE

- A. Application:
 - 1. Apply on gypsum board wall following manufacturer's printed directions for a medium build peel texture.
 - 2. Before texture application, finish gypsum board as specified for Level 3.
 - 3. When surfaces are prepared and dry, apply sealer and allow to dry. Mix texture finish material as directed by manufacturer.
 - 4. Use spray equipment of a size and type to assure acceptable results.

- 5. Apply by spray only at a coverage rate as recommended by manufacturer and in accordance with directions printed on container. Apply material to blend uniformly and cover fully without starved spots or other evidence of thin application. Provide uniform texture without application patterns.
- 6. After spray application, knockdown and flatten high spots with trowel to produce a Brocade or Travertine marble texture.

3.11 ADJUST AND CLEAN

- A. Clean: Remove droppings or texture overspray from walls, windows, and floor, leaving room clean for following trades.
- B. Nail Pop: Repair nail pop by driving new nail approximately 1-1/2 inches from nail pop and reseat nail. When face paper is punctured, drive new nail or screw approximately 1-1/2 inches from defective fastening and remove defective fastening. Fill damaged surface with compound.
- C. Ridging:
 - 1. Do not repair ridging until condition has fully developed, approximately 6 months after installation or one heating season.
 - a. Sand ridges to reinforcing tape without cutting through tape.
 - b. Fill concave areas on both sides of ridge with topping compound.
 - c. After fill is dry, blend in topping compound over repaired area.
 - 2. Fill cracks with compound and finish smooth and flush.

END OF SECTION

SECTION 09 30 00 TILING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI):
 - a. A108.1A, Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar.
 - b. A108.1B, Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar.
 - c. A108.1C, Contractor's Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar.
 - d. A108.4, Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive.
 - e. A108.5, Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
 - f. A108.6, Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy.
 - g. A108.8, Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout.
 - h. A108.9, Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout.
 - i. A108.10, Installation of Grout in Tilework.
 - j. A108.11, Interior Installation of Cementitious Backer Units.
 - k. A118.1, Dry-Set Portland Cement Mortar.
 - 1. A118.3, Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy and Water-Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.
 - m. A118.4, Latex-Portland Cement Mortar.
 - n. A118.5, Chemical Resistant Furan Mortars and Grouts for Tile Installation.
 - o. A118.6, Standard Cement Grouts for Tile Installation.
 - p. A118.10, Load Bearing, Bonded, Waterproof Membranes for Thin-set Ceramic Tile and Dimension Stone Installation.
 - q. A136.1, Organic Adhesives for Installation of Ceramic Tile.
 - r. A137.1, Ceramic Tile.
- 2. ASTM International (ASTM):
 - a. A497/497M, Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete.
 - b. C144, Standard Specification for Aggregate for Masonry Mortar.
 - c. C150, Standard Specification for Portland Cement.
 - d. C206, Standard Specification for Finishing Hydrated Lime.
 - e. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
 - f. C267, Standard Test Method for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.
 - g. C395, Standard Specification for Chemical-Resistant Resin Mortars.
 - h. C847, Standard Specification for Metal Lath.
 - i. C920, Standard Specification for Elastomeric Joint Sealants.
 - j. D226, Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
- 3. South Coast Air Quality Management District: SCAQMD Rule 1168 Adhesive and Sealant Applications.
- 4. Tile Council of North America (TCA): Handbook for Ceramic Tile Installation.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Samples:
 - a. Two for each color, pattern, and type of tile specified.
 - b. Size: Approximately 12 inches square.
 - c. Mark Samples clearly to indicate color or shade, location in which to be used, and manufacturer's name.
- B. Informational Submittals:
 - 1. Certification of Compliance: For tile, mortar, grouts, and adhesives.
 - 2. Manufacturer's Instructions: For storage, mixing, application, cleanup, and use of proposed mortars, grouts, and adhesives.
 - 3. Tile Manufacturer's Maintenance Guidelines: For Owner's use in maintaining ceramic tilework specified herein.

1.03 QUALITY ASSURANCE

A. Perform Work in accordance with TCA Handbook and ANSI A108 Series/A118 Series.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Set and grout tile in portland cement mortar when ambient temperature is at least 50 degrees F and rising. Follow ANSI A108.1A or ANSI A108.1B, as recommended by ANSI A108.1C.
- B. Comply with minimum temperature recommendations of manufacturers for bonding and grouting materials other than portland cement mortar.

1.05 EXTRA MATERIALS

A. Tile: Furnish extra 2 percent of each tile used in clean, marked cartons for Owner's future use.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials and products specified in this section shall be products of:
 - 1. American Olean Tile Co.
 - 2. Dal-Tile Corp.
 - 3. United States Ceramic Tile Co.

2.02 MATERIALS

- A. Unglazed Ceramic Floor Tile (UCFT-1): ANSI A137.1, Section 5.1, porcelain type, smooth cushion edge, nominal face size 12 inches by 12 inches. Furnish slip-resistant tile with 7-1/2 percent abrasive grain content in all areas where floor tile is scheduled or shown on the Drawings.
- B. Unglazed Ceramic Floor Tile (UCFT-2): ANSI A137.1, Section 5.1, porcelain type, smooth cushion edge, nominal face size 2 inches by 2 inches. Furnish slip-resistant tile with 7-1/2 percent abrasive grain content in all areas where floor tile is scheduled or shown on the Drawings.
- C. Glazed Wall Tile (GCWT):
 - 1. ANSI A137.1, Section 6.1.
 - 2. Cushion edges, face finished with colored bright glaze, nominal face size 3 inches by 6 inches.
- D. Coved Base (CERB): Cushion edges, face finished with colored bright glaze, nominal face size 6 inches by 12 inches.
- E. Latex-Portland Cement Mortar: ANSI A118.4.

F. Latex-Portland Cement Grout: Portland cement grout with latex additive, commercial quality, ANSI A118.6.

2.03 ANCILLARY MATERIALS

- A. Expansion Joints:
 - 1. Sealant: Silicone rubber type, meeting ASTM C920, Type S, Grade P, Class 25, Use T, color to match grout, with Shore A hardness of minimum 25 for joints in horizontal surfaces and minimum 35 in traffic areas.
 - 2. Backup Material: Flexible and compressible type, nonstaining and compatible with sealants used.
- B. Edge Strips: Stainless steel, Alloy 316 flat bar, 1/8-inch by depth of tile and mortar.
- C. Tile Cleaner: Neutral tile cleaner solution acceptable to tile manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Examine surfaces to receive ceramic tile, setting beds, or accessories prior to tile installation.
- B. Correct defects or adverse conditions affecting quality and execution of tile installation.
- C. Surfaces to receive tile shall be plumb, level, and true with square corners.
- D. Tolerances for Surfaces to Receive Tile:
 - 1. Portland Cement and Epoxy Mortar Methods:
 - a. Maximum Variation in Subfloor Surface: 1/4-inch in 10 feet.
 - b. Maximum Variation in Vertical and Ceiling Surfaces: 1/4-inch in 8 feet.
- E. Grounds, anchors, plugs, hangers, bucks, electrical and mechanical work, in or behind tile, to be installed prior to proceeding with tilework.
- F. Protection: Protect adjoining work surfaces before tilework begins.
- G. Make substrate firm, dry, clean, and free of oily or waxy films.

3.02 INSTALLATION

- A. Prepare surfaces, fit, set, or bond tile, grout and clean tile in accordance with applicable requirements of ANSI Standards for setting method specified, except as otherwise noted.
- B. Workmanship, Cutting, Fitting, and Grout Joint Size:
 - 1. Center and balance areas of tile.
 - 2. Generally start full size tiles at outside corners and leave cut tiles for inside corners.
 - 3. Tile Cutting:
 - a. Minimize number of cuts.
 - b. No cuts smaller than half size without approval of Engineer.
 - c. Make all cuts on the outer edges of the field.
 - d. Smooth cut edges. Install tile without jagged or flaked edges.
 - e. Do not split tile unless no other alternative is possible.
 - 4. Fit tile closely where edges will be covered by trim, escutcheons, or other similar devices.
 - 5. Maintain heights of tile work in full courses to nearest obtainable dimension where heights are given in feet and inches and are not required to fill vertical spaces exactly.
 - 6. Allowable Lippage: 1/32-inch.
 - 7. Grout Joint Size: 1/8-inch.
 - 8. Install accessories in tile work to be evenly spaced, properly centered with tile joints, and level, plumb, and true to the correct projection. Install accessories at locations and heights shown or designated.
- C. Trim: Provide bases, caps, stops, returns, trimmers, and other shapes to finish installation.
- D. Setting Wall Tile (Thin-Set Application):
 - 1. On Cementitious Backer Board Walls: Meet TCA Method W244C.
 - 2. Use latex-portland cement grout.
- E. Setting Floor Tile (Thin-Set Application):
 - 1. On Concrete: Meet TCA Method F113 with latex-portland cement grout.
- F. Edge Strips:
 - 1. At openings without thresholds and similar discontinuous edges of thinset tile floors.

- 2. Where ceramic tile floors are adjacent to other flooring material at same level.
- 3. Where ceramic tile cove base is combined with other types of flooring.

3.03 CLEANING AND SEALING

- A. Clean tile surfaces thoroughly on completion of grouting.
- B. Remove grout haze, observing tile manufacturer's recommendations as to use of acid and chemical cleaners.
- C. Rinse tilework thoroughly with clean water before and after using chemical cleaners.
- D. Polish surface of glazed tilework with soft cloth.
- E. After grout has cured for 10 days, clean and seal nonglazed tiles following sealer manufacturer's instructions and recommendations.

3.04 PROTECTION

- A. From Construction Dirt:
 - 1. Apply protective coat of neutral cleaner solution, one part cleaner to one part water, to clean completed tile walls and floors.
 - 2. Cover tile floors with heavy-duty, nonstaining construction paper, masked in-place.
 - 3. Just before substantial completion, remove paper and rinse protective coat of neutral cleaner from tile surfaces.
- B. From Traffic:
 - 1. Prohibit foot and wheel traffic from using newly tiled floors for at least 7 days.
 - 2. Place large, flat boards in walkways and wheel ways for 7 days where use of newly tiled floor with cement type grout is unavoidable.

END OF SECTION

SECTION 09 51 13 ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A641/A641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - b. C635/C635M, Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings.
 - c. C636/C636M, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - d. E1264, Standard Classification for Acoustical Ceiling Products.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Detailed layout of grid indicating hanger spacing, fastening and splicing details, change in level details, and access location.
- B. Informational Submittals: Manufacturer's recommendation for installation of system.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials with manufacturer's labels indicating brand name, pattern, size and thickness.
- B. Store materials in original protective packaging to prevent soiling, physical damage, or wetting.

1.04 ENVIRONMENTAL REQUIREMENTS

- Where acoustical materials are to be installed, maintain humidity of 65 percent to 75 percent in area for 25 hours before, during, and 25 hours after installation.
- B. Maintain uniform temperature of 55 degrees F to 70 degrees F prior to and during installation of materials.

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1.05 EXTRA MATERIAL

A. Provide acoustical units from same production run as installed equal to 1 percent of area.

PART 2 PRODUCTS

2.01 SUSPENSION SYSTEMS

- A. Components, Materials, and Accessories: Product of a single manufacturer.
- B. ASTM C635/C635M, Intermediate Duty:
 - 1. Exposed Aluminum Tee Grid:
 - a. Nonrated, light-duty, spaced to fit lay-in panels.
 - b. Color: White Aluminum.
 - c. Exposed Flange Width: 15/16-inch.
 - d. Edges: Single molding to match grid.
 - e. Manufacturers and Products:
 - 1) Chicago Metallic Corp.; All Aluminum 830 System.
 - 2) Armstrong; AL Prelude Plus system.
 - 2. Edge Molding:
 - a. Minimum 0.020-inch steel, channel- or angle-shaped.
 - b. Flange Width: 15/16-inch minimum.
 - c. Finish to match main members.
 - 3. Hanger Wire: ASTM A641/A641M, minimum 12-gauge, galvanized, soft-annealed, mild steel wire.
 - 4. Wire Ties: ASTM A641/A641M, 18-gauge, galvanized, annealed steel wire.

2.02 ACOUSTICAL UNITS

- A. Recessed Edge Lay-In Panels (ACT-1):
 - 1. Material: Fire-resistive mineral fiber, Class A.
 - 2. In accordance with ASTM E1264, Type III, Form 2.
 - 3. Pattern: Textured, fissured.
 - 4. Noise Reduction Coefficient (NRC): 0.60 to 0.70.
 - 5. Ceiling Attenuation Class (CAC): 30 to 39.
 - 6. Light Reflectance: LR 0.75.
 - 7. Nominal Size: 24 inches by 24 inches by 3/4-inch thick.
 - 8. Edges: Reveal or rabbeted.
 - 9. Finish and Color: Painted white, unless scheduled otherwise.
 - 10. Manufacturers and Products:
 - a. Armstrong; Item 540 Travertone Sanserra.
 - b. Celotex; Item PST-454, Everest.

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- c. U.S.G.; Item 3845, Auratone, Aspen.
- B. Plastic Faced Lay-In Panels (ACT-2):
 - 1. Material: Fiberglass.
 - 2. In accordance with ASTM E1264, Type XII, Form 1.
 - 3. Pattern: Stipple or nubby.
 - 4. Noise Reduction Coefficient (NRC): 0.70 to 0.80.
 - 5. Ceiling Attenuation Class (CAC): 20 minimum.
 - 6. Light Reflectance: LR 0.75 or over.
 - 7. Nominal Size: 24 inches by 24 inches by 5/8-inch thick.
 - 8. Edges: Square.
 - 9. Finish and Color: White vinyl facing.
 - 10. Manufacturers and Products:
 - a. Armstrong; Item 2983, Pebble.
 - b. U.S.G.; Item 7001G, Premier Nubby.

PART 3 EXECUTION

3.01 SEQUENCING

- A. Lay out grid.
- B. Coordinate with mechanical and electrical equipment in framing and cutting material around ceiling penetrations.
- C. Install suspension systems after mechanical work above is complete.
- D. Install acoustical units.

3.02 INSTALLATION OF SUSPENDED GRID SYSTEM

- A. Hang level and in straight alignment directly from structure in accordance with ASTM C636/C636M and manufacturer's printed instructions.
- B. Hanger Wires:
 - 1. Space maximum 4 feet on center each direction and securely attach to structure above.
 - 2. Install additional hangers at ends of each suspension member and at light fixtures, 6 inches from vertical surfaces.
 - 3. Do not splay wires more than 5 inches in a 4-foot vertical drop.
 - 4. Provide four-way wire splays at 45 degrees from main runner to support structure for every 144 square feet of ceiling area.
 - 5. Wrap wire minimum three times horizontally, turning ends upward.

- 6. Where hanger wires cannot be hung vertically from structure above because of ducts, pipes, cable trays, or other interferences, provide steel channel trapezes (minimum 2-inch deep, 16-gauge cold-rolled carrying channels) hung on steel rods or 8-gauge wire from structural members above. Hang ceiling wires from these trapezes or similar members supporting ducts or pipes. Do not hang directly from ducts or pipes.
- C. Edge Molding:
 - 1. Install at intersection of suspended ceiling and vertical surfaces.
 - 2. Miter corners where moldings intersect or install corner caps.
 - 3. Attach to vertical surface with mechanical fasteners.
- D. Provide additional channels, hangers, and trapezes as required to support edges of ceiling around and under mechanical and electrical work.

3.03 INSTALLATION OF ACOUSTICAL UNITS

- A. Upon completion of suspended grid system and other concealed work, install with pattern running in one direction.
- B. Place material to bear all around on suspension members.

3.04 CLEANING

- A. Clean soiled or discolored unit surfaces after installation.
- B. Touch up scratches, abrasions, voids, and other defects in painted surfaces.

3.05 SCHEDULE OF CEILING TYPES

- A. Areas to Receive Acoustical Ceilings: Indicated on Interior Finish Schedule located on the Drawings by type described below.
- B. Acoustical Ceiling Type 1 & 2 (ACT-1 & ACT-2):
 - 1. Suspension System: Exposed aluminum tee grid system, 24 inches by 24 inches.
 - 2. Exposed grid with main runners at 48 inches on center and cross tees at 24 inches on center.
 - 3. Lay out grid to provide symmetrical borders as shown and which are not less than half the size of the lay-in panels.
 - 4. Acoustical Units: As shown on Interior Finish Schedule.

END OF SECTION

ACOUSTICAL PANEL CEILINGS 09 51 13 - 4

SECTION 09 65 01 RESILIENT BASE

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - ASTM International (ASTM):
 a. F1861, Standard Specification for Resilient Wall Base.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Samples: Two 2-1/2-inch wide strips of base material.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 2. Operation and Maintenance Data:
 - a. List of recommended maintenance products, methods, and procedures.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Unless otherwise directed by Engineer, store materials in original containers at not less than 70 degrees F for not less than 24 hours immediately before installation.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Maintain temperature in space to receive flooring between 70 and 90 degrees F for not less than 24 hours before and 48 hours after installation.
- B. Maintain minimum temperature of 55 degrees F after flooring is installed, except as specified above.

1.05 EXTRA MATERIALS

A. Furnish additional rubber base from same production run as installed material.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flooring products of the following manufacturers meeting these Specifications may be used on this Project:
 - 1. Base Basis of Design: Roppe Rubber Company.
 - a. Other manufacturers:
 - 1) R. C. Musson Rubber Co.
 - 2) Johnsonite, Division of Duramax, Inc.

2.02 FLOOR COVERING MATERIALS

- A. Rubber Base: ASTM F1861, Type TP, Group 2, 0.125-inch thick, straight or coved style, 4 inches high.
 - 1. 4-inch Straight Base (RUB).
 - 2. Manufacturer: Roppe Rubber Base "Or-equal," approved.
- B. Adhesive: Type and brands of adhesive as recommended by manufacturer of covering material for conditions of installation.
- C. Primer and Crack Filler: Type and brand recommended by floor covering manufacturer.
- D. Wax: Furnish wax, cleaner, or other finishing material as recommended by floor covering manufacturer for the particular type of flooring material.
- E. Floor Filler: Asphalt mastic as manufactured by Armstrong, Lancaster, PA, or National Floor Products Co., Florence, AL.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrate for excessive moisture content and unevenness preventing execution and quality of resilient flooring as specified.
- B. Correct defects before installation of resilient flooring.

3.02 PREPARATION

A. Remove dirt, oil, grease, or other foreign matter from surfaces to receive floor covering materials.

- B. Fill cracks less than 1/16-inch wide and depression less than 1/8-inch deep with floor filler.
- C. Prime surfaces other than wood if recommended by floor covering manufacturer.

3.03 INSTALLATION OF BASE

- A. Remove defects in wall and floor that would prevent level and true installation of base material.
- B. Install base around perimeter of room or space, where shown, and at toe spaces of casework and cabinets.
- C. Unroll base material and cut into accurate lengths as desired or as required for minimum number of joints.
- D. Match edges of seams or double cut adjoining lengths to give continuous appearance.
- E. Install with tight butt joints with no joint widths greater than 1/64-inch.
- F. Apply adhesive and firmly adhere to wall surfaces.
- G. Press down so bottom cove edge follows floor profile.
- H. Ensure top and bottom edges of base are in firm contact with walls and floors.
- I. Form internal and external corners by using premolded corners. Other methods, acceptable to Engineer, may be used if premolded corners are not available.
- J. Scribe base accurately to abutting materials.

3.04 CLEANING AND PROTECTION

- A. Upon completion of the installation of floor covering and adjacent work, and after materials have set, clean surfaces with a neutral cleaner as recommended by manufacturer for type of floor covering material installed.
- B. Repair adjacent surfaces damaged by flooring installation.
- C. Protect completed work from traffic and damage until Substantial Completion by covering with plastic sheet, kraft paper, or plywood panels.

3.05 INSTALLATION SCHEDULE

A. Areas to receive rubber base are indicated in Interior Finish Schedule on the Drawings.

END OF SECTION

SECTION 09 90 05 ARCHITECTURAL PAINTING

PART 1 GENERAL

1.01 DEFINITIONS

- A. Terms used in this section:
 - 1. Coverage: Total minimum dry film thickness in mils, or square feet per gallon.
 - 2. FRP: Fiberglass Reinforced Plastic.
 - 3. HCl: Hydrochloric Acid.
 - 4. MDFT: Minimum Dry Film Thickness.
 - 5. MDFTPC: Minimum Dry Film Thickness Per Coat.
 - 6. mil: Thousandth of an inch.
 - 7. Military Specification-Paint.
 - 8. PSDS: Paint System Data Sheet.
 - 9. SFPG: Square Feet Per Gallon.
 - 10. SFPGPC: Square Feet Per Gallon Per Coat.
 - 11. SP: Surface Preparation.
 - 12. Existing: Those coated surfaces that are cut into, connected to, or otherwise changed or affected by the work of this contract.
- B. Paint Terms: Conform to ASTM D16.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data: Manufacturer's descriptive literature for coating materials and coating application accessories.
 - a. For each paint system used, furnish a Paint System Data Sheet (PSDS) and technical data sheet for each product used in the paint system. PSDS form is appended to the end of this section.
 - b. Submit required information on a system by system basis.
 - c. Provide copies of paint system submittals to applicator.
 - 2. Verification Samples: Two samples, minimum size 6 inches (152 mm) square, representing actual color and finish of each finish coating type, color, and finish to be applied.
- B. Informational Submittals:
 - 1. List of references substantiating applicator's experience.

2. Manufacturer's printed application instructions for each product, including product storage requirements and surface preparation requirements.

1.03 QUALITY ASSURANCE

A. Applicator's Experience: Minimum 5 years' practical experience in application of specified products and approved by the paint manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store products of this section in manufacturer's unopened packaging until installation.
- B. Establish and maintain storage area conditions for products of this section in accordance with manufacturer's instructions until installation.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction over project.

1.05 PROJECT CONDITIONS

- A. Do not apply coatings to exterior surfaces except under environmental conditions recommended by coating manufacturer.
- B. Establish and maintain environmental conditions recommended by coating manufacturer before, during, and after application of coatings to interior surfaces.
- C. During application of coating materials, post "WET PAINT" signs.
- D. During application of solvent-based materials, post "NO SMOKING" signs.

1.06 SEQUENCING

A. Do not allow application of finish coats in an area until moisture-producing construction activities, dust-producing construction activities, and other construction activities which could impair performance or appearance of finish coatings, have been completed in that area.

1.07 EXTRA MATERIALS

A. Supply for each finish coating material, color, and finish specified 2 gallons (7.75L) of paint material, in sealed 1-gallon (3.875L) containers, marked with color and finish identification.

B. Custom Colors: Provide details of color formulae and product availability.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Products of the following manufacturers, meeting these specifications, may be used on this project:
 - 1. Sherwin Williams, Cleveland, OH.
 - 2. Duron, Inc., Beltsville, MD.
 - 3. PPG Industries.
 - 4. TNEMEC.
- B. Unless otherwise specified for an individual product or material, supply products specified in this section from the same manufacturer.

2.02 MATERIALS

- A. General:
 - 1. Unless otherwise indicated, furnish factory-mixed paints. When required, mix coatings to correct consistency in accordance with manufacturer's instructions before application. Do not dilute or thin paints, except as instructed.
 - 2. Do not add additives, except as instructed or recommended by paint manufacturer.
 - 3. Furnish each coating material in quantity required for this section from a single production run.
 - 4. Colors: To be selected by Architect from manufacturer's full range of available colors.
- B. Paint Application Accessories: As specified in this section or as recommended by paint manufacturer's application instructions, including but not limited to thinners, sealers, primers, cleaning agents, etching agents, cleaning cloths, sanding materials, and clean-up materials.
- C. Acrylic Latex, Flat: Sherwin-Williams; ProMar 200 Flat B31W200.
- D. Acrylic Texture Coating: Sherwin-Williams; Conflex, UltraCrete, Medium coarse.
- E. Latex Primer Sealer: Sherwin-Williams; PrepRite High-Build B28W600.
- F. Block Filler: Sherwin-Williams; ProMar Interior/Exterior Block Filler B25.

G. Concrete Primer: Sherwin-Williams; Loxon Concrete and Masonry Primer-Sealer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Immediately prior to coating application, ensure that surfaces to receive coatings are dry.
- B. Ensure that moisture-retaining substrates to receive coatings have moisture content within tolerances allowed by coating manufacturer, using moisture measurement techniques recommended by coating manufacturer.
- C. Immediately prior to coating application, examine surfaces to receive coatings for surface imperfections and for contaminants which could impair performance or appearance of coatings, including but not limited to, loose primer, rust, scale, oil, grease, mildew, algae, or fungus, stains or marks, cracks, indentations, or abrasions.
- D. Correct the above conditions and other conditions that could impair performance or appearance of coatings in accordance with specified surface preparation procedures before proceeding with coating application.

3.02 PREPARATION

- A. Do not start work until surfaces to be finished are in proper condition to produce finished surfaces of uniform, satisfactory appearance.
- B. Stains and Marks: Remove completely, if possible, using materials and methods recommended by coating manufacturer; cover stains and marks which cannot be completely removed with isolating primer or sealer recommended by coating manufacturer to prevent bleed-through.
- C. Mildew, Algae, and Fungus: Remove, using materials and methods recommended by coating manufacturer.
- D. Remove dust and loose particulate matter from surfaces to receive coatings immediately prior to coating application.
- E. Remove or protect hardware, electrical plates, mechanical grilles and louvers, lighting fixture trim, and other items not indicated to receive coatings that are adjacent to surfaces to receive coatings.

- F. Existing Painted Surfaces: Remove loose and peeling paint. Degloss surface if recommended by manufacturer. Sand smooth. Clean entire surface prior to painting.
- G. Aluminum Surfaces: Remove surface contamination by steam or high pressure water. Remove oxidation by phosphoric acid-water solution etching and solvent washing. Apply specified primer as soon as cleaned surfaces are dry.
- H. Concrete and Concrete Masonry: Clean surfaces free of loose particles, sand, efflorescence, laitance, form oil, curing compounds, and other substances which could impair coating performance or appearance.
- I. Concrete Floors: Remove contaminants which could impair coating performance or appearance, acid-etch, flush with clean water; verify alkaline-acid balance recommended by coating manufacturer; mechanically abrade surface, if required, to achieve medium-sandpaper texture.
- J. Galvanized Surfaces: Remove surface contamination and oils by solvent cleaning (SSPC-SP1) and allow to dry. Apply Galvanized Metal Primer in accordance with manufacturer instructions.
- K. Wood:
 - 1. Seal knots, pitch streaks, and sap areas with sealer recommended by coating manufacturer; fill nail recesses and cracks with filler recommended by coating manufacturer; sand surfaces smooth.
 - 2. Apply primer coat to back of wood trim and paneling.
- L. Gypsum Board: Repair cracks, holes, indentations, and other surface defects using joint compound to produce surface flush with adjacent undamaged surface; sand to produce uniform flat surface when dry.
- M. Gypsum Plaster: Cut out cracks, holes, indentations, and other surface defects to extent required for bonding adhesion; apply patching plaster or joint compound to produce surface flush with adjacent undamaged surface; sand to produce uniform flat surface when dry; allow to cure 30 days before coating application.
- N. Wood and Metal Doors: Seal top and bottom edges with specified primer.
- O. Uncoated Steel and Iron Surfaces: Remove grease, rust, scale, and dust from steel and iron surfaces in accordance with Solvent Cleaning SSPC-SP1. Where heavy coatings of scale or contaminants are evident, clean in accordance with Hand Tool Cleaning SSPC-SP2 or other approved SSPC-SP method as needed.

P. Shop Primed Steel Surfaces: Remove loose primer and dust. Sand and feather edges to smooth surface. Clean areas with solvent and spot prime bare metal surfaces with appropriate primer recommended by manufacturer.

3.03 APPLICATION

- A. Apply paint where indicated in Interior Finish Schedule.
- B. Apply each coat to uniform coating thickness following manufacturer's instructions, not exceeding manufacturer's specified maximum spread rate for indicated surface; thins, brush marks, roller marks, orange-peel, or other application imperfections are not permitted.
- C. For opaque finishes, tint each coat, including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
- D. Allow manufacturer's specified drying time, and ensure correct coating adhesion, for each coat before applying next coat.
- E. Inspect each coat before applying next coat; touch-up surface imperfections with coating material, feathering, and sanding if required; touch-up areas to achieve flat, uniform surface without surface defects visible from 5 feet (1.5 m).
- F. Do not apply succeeding coat until previous coat has been approved by Engineer; only Engineer-approved coats will be considered in determining number of coats applied.
- G. Remove dust and other foreign materials from substrate immediately prior to applying each coat.
- H. Where coating application abuts other materials or other coating color, terminate coating, making clean sharp termination line without coating overlap.
- I. Where color changes occur between adjoining spaces, through framed openings that are of same color as adjoining surfaces, change color at outside stop corner nearest to face of closed door.
- J. Re-prepare and recoat unsatisfactory finishes; refinish entire area to corners or other natural terminations.

3.04 ITEMS NOT TO BE PAINTED

- A. Do not paint the following:
 - 1. Items specified or provided with factory finish.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Brick, precast concrete, integrally colored plaster.
 - 5. Concrete masonry in utility, mechanical, and electrical spaces.
 - 6. Stainless steel, anodized aluminum, bronze, terne, or lead.
 - 7. Equipment nameplates, fire rating labels, and operating parts of equipment.
 - 8. Acoustical materials.
 - 9. Concealed piping, ductwork, and conduit.
- B. Materials and products having factory-applied primer are not considered factory finished.

3.05 PAINT SYSTEMS

A. System No. 113 Concrete, Eggshell:

Surface Prep.	Paint Material	Min. Coats, Cover
In accordance Concrete Surface Preparation as recommended by Manufacturer	Concrete Acrylic Coating Primer-Sealer	1 coat, as recommended by Manufacturer
	Acrylic Textured Coating	2 coats, 240 SFPGPC

B. System No. 115 Gypsum Board and Plaster, Flat:

Surface Prep.	Paint Material	Min. Coats, Cover
Gypsum Board or Plaster	Latex Primer/Sealer	1 coat, 350 SFPG
	Acrylic Latex (Flat)	2 coats, 240 SFPGPC

END OF SECTION

SECTION 10 14 00 SIGNAGE

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards that may be referenced in this section:
 - 1. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
 - 2. ASTM International (ASTM):
 - a. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - b. D709, Standard Specification for Laminated Thermosetting Materials.
 - 3. National Fire Protection Association (NFPA):
 - a. 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
 - b. HAZ-01, Fire Protection Guide to Hazardous Materials.
 - 4. Occupational Safety and Health Act (OSHA).

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Drawings showing layouts, actual letter sizes and styles, and Project-specific mounting details.
 - b. Manufacturer's literature showing letter sizes and styles, sign materials, and standard mounting details.
 - 2. Samples: One full size for each type of nameplate, sign, and label specified.
 - 3. One letter sample of the Channel letters proposed for the Entrance Sign. May be one of the actual letters to be installed.
- B. Informational Submittals: Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 GENERAL

- A. 5.5 inches by 5.5 inches minimum size with square corners. Minimum 2-layer acrylic, 1/8-inch thick.
 - 1. All space identification signs throughout the campus shall be matching in style and color and font size and style.
 - 2. Signs A must be all from the same sign product system.
 - 3. Color background shall be in contrast selected by Owner to contrast with block Helvetica lettering. Manufacturer to recommend font size for signs sized as stated above.
- B. ADA Compliant. Tactile characters/symbols both in reading words and Grade 2 Braille shall be raised 1/32 inch from the sign plate face. Florida ADA code compliant. Use symbols of accessibility in compliance with the Fifth Edition of the Florida Accessibility Code.
- C. Basis of Design: Window Sign with Room Name or Number and matching Braille Signage manufactured by the Office Sign Company.

2.02 ACRYLIC ADA SPACE NAME PLAQUES (TYPE A INTERIOR)

A. Specific scheduled spaces shall have sign mounted in compliance with Florida Accessibility Code. Toilet Rooms, Stairs, Elevator and common facilities will have Braille lettering as well. All Space identification signs shall be ADA Compliant. Spaces shall include room names, space names, and signs for toilet facilities, shower facilities, locker rooms, and safety messages throughout the buildings. See sign schedule.

2.03 FIBERGLASS SIGN (EXTERIOR) TYPE F

- A. Material: Three-ply laminated fiberglass, minimum 1/8-inch thick, with contrasting color core message layer between two clear weather-resistant surface layers.
- B. Manufacturers:
 - 1. Best Manufacturing Co.
 - 2. Brady Signmark.

2.04 BUILDING SIGN (EXTERIOR) TYPE G

1. Contractor shall submit drawings for approval.

2. See sign schedule and Architectural drawings for sign location and letter dimensions.

2.05 ANCILLARY MATERIALS

- A. Fasteners: Stainless steel screws or bolts of appropriate sizes.
- B. Wood Posts: Preservative treated 4 by 4 wood as specified in Section 06 10 00, Rough Carpentry.
- C. Pipe Posts: 2-1/2-inch galvanized steel pipe meeting ASTM A53/A53M, Type S, Grade B.
- D. Chain: Type 304 stainless steel, No. 16 single jack chain or No. 2 double loop coil chain.
- E. Manufacturer's standard brackets for wall mounting of two-sided exit signs.

PART 3 EXECUTION

- 3.01 INSTALLATION—GENERAL
 - A. In accordance with manufacturer's recommendations.
 - B. Mount securely, plumb, and level.

3.02 DOOR NAMEPLATES AND PICTORIAL SYMBOLS

- A. Attach to doors with self-sticking permanent adhesive. See Door and Hardware Schedule for locations and messages.
- B. Mount with bottom of nameplate at 5 feet 6 inches above floor.

3.03 SIGNS

- A. General:
 - 1. Fasten to walls or posts, or hang as scheduled.
 - 2. Anchor in place for easy removal and reinstallation with ordinary hand tools.
- B. Information, Exit, and Safety Signs: Install facing traffic. Locate for high visibility with minimum restriction of working area around walkways and equipment.

3.04 SUPPLEMENTS

- A. The supplement listed below, following "End of Section," is a part of this specification.
 - 1. Sign Schedule: Tabulation of characteristics and mounting information for warning, informational and unlighted exit signs on Project. Provide items as scheduled. Meet requirements of Occupational Safety and Health Act (OSHA).

END OF SECTION

	SIGN						MOUNTING			L	ETTERING	3		OTHER REQUIRE		
LOCATION	QT Y	MARK	TYPE	FORMAT	MAX	. SIZE	COLOR	LOCATION	METHOD	HEIGHT TO CENTERLIN	HEIGHT	STYLE	COLOR	MESSAGE	FACES	WENTS
					WIDTH	HEIGHT				E						
TICKETING BUILDING	1	S1	F	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	TICKETING BUILDING	1	ADA Compliant. Tactile characters/ symbols
TICKETING BUILDING	1	S2	A	By approved submittal	5.5"	5.5"	TBD	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	RESTROO M (UNISEX GRAPHIC SYMBOL W/ WORD RESTROO M)	1	
TICKETING BUILDING	1	S3	A	By approved submittal	5.5"	5.5"	TBD	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	TICKETS	1	
TICKETING BUILDING	1	S4	F	By approved submittal	5.5"	5.5"	TBD	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	MECH/ELE C	1	
RESTROOM BUILDING	1	S5	F	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	MECH/ELE C	1	ADA Compliant. Tactile characters/ symbols
RESTROOM BUILDING	1	S6	F	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	WOMEN RESTROO M (W/ GRAPHIC SYMBOL)	1	ADA Compliant. Tactile characters/ symbols

	SIGN			SIGN MOUNTING LETTERING						OTHER REQUIRE						
LOCATION	QT Y	MARK	TYPE	FORMAT	MAX	. SIZE	COLOR	LOCATION	METHOD	HEIGHT TO CENTERLIN	HEIGHT	STYLE	COLOR	MESSAGE	FACES	MENTS
					WIDTH	HEIGHT				E						
RESTROOM BUILDING	1	S7	F	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVE- TICA	BLACK	MEN RESTROO M (W/ GRAPHIC SYMBOL)	1	ADA Compliant. Tactile characters/ symbols
RESTROOM BUILDING	1	S8	A	By approved submittal	5.5"	5.5"	TBS	DOOR	PER- MANENT TAPE	5'-0"	1"	HELVETIC A	BLACK	JANITOR	1	
TICKETING BUILDING	1	S9	G	See Archite	ectural Draw	rings.	•	See Architectural Drawings	BOLTS/S CREWS	As directed	By approved submittal	To match adjacent Community Center sign	TBS	ROGER SCOTT POOL TICKETING	1	

SIGNAGE 10 14 00 SUPPLEMENT 1 - 2

SECTION 10 21 00 COMPARTMENTS AND CUBICLES

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes solid polymer units as follows:
 - 1. Urinal Screens: Wall hung.
 - 2. Toilet Enclosures: Overhead braced and floor anchored.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI):
 - a. A117.1, Accessible and Usable Buildings and Facilities.
 - b. Z124.2, Plastic Shower Receptors and Shower Stalls.
 - 2. Americans with Disabilities Act (ADA).
 - 3. ASTM International (ASTM):
 - a. A276, Specification for Stainless Steel Bars and Shapes.
 - b. A591/A591M, Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight (Mass) Applications.
 - c. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - d. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - e. B221/B221M, Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - f. F593, Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - g. F594, Specification for Stainless Steel Nuts.
 - 4. Code of Federal Regulations (CFR): 40 CFR 59, National Volatile Organic Compound Emission Standards for Consumer and Commercial Products.
 - 5. Federal Specifications, Standards and Commercial Item Descriptions, (FS): A-A-60003, Partitions, Toilet, Complete.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Include plans, sections, elevations, material descriptions, dimensions, and attachments to other work.
 - a. Show locations of cutouts for compartment-mounted grab bars.
 - b. Show locations of reinforcements and attachments for compartment-mounted toilet accessories.
 - c. Product Data: Manufacturer's detailed technical data for toilet compartments and urinal screens specified. Include details of anchors, hardware, and fastenings.
 - 2. Samples for Initial Selection: For each type of unit indicated.
 - 3. Samples for Verification:
 - a. Of each type of color and finish required for units, prepared on a 6-inch by 6-inch square sample of same thickness and material indicated for the Work.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Experienced installer who has 5 years' experience with projects completed in phenolic-core compartment installations similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to this Project with a minimum of 5 years' experience in similar sized projects.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project Site in undamaged condition.
- B. Store and handle phenolic-core and related materials to prevent deterioration or damage as a result of moisture, temperature changes, contaminants, corrosion, breakage, chipping, or warping.
- C. Stack or brace phenolic-core on edge on leveled and adequate A-frames in a manner that prevents undue stresses causing chipping, cracking, and breaking.

PART 2 PRODUCTS

2.01 SOLID POLYMER UNITS

- A. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1-inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Color and Pattern: One color and pattern in each room as selected by Engineer from manufacturer's full range of colors and patterns.
- B. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; polymer or stainless steel.
- C. Polymer Color and Pattern: Matching pilaster.
- D. Brackets Fittings: Stirrup Type: Ear or U-brackets, chrome-plated, nonferrous, cast zinc alloy (zamac) or clear anodized aluminum.
- E. Full-Height (Continuous) Type: Manufacturer's standard design; polymer or extruded aluminum.
 - 1. Polymer Color and Pattern: Matching pilaster.
- F. Manufacturers:
 - 1. Bradley Corporation; Mills Partitions.
 - 2. Capitol Partitions, Inc.
 - 3. Comtec Industries.
 - 4. General Partitions Mfg. Corp.
 - 5. Santana Products, Inc.

2.02 ACCESSORIES

- A. Dowels: Provide 1/4-inch (6.4-mm) diameter dowels fabricated from Type 304 stainless steel, ASTM A276.
- B. Fittings: Cast stainless steel, angle type fittings, with 1-3/4-inch by 1-3/4-inch (44.5-mm by 44.5-mm) legs, 1-1/4 inches (32 mm) long, and capable of supporting compartment components in configuration indicated.
- C. Exposed Anchors and Fasteners: #4 Brushed Stainless Steel fasteners with theft-resistant-type heads. Provide sex-type through bolts with theft-resistant spanner heads and threaded brass rods for attachments to stone.

D. Bolts, Nuts, and Washers: Provide Type 304 stainless steel bolts complying with ASTM F593, nuts complying with ASTM F594, and washers and lock washers for connection to overhead support as indicated.

2.03 FABRICATION

- A. General:
 - 1. Provide standard doors, panels, screens, and pilasters fabricated for compartment system.
 - 2. Provide units with cutouts and drilled holes to receive compartmentmounted hardware, accessories, and grab bars, as indicated.
 - 3. Provide internal reinforcement in metal units for compartment-mounted hardware, accessories, and grab bars, as indicated.
- B. Wall-Hung Screens: Provide units in sizes indicated of same construction and finish as compartment panels, unless otherwise indicated.
- C. Doors: Unless otherwise indicated, provide 24-inch (610-mm) wide inswinging doors for standard toilet compartments and 36-inch (914-mm) wide out-swinging doors with a minimum 32-inch (813-mm) wide clear opening for compartments indicated to be handicapped accessible.
 - 1. Hinges: Manufacturer's self-closing piano type that can be adjusted to hold door open at any angle up to 90 degrees.
 - 2. Latch and Keeper: Recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. At compartments indicated to be handicapped accessible, provide units that comply with accessibility requirements of authorities having jurisdiction.
 - 3. Coat Hook: Manufacturer's standard combination hook and rubbertipped bumper; sized to prevent door from hitting compartmentmounted accessories.
 - 4. Door Bumper: Manufacturer's standard rubber-tipped bumpers at outswinging doors or entrance screen doors.
 - 5. Door Pull: At out-swinging doors, manufacturer's standard unit that complies with accessibility requirements of authorities having jurisdiction. Provide units on both sides of doors at compartments indicated to be handicapped accessible.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Coordinate layout and installation of supports, inserts, and anchors built into other units of work for toilet compartment anchorage.
- D. Coordinate toilet stall required reinforcing, openings for toilet accessories and grab bars.

3.02 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written installation instructions.
 - 2. Install units rigid, straight, level, and plumb.
 - 3. Secure units in position with manufacturer's recommended anchoring devices.
 - 4. Maximum Clearances:
 - a. Pilasters and Panels: 1/2-inch (13 mm).
 - b. Panels and Walls: 1-inch (25 mm).
 - 5. Stirrup Brackets: Secure panels to walls and to pilasters with not less than three brackets attached at midpoint and near top and bottom of panel.
 - a. Locate wall brackets so holds for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Floor-Anchored Units:
 - 1. Set pilasters with anchors penetrating not less than 2 inches (50 mm) into structural floor, unless otherwise indicated in manufacturer's written instructions.
 - 2. Level, plumb, and tighten pilasters.
 - 3. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

- C. Wall-Hung Urinal Screens:
 - 1. Attach with anchoring devices to suit supporting structure.
 - 2. Set units level and plumb and to resist lateral impact.

3.03 ADJUSTING AND CLEANING

- A. Adjust and lubricate hardware for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return to fully closed position.
- B. Clean exposed surfaces of partition systems using materials and methods recommended by manufacturer, and provide protection as necessary to prevent damage during remainder of construction period.

END OF SECTION

SECTION 10 28 00 TOILET AND BATH ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Fire Protection Association (NFPA): 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.

1.02 DESIGN REQUIREMENTS

A. Design grab bars, shower seats, dressing room bench seats and attachments to resist minimum 250-pound concentrated load applied at any point in any direction.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Manufacturer's literature clearly indicating:
 - 1) Architect's identification mark, size, and description of components.
 - 2) Base material with surface finish inside and out.
 - 3) Hardware and locks and attachment devices.
 - 4) Description of rough-in framing.
 - 5) Manufacturer's cut sheets.
 - 6) Details of blocking and anchorage required.
- B. Informational Submittals:
 - 1. Distributor's List: List of local distributors for supplies required for accessories installed.
 - 2. Cleaning instructions.

1.04 QUALITY ASSURANCE

- A. Flame Resistant Fabric: Passes when tested in accordance with NFPA 701, Test 1 or Test 2.
- B. Recycled Content Materials: Furnish materials with recycled content.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials and products specified in this section shall be products of:
 - 1. Bobrick Washroom Equipment, Inc.
 - 2. Bradley Corp.
 - 3. Accessory Specialties, Inc.
 - 4. Watrous, Inc.
 - 5. Koala Kare
 - 6. American Specialties, Inc.

2.02 TOILET AND BATH ACCESSORIES

A. Furnish accessory items listed where indicated by mark or note on the Drawings.

Item	Mark	Koala Kare	Bobrick	Bradley
Surf. Mounted Dual Roll Toilet Paper Dispenser	TPD-1		No. B-2740	No. 5241-50
Wall Mounted Liquid Soap Dispenser	SD-2		No. B-4112	No. 6542
Mirror, Size on Dwgs	MIR		No. B-290	No. 780
Surf. Mounted Paper Towel Dispenser and Receptacle	PTD-1		No. B-359039	
Surf. Mounted Napkin Disposal	ND		No. B-270	No. 4781-15
Mop and Broom Holder (24")	M&BH		No. B-223 x 24	No. 9953
Grab Bars (straight) (36")	GB-1		No. B-6806-36	No. 812-001-36
Grab Bars (straight) (42")	GB-2		No. B-6806-42	No. 812-001-42
Grab Bars (shower, corner type)	GB-6		No. B-6861	No. 812-036/03 7 Modified (15"x30")
Horizontal Surface-Mounted Baby Changing Station	CS	KB300-00		

B. Baby Changing Station:

- 1. Minimum weight capacity: 50 pound.
- 2. User-friendly child safety strap.
- 3. Complies with ASTM F2285 static load performance requirements.

TOILET AND BATH ACCESSORIES 10 28 00 - 2

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- 4. Antimicrobial surface.
- 5. Built-in dual liner dispenser.
- 6. Color: Selected by Owner.
- 7. Installation: wall mounted.
- C. Finish:
 - 1. Satin stainless steel.
 - 2. Manufacturer's or brand name on face of units is not acceptable.
- D. Anchors: Furnish anchors, fasteners, or other devices necessary for a complete, secure installation.
 - 1. Fasteners: Tamper-proof screws or bolts.
- E. Supplies: Furnish fill supplies, such as paper goods, soap, and napkins, as recommended by accessory manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Coordinate support framing and backing as necessary for proper installation of accessories.
- B. Coordinate the Work with placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

3.02 INSTALLATION

- A. Mounting Heights and Locations: Locate where mark is shown on the Drawings at height required by accessibility regulations.
- B. Follow manufacturer's instruction and recommendations.
- C. Install and securely anchor accessories in their proper locations, plumb and level, and without distortion.
- D. Remove protective masking and clean surfaces, leaving them free of soil and imperfections.
- E. Fill units with necessary supplies within 10 days before Substantial Completion.
- F. Deliver to Owner keys and devices required to fill and service units.
3.03 CLEANING

A. Clean and repair existing toilet accessories which remain or are to be reinstalled.

END OF SECTION

TOILET AND BATH ACCESSORIES 10 28 00 - 4

SECTION 10 44 00 FIRE PROTECTION SPECIALTIES AND SAFETY EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Factory Mutual (FM).
 - 2. Mine Safety and Health Administration (MSHA).
 - 3. National Fire Protection Association (NFPA):
 - a. 10, Standard for Portable Fire Extinguishers.
 - b. 30, Flammable and Combustible Liquids Code.
 - 4. National Institute for Occupational Safety and Health (NIOSH).
 - 5. Occupational Safety and Health Administration (OSHA).
 - 6. UL: Fire Protection Equipment Directory.

1.02 PERFORMANCE REQUIREMENTS

- A. Conform to NFPA 10.
- B. Provide extinguishers classified and labeled by UL for purpose specified and indicated.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Fire Extinguishers: Manufacturer's product data for each item, including sizes, ratings, UL listings, or other certifications, and mounting information.
 - b. Product Data: Extinguisher operational features, color and finish, and anchorage details.
- B. Informational Submittals:
 - 1. Manufacturer's Installation Instructions:
 - a. Special criteria and wall opening coordination requirements.
 - b. Manufacturer's installation details.
 - c. Extinguisher location plan.
 - 2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

3. Operation and Maintenance Data: Submit test, refill or recharge schedules and recertification requirements.

1.04 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 61 00, Common Product Requirements: Environmental conditions affecting products onsite.
- B. Do not install extinguishers when ambient temperatures are capable of freezing extinguisher ingredients.

PART 2 PRODUCTS

2.01 PORTABLE FIRE EXTINGUISHERS

- A. Manufacturers:
 - 1. Basis of Design: JL Industries, Cosmopolitan model.
 - 2. Other Manufacturers:
 - a. Larsen's Manufacturing Co.
 - b. Nystrom Products Co.
 - c. Potter Roemer.
- B. General:
 - 1. Conform to NFPA 10 for fire extinguishers.
 - 2. Furnish fire extinguishers and cabinets from one manufacturer.
 - 3. UL listed, charged and ready for service.
- C. Multipurpose Hand Extinguisher (F. Ext-1):
 - 1. Tri-class dry chemical extinguishing agent.
 - 2. Pressurized, red enameled steel shell cylinder.
 - 3. Activated by top squeeze handle.
 - 4. Agent propelled through hose or opening at top of unit.
 - 5. For use on A, B, and C class fires.
 - 6. Minimum UL Rating: 4A-60B:C, 10-pound capacity.

2.02 ACCESSORIES

- A. Extinguisher Brackets: For hand extinguishers not located in cabinets, furnish heavy-duty brackets with clip-together strap for wall mounting formed steel, enamel finish.
- B. Graphic Identification: Provide graphic identification marking for each fire extinguisher type. OSHA approved pictorial markings to indicate the extinguisher uses and nonuses on a single label.

- C. Fasteners: Furnish necessary screws, bolts, brackets, and other fastenings of suitable type and size to secure items of fire and safety equipment in position.
 - 1. Metal expansion shields for machine screws at concrete and masonry.
 - 2. Interior: Rust-resistant.
 - 3. Exterior: Stainless steel.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Install where indicated or directed and in accordance with manufacturer's recommendations.
 - B. Secure brackets rigidly to structure.
 - C. Provide adequate backing for mounting surfaces.
 - D. Position signage as required by authorities having jurisdiction.

3.02 PORTABLE FIRE EXTINGUISHERS AND CABINETS

- A. Provide at locations shown or as directed by Engineer.
- B. Mount hangers securely in position, following manufacturer's recommendations.
- C. Top of Extinguisher: No more than 54 inches above floor.
- D. Install wall brackets, maximum 48 inches from finished floor to top of extinguisher handle.

END OF SECTION

SECTION 12 20 00 WINDOW TREATMENTS

PART 1 GENERAL

1.01 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings: Details of installation indicating size, attachments, and clearances of operating hardware with other construction.
- B. Product Data: Manufacturer's data sheets shall be submitted for each product specified, including:
 - 1. Preparation instructions and recommendations.
 - 2. Finishes, material descriptions, dimensions of individual components.
 - 3. Construction and installation instructions.
 - 4. Manufacturers recommendations for maintenance and cleaning.
- C. Sample: Contractor shall supply one sample shade of each type specified in for approval. Supplied units shall be furnished complete with all required components, mounting and associated hardware, instructions and warranty.

1.02 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Experienced and regularly engaged in the installation of window treatments.
 - 2. Use proper facilities and methods for production of the Work.
 - 3. Acceptable to the Engineer.
- B. Mockups: Provide one mock-up shade for each roller shade type/assembly specified. Approved mockup will be used as control Sample for workmanship and fabrication.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Handle in accordance with manufacturer's instructions.
- B. Storage and Protection: Store window covering and accessories in unopened packages in manner to prevent damage from environmental and construction operations.

1.04 SPECIAL GUARANTEE

A. Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of Work specified in this Specification section found defective during a period of 3 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

- A. Heavy Duty Manual Roller Shade:
 - 1. Fabric: Inherently anti-static, flame retardant, fade and stain resistant, light filtering fabrics providing 0 percent to 20 percent openness, containing fiberglass, PVC, polyester, acrylic, vinyl laminates, cotton, and vinyl coatings (based upon fabric choice).
 - a. Finish to be selected by architect from manufacturer's available contract colors.
 - 2. Control System:
 - a. Clutch Operated: Chain-driven operator capable of lifting up to 20 pounds of weight with a maximum allowable pull force of 10 pounds. Utilization of adjustment-free continuous qualified Type 304 stainless ball or fiberglass nylon chain. Components must be maintenance-free from adjustments or lubrication for trouble-free lifetime operation.
 - b. Chain anchor device to be compliant with WCMA safety standard A100.1.1-2010 and must prevent the clutch system from moving the roller shade through lowering and raising if not properly installed as specified in ANSI Standard Section 6.5.2.
 - c. Roller Tube: Circular-shaped aluminum tube extruded from alloy and temper 6063 T-6. Extruded tube to have a .063-inch wall thickness (2.5-inch outside diameter to have a 0.79-inch wall thickness). Heavily reinforced with internal ribs and flutes providing additional tensile strength and allows for secure placement of clutch and end plug.
 - d. Spring-loaded idle end: Reinforced idler assembly containing spring loaded end plug with positive locking wheel allowing for up to 7/8-inch adjustment and provides for a secure installation and removal of shade. Locking tube bearing plug contains minimum 6 ribs and flutes and inserted a minimum of 2-3/8-inch into roller tube on heavy duty systems.

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- e. Bottom Bar: Industry standard sealed hem bar with weight sewn into pocket providing for tracking adjustments and uniform look of the hanging fabric panel.
- f. Mounting Hardware: Manufacturer's heavy duty bracket constructed of hardened steel to support full weight of shade with bracket and screw hole covers to provide uniform look. Locking mechanism on bracket adapter provides for a secure installation and removal of the shade. Corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and site conditions.
- g. Fascia: L-shaped removable aluminum extrusion valance that attaches to brackets and conceals roller shade. Fascia at the bottom enclosure must allow a maximum of 1-inch gap to allow fabric to come through. Exposure underneath greater than 1-inch is not to be accepted.
- 3. Manufacturers:
 - a. Hunter Douglas.
 - b. Lutron.
 - c. SWFcontract.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify field measurements of openings to receive blinds, and provide systems in coordination with work of other trades. Delay installation until all other finish Work in spaces is complete.

3.02 ROLLER SHADE INSTALLATION

A. Install the hardware to manufacturer's recommendations as approved for conditions of the installation. Install in accurate locations, make plumb, true to line, complete with accessories required for satisfactory operations, attach to building construction using approved type of fasteners so as to be rigid and secure, taking care to prevent cracking, marring, or other damage to adjacent finished surfaces.

3.03 ADJUSTING

A. After installation, test and adjust each unit.

3.04 CLEANING

A. Leave installation in a clean and dust-free condition.

3.05 INSTALLATION SCHEDULE

A. Install blinds at all windows indicated in Window Schedule.

END OF SECTION

WINDOW TREATMENTS 12 20 00 - 4

SECTION 22 07 00 PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society of Heating, Refrigerating & Air-Conditioning Engineers Inc. (ASHRAE): 90.1, Energy-Efficient Design of New Buildings except Low-Rise Residential Buildings.
 - 2. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - c. C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - d. C547, Standard Specification for Mineral Fiber Pipe Insulation.
 - 3. National Fire Protection Association (NFPA): 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

1.02 SUBMITTALS

- A. Action Submittals: Product description, include list of materials, thickness for each service scheduled, and locations.
- B. Informational Submittals:
 - 1. Proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.
 - 2. Manufacturer's installation instructions.

1.03 QUALITY ASSURANCE

- A. Provide standard, cataloged products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.
- B. Provide materials by firms engaged in the manufacture of insulation products of the types and characteristics specified herein, whose products have been in use for not less than 5 years.

C. UL Listing or satisfactory certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Stamp or Label:
 - 1. Deliver insulation, jackets, cements, adhesives and coatings with a manufacturer's stamp or label attached, giving name of manufacturer, brand, and description of material.
 - 2. Insulation Packages and Containers: Mark "asbestos-free."

PART 2 PRODUCTS

2.01 GENERAL

- A. Insulation Exterior: Cleanable, grease-resistant, nonflaking, and nonpeeling.
- B. Conform to referenced publications and specified temperature ranges and densities in pounds per cubic foot.
- C. Insulation for Fittings, Flanges, and Valves: Premolded, precut, or jobfabricated insulation of same thickness and conductivity as used on adjacent piping.
- D. Fire Resistance:
 - 1. Provide noncombustible insulation, adhesives, vapor barrier materials and other accessories, except as specified herein.
 - 2. Use no fugitive or corrosive treatments to impart flame resistance.
 - 3. Flame proofing treatments subject to deterioration as a result of effects of moisture or high humidity are not acceptable.
 - 4. Fire Hazard Rating for Materials including Facings, Mastics, and Adhesives: Not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke, developed as per tests conducted in accordance with NFPA 255 methods.
 - 5. Materials exempt from fire-resistant rating:
 - a. Nylon anchors.
 - b. Treated wood inserts.
 - 6. Materials exempt from fire-resistant rating when installed in outside locations, buried, or encased in concrete:
 - a. Polyurethane insulation.
 - b. PVC casing.
 - c. Fiberglass-reinforced plastic casing.

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2.02 PIPE INSULATION

- A. Type P3—Elastomeric (ASTM C534, Minus 40 Degrees F to 220 Degrees F):
 - 1. Flexible, closed cell elastomeric.
 - 2. Nominal 6 pcf density, K factor 0.27 maximum at 75 degrees F mean.
 - 3. Water Vapor Transmission: 0.1 perm-inch, or less.
 - 4. Manufacturers and Products:
 - a. Armacell; AP Armaflex.
 - b. Nomaco; K-Flex LS.

2.03 INSULATION FINISH SYSTEMS

- A. Type F1—PVC:
 - 1. Polyvinyl chloride (PVC) jacketing, white, for straight run piping and fitting locations, temperatures to 150 degrees F.
 - 2. Manufacturers and Products:
 - a. Johns Manville; Zeston.
 - b. Ceel-Co; 550.
- B. Type F2—Paint:
 - 1. Acrylic latex paint, white, and suitable for outdoor use.
 - 2. Manufacturer and Product: Armstrong; WB Armaflex finish.

PART 3 EXECUTION

3.01 INSTALLATION OF INSULATION

- A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.
- B. Apply insulation over clean, finish painted, and dry surfaces.
- C. Install insulation after piping system has been pressure tested and leaks corrected.
- D. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
- E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces of scraps abutting each other.
- F. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

- G. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Seal open ends of insulation with mastic. Sectionally seal butt ends of chilled water and condensate drain piping insulation at fittings with white vapor barrier coating.
- H. Cover valves, flanges, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job-fabricated units. Finish cold pipe fittings with white vapor barrier coating and hot piping with white vinyl acrylic mastic, both reinforced with glass cloth.
- I. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.
- J. Install protective metal shields and foamglass inserts where pipe hangers bear on outside of insulation.
- K. Insulation on piping that is to be heat traced shall be installed after installation of heat tape.
- L. Insulate valve bodies, flanges, and pipe couplings.
- M. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
- N. Do not insulate flexible pipe couplings and expansion joints.
- O. Do not allow insulation to cover nameplates or code inspection stamps.
- P. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
- Q. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.
- R. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.
- S. Placement:
 - 1. Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.
 - 2. Insulate valves and fittings with sleeved or cut pieces of same material.
 - 3. Seal and tape joints.
- T. Insulation at Hangers and Supports: Install under piping, centered at each hanger or support.

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- U. Vapor Barrier:
 - 1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
 - 2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
 - 3. Do not use staples and screws to secure vapor sealed system components.

3.02 INSTALLATION OF INSULATION FINISH SYSTEMS

- A. Use a continuous friction type joint to hold jacket in-place, providing positive weatherproof seal over entire length of jacket.
- B. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
- C. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
- D. Do not use screws or rivets to fasten the fitting covers.
- E. Install removable prefabricated aluminum covers on exterior flanges and unions.
- F. Caulk and seal exterior joints to make watertight.

3.03 INSULATION APPLICATIONS

- A. Potable Cold Water:
 - 1. Type P3, elastomeric.
 - 2. 1-inch thickness for all pipe sizes.
- B. Potable Hot Water:
 - 1. Type P3, elastomeric.
 - 2. 1-inch thickness for all pipe sizes.
- C. Pipe Hangers:
 - 1. Type P3, Elastomeric: Rigid insulation section with 9-inch-long, 16-gauge galvanized steel saddle.

3.04 INSULATION FINISH APPLICATIONS

A. Piping Insulation (Concealed Areas): Factory finish.

- B. Piping Insulation (Exposed to View, Indoors): Factory finish.
- C. Piping Insulation (Outdoors): Factory finish.
- D. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

3.05 FIELD QUALITY CONTROL

A. Test factory-applied materials assembled. Field-applied materials may be tested individually.

END OF SECTION

SECTION 22 10 01 PLUMBING PIPING AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Gas Association (AGA):
 - a. B109.1, Diaphragm Type Gas Displacement Meters (under 500 Cubic Feet Per Hour Capacity).
 - b. B109.2, Diaphragm Type Gas Displacement Meters (500 Cubic Feet Per Hour Capacity and Over).
 - 2. American National Standards Institute (ANSI).
 - 3. American Public Works Association (APWA): Uniform Color Code.
 - 4. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - b. B31.9, Building Services Piping.
 - 5. American Society of Sanitary Engineering (ASSE):
 - a. 1010, Performance Requirements for Water Hammer Arresters.
 - b. 1050, Performance Requirements for Stack Air Admittance Valves for Sanitary Drainage Systems.
 - c. 1051, Performance Requirements for Individual and Branch Type Air Admittance Valves for Sanitary Drainage Systems.
 - d. 1070, Performance Requirements for Water Temperature Limiting Devices.
 - e. 1071, Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment.
 - 6. ASTM International (ASTM):
 - a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
 - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
 - d. A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications.
 - e. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - f. A179/A179M, Standard Specification for Seamless Cold-Drawn Low-Carbon Steel Heat-Exchanger and Condenser Tubes.
 - g. A181/A181M, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

- h. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
- i. A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
- j. A197/A197M, Standard Specification for Cupola Malleable Iron.
- k. A234/A234M, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- 1. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- m. A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
- n. A518/A518M, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
- o. A536, Standard Specification for Ductile Iron Castings.
- p. A563, Standard Specification for Carbon and Alloy Steel Nuts.
- q. A861, Standard Specification for High-Silicon Iron Pipe and Fittings.
- r. A888, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- s. B32, Standard Specification for Solder Metal.
- t. B61, Standard Specification for Steam or Valve Bronze Castings.
- u. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- v. B75/B75M, Standard Specification for Seamless Copper Tube.
- w. B88, Standard Specification for Seamless Copper Water Tube.
- x. B98/B98M, Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.
- y. B127, Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip.
- z. B139/B139M, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
- aa. B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire.
- bb. B194, Standard Specification for Copper-Beryllium Alloy Plate, Sheet, Strip, and Rolled Bar.
- cc. B306, Standard Specification for Copper Drainage Tube (DWV).
- dd. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- ee. C1173 Standard Specification for Flexible Transition Couplings for Underground Piping Systems.

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- ff. C1277, Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- gg. C1460, Standard Specification for Shielded Transition Couplings for use with Dissimilar DWV Pipe and Fittings Above Ground.
- hh. C1540, Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
- D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- jj. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- kk. D2000, Standard Classification System for Rubber Products in Automotive Applications.
- D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
- mm. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
- nn. D2513, Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.
- oo. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
- pp. D2683, Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing.
- qq. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
- rr. D3035, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- ss. D3261, Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
- tt. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- uu. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- vv. E438, Standard Specification for Glasses in Laboratory Apparatus.
- ww. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- xx. F714, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- yy. F876, Standard Specification for Crosslinked Polyethylene (PEX) Tubing.

- zz. F877, Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems.
- aaa. F1412, Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.
- bbb. F1924, Standard Specification for Plastic Mechanical Fittings for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing.
- ccc. F1973, Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems.
- ddd. F2023, Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Pipe, Tubing and Systems to Hot Chlorinated Water.
- eee. F2080, Standard Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (PE-RT) Pipe.
- 7. American Water Works Association (AWWA):
 - a. C104/A21.4, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - b. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
 - c. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - d. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - e. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast.
 - f. C203, Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot-Applied.
 - g. C207, Steel Pipe Flanges for Waterworks Service Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).
 - h. C505, Resilient-Seated Gate Valves for Water Supply Service.
 - i. C550, Protective Interior Coatings for Valves and Hydrants.
 - j. C606, Grooved and Shouldered Joints.
 - k. C651, Disinfecting Water Mains.
 - 1. C904, Crosslinked Polyethylene (PEX) Pressure Pipe, 1/2 In. (13 mm) Through 3 In. (76 mm), for Water Service.
- 8. Canadian Gas Association CGA 3.11, Lever-Operated Pressure-Lubricated Plug-Type Gas Shut-Off Valves.
- 9. Cast Iron Soil Pipe Institute (CISPI):
 - a. 301, Standard Specification for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

- b. 310, Specification for Couplings for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Strom Drain, Waste, and Vent Piping Applications.
- 10. CSA Group.
- 11. FM Global (FM).
- 12. International Association of Plumbing and Mechanical Officials (IAPMO).
- 13. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
 - a. SP-58, Pipe Hangers and Supports Materials, Design, Manufacture, Selection, Application, and Installation.
 - b. SP-69, Pipe Hangers And Supports Selection And Application.
 - c. SP-80, Bronze Gate, Globe, Angle, and Check Valves.
 - d. SP-110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- 14. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components Lead Content.
- 15. Plumbing and Drainage Institute (PDI): WH 201, Water Hammer Arresters Standard.
- 16. UL.
- United States Department of Transportation (USDOT), 49 CFR Part 192, Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards.

1.02 DESIGN REQUIREMENTS

- A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
 - 1. Building Service Piping: ASME B31.9, as applicable.
 - 2. ICC International Plumbing Code.
 - 3. Local plumbing code.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product data sheets.
 - 2. Shop Drawings:
 - a. Show Contractor recommended changes in location of fixtures or equipment.

- 3. Isometric riser diagrams.
- B. Informational Submittals:
 - 1. Changes in location of equipment or piping that affect connecting or adjacent work, before proceeding with the Work.
 - 2. Complete list of products proposed for installation.
 - 3. Test records produced during testing.
 - 4. For Polyethylene (PE) Pipe:
 - a. Certificates of qualification for persons to be fusing PE pipe.
 - b. Experience and training record of persons to be fusing PE pipe.
 - c. Testing Plan:
 - 1) Submit at least 15 days prior to testing; include following as a minimum:
 - a) Testing dates.
 - b) Piping systems and section(s) to be tested.
 - c) Method of isolation.
 - d) Method of conveying water from source to system being tested.
 - d. Certifications of Calibration: Approved testing laboratory certificate if pressure gauge for hydrostatic test has been previously used. If pressure gauge is new, no certificate is required.
 - e. Test report documentation.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 PIPING

- A. Piping Schedule: Refer to:
 - 1. The Drawings.
 - 2. Article Supplements.

PLUMBING PIPING AND ACCESSORIES 22 10 01 - 6 B. Piping Material: Refer to Piping Data Sheet(s), Article Supplements

2.03 PIPE HANGERS AND SUPPORTS

- A. Hangers:
 - 1. Clevis Type: MSS SP-58 and MSS SP-69, Type 1 or Type 6.
 - a. Anvil; Figure 104 or 260, sizes 1/2-inch through 30 inches.
 - b. B-Line; Figure B3198H or B3100, sizes 3/8-inch through 30 inches.
 - 2. Hinged Split-Ring Pipe Clamp: MSS SP-58 and MSS SP-69, Type 6 or Type 12.
 - a. Anvil; Figure 104, sizes 3/4-inch through 8 inches.
 - b. B-Line; Figure B3198H, sizes 3/8-inch through 3 inches.
 - 3. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP-58.
 - 4. Attachments:
 - a. I-Beam Clamp: Concentric loading type, MSS SP-58 and MSS SP-69, Type 21, Type 28, Type 29, or Type 30, which engage both sides of flange.
 - b. Concrete Insert: MSS SP-58 and MSS SP-69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
- B. Saddle Supports:
 - 1. Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
 - a. Nonadjustable Saddle: MSS SP-58 and MSS SP-69, Type 37 with U-bolt.
 - 1) Anvil; Figure 259, sizes 4 inches through 36 inches.
 - 2) B-Line; Figure B3090, sizes 2-1/2 inches through 36 inches.
 - b. Adjustable Saddle: MSS SP-58 and MSS SP-69, Type 38 without clamp.
 - 1) Anvil; Figure 264, sizes 2-1/2 inches through 36 inches.
 - 2) B-Line; Figure B3093, sizes 2-1/2 inches through 36 inches.
- C. Wall Brackets:
 - 1. Welded Steel Bracket: MSS SP-58 and MSS SP-69, Type 33 (heavyduty).
 - a. Anvil; Figure 199, 3,000-pound rating.
 - b. B-Line; Figure B3067, 3,000-pound rating.
 - 2. One-Hole Clamp: Anvil; Figure 126, sizes 3/8-inch through 4 inches.
 - 3. Channel Type:
 - a. Unistrut.

- b. Anvil; Power-Strut.
- c. B-Line; Strut System.
- d. Aickinstrut (FRP).

D. Pipe Clamps:

- 1. Riser Clamp: MSS SP-58 and MSS SP-69, Type 8.
 - a. Anvil; Figure 261, sizes 3/4-inch through 24 inches.
 - b. B-Line; Figure B3373, sizes 1/2-inch through 30 inches.
- E. Channel Type Support Systems:
 - 1. Channel Size: 12-gauge, 1-5/8-inch-wide minimum steel, 1-1/2-inch-wide minimum FRP.
 - 2. Members and Connections: Design for all loads with safety factor of 5.
 - 3. Manufacturers and Products:
 - a. B-Line; Strut System.
 - b. Unistrut.
 - c. Anvil; Power-Strut.
 - d. Aickinstrut (FRP System).
- F. Accessories:
 - 1. Insulation Shields:
 - a. Type: Galvanized steel or stainless steel, MSS SP-58 and MSS SP-69, Type 40.
 - b. Manufacturers and Products:
 - 1) Anvil; Figure 167, sizes 1/2-inch through 24 inches.
 - 2) B-Line; Figure B3151, sizes 1/2-inch through 24 inches.
 - 2. Welding Insulation Saddles:
 - a. Type: MSS SP-58 and MSS SP-69, Type 39.
 - b. Manufacturers and Products:
 - c. Anvil; Figure Series 160, sizes 1-inch through 36 inches.
 - d. B-Line; Figure Series B3160, sizes 1/2-inch through 24 inches.
- G. Galvanize hangers, rods, clamps, protective shields, and hanger accessories.
- H. Trapeze Hangers:
 - 1. Assembly consisting of structure attachments with rod size dependent upon total weight supported, and spacing of assemblies determined by minimum pipe size included in group supported.
 - 2. Trapeze Horizontal: Structural angle or channel section of sufficient size to prevent measurable sag between rods.
 - 3. Manufacturers and Products: a. Unistrut.

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- b. B-Line; Strut System.
- c. Anvil; Power-Strut.
- d. Aickinstrut (FRP System).

2.04 INSULATION

- A. As specified in Section 22 07 00, Plumbing Piping Insulation.
- B. As specified in Section 23 07 00, HVAC Insulation.

2.05 VALVES

- A. General:
 - 1. Furnish complete with necessary operating hand wheels, chain wheels, extension stems, floor stands, worm and gear operators, operating nuts, chains, and wrenches.
 - 2. Renewable Parts Including Discs, Packing, and Seats: Types as recommended by valve manufacturer for intended service.
 - 3. Units shall have name of manufacturer and size of valve cast on body or bonnet or shown on a permanently attached plate in raised letters.
- B. Design Features:
 - 1. Brass and bronze components, including appurtenances in contact with water.
 - 2. Alloys containing less than 16 percent zinc and 2 percent aluminum.
 - 3. Alloys are of the following ASTM designations:
 - a. B61, B62, B98/B98M (Alloy A, B, or D), B127, B139 (Alloy A), B164, and B194.
 - b. Stainless steel Alloy 18-8 may be substituted for bronze as an option with approval of Engineer.
 - 4. Gland Bolts on Iron Body Valves: Bronze, fitted with brass nuts.
- C. Valve Operators:
 - 1. Open by turning counterclockwise.
 - 2. Worm and Gear Operators On Manually Operated Valves: Totally enclosed design, proportioned as to permit operation of valve under full operating head with maximum pull of 40 pounds on handwheel or crank.
 - 3. Self-locking type to prevent the disc or plug from creeping.
 - 4. Self-Locking Worm Gears:
 - a. One-piece design of gear bronze material, accurately machine cut.
 - b. Worm: Hardened alloy steel, with thread ground and polished.
 - c. Reduction gearing shall run in a proper lubricant.

- 5. Galvanize handwheels.
- D. Globe Valves:
 - 1. Type V235 Angle Type Hose Valve 3/4-inch:
 - a. 3/4-inch NPT female inlet, 3/4-inch male hose thread outlet, heavy rough brass body rated 125 psi, lockshield bonnet, removable handle, atmospheric vacuum breaker conforming to ASSE 1011 and IAPMO code.
 - b. Manufacturers and Products:
 - 1) Acorn; 8126, surface pipe mount valve, bent nose without flange.
 - 2) Acorn; 8121, surface mount through wall valve, bent nose with flange.
 - 3) Acorn; 8131, pipe and pedestal mounted valve located above 6 inches, straightnose.
 - 4) Acorn; 8136, pedestal mounted valve located lower than 6 inches, inverted nose.
- E. Ball Valves:
 - 1. Type V300 Ball Valve 3 inches and Smaller for General Water and Air Service:
 - a. Two-piece, standard port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound CWP, 150-pound SWP, complies with MSS SP-110.
 - b. Manufacturers and Products:
 - 1) Threaded:
 - a) Conbraco Apollo; 70-100.
 - b) Nibco; T-580-70.
 - 2) Soldered:
 - a) Conbraco Apollo; 70-200.
 - b) Nibco; S-580-70.
 - 2. Type V301 Ball Valve 2 inches and Smaller for General Water and Air Service:
 - a. Two-piece, full port, NPT threaded ends, bronze body and end piece, hard chrome-plated solid bronze or brass ball, RTFE seats and packing, blowout-proof stem, adjustable packing gland, zinc-coated steel hand lever operator with vinyl grip, rated 600-pound WOG, 150-pound SWP, complies with MSS SP-110.

- b. Manufacturers and Products:
 - 1) Threaded:
 - a) Conbraco Apollo; 77-100.
 - b) Nibco; T-585-70.
 - 2) Soldered:
 - a) Conbraco Apollo; 77-200.
 - b) Nibco; S-585-70.
- 3. Type V304 Ball Valve 2 inches and Smaller for General Water and Air Service:
 - a. Three-piece body type, bronze body and end pieces, hard-chrome plated bronze or brass ball, full bore port, RTFE seats and packing, blowout-proof stem, zinc-plated steel hand lever operator with vinyl grip.
 - b. Rated 6-pound WOG, 150-psi SWP.
 - c. Manufacturers and Products:
 - 1) Threaded Ends:
 - a) Milwaukee; BA-300.
 - b) Nibco; T-595-Y.
 - c) Conbraco Apollo; 82-100.
 - 2) Soldered Ends:
 - a) Milwaukee; BA-350.
 - b) Nibco; S-595-Y.
 - c) Conbraco Apollo; 82-200.
- 4. Type V311 Ball Valve 2 inches and Smaller for Natural Gas and Propane Service:
 - a. UL Listed for gas to 125 psig and flammable liquids to 250 psig:
 - b. Two-piece body type, bronze or forged brass body and end pieces, hard-chrome plated bronze or brass ball, full bore port, RTFE seats and packing, blowout-proof stem, zinc-plated steel hand lever operator with vinyl grip.
 - c. Full port through 1-inch. Standard port 1-1/4 inches to 2 inches.
 - d. Rated 250-pound WOG.
 - e. Approvals:
 - 1) CSA certified.
 - 2) UL 842 Listed for flammable liquids and gases.
 - 3) MSS SP-110 compliant.
 - f. Manufacturers and Products:
 - 1) Threaded Ends:
 - a) Conbraco Apollo; 80-100.
 - b) Norgas; S95 Series.
 - c) Watts; FBV-3C.
 - d) Nibco; T-585-70-UL (1/4-inch to 1-inch),
 - T-580-70-UL (1-1/4-inch to 2 inches).

- 5. Type V330, Thermoplastic Ball Valves 2 inches and Smaller for Water Service:
 - a. Rated 150 psi at 105 degrees F, with ASTM D1784, Type I, Grade 1 polyvinyl chloride (PVC) body, ball, and stem.
 - b. End entry, double union design, with replaceable Teflon seats and Viton or Teflon O-ring stem seals.
 - c. Furnish with hand lever operator.
 - d. Single union ball valves with flanged ends drilled to 150-pound ANSI Standard are acceptable.
 - e. Manufacturers:
 - 1) Asahi/America.
 - 2) R&G Sloane Manufacturing Co., Inc.
- F. Plug Valve:
 - 1. Type V409 Lubricated Tapered Plug Valve 1/2-inch to 6 inches for Natural Gas Service:
 - a. Lubricated type with grey iron or semi-steel body and plug, rated 200 CWP working pressure, with bubble-tight gas shutoff.
 - b. Plug lubrication with side mount sealant injection fitting.
 - c. Plug mechanically balanced with spring for predictable operating torque.
 - d. Flanged ends 2-1/2 inches and larger, threaded ends for smaller valves.
 - e. Actuator rated with actuator mounting pads where required.
 - f. Round or rectangular port of no less than 80 percent of connecting pipe area.
 - g. Buna-N O-ring, stainless spring and stem, TFE stem seal.
 - h. Standards Conformance:
 - 1) Canadian Gas Association CGA 3.11, Lever-Operated Pressure-Lubricated Plug-Type Gas Shut-Off Valves.
 - United States Department of Transportation (DOT),
 49 CFR Part 192, Pipeline Safety Regulations.
 - i. Operators:
 - 1) 3-inch and 4-inch Valves: Wrench lever manual.
 - 2) 6-inch Valves: Totally enclosed, geared, manual operator, with handwheel, 2-inch nut, or chain wheel.
 - j. Manufacturers and Products:
 - 1) Flowserve Nordstrom; Figure 114 (1/2-inch to 2 inches), Figure 115 (2-1/2 inches to 4 inches).
 - 2) Homestead; Figure 601 (1/2-inch to 2 inches), Figure 602 (2-1/2 inches to 6 inches).
 - 3) Milliken; Series 200M (1/2-inch to 2 inches), Series 201M (2-1/2 inches to 6 inches).

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- G. Check Valves:
 - 1. Type V600, Check Valves 3 inches and Smaller:
 - a. Bronze body, wye pattern, threaded ends and cap, regrinding seat, and swing type disc.
 - b. Rated 125-pound SWP, 200-pound WOG.
 - c. Manufacturers and Products:
 - 1) Crane; No. 37.
 - 2) Walworth Co.; Figure 406.
 - 2. Type V602 Check Valve 2 inches and Smaller:
 - a. All bronze, threaded cap, threaded ends, swing type replaceable Teflon disc and bronze disc holder, rated 150-pound SWP, 300-pound WOG.
 - b. Manufacturers and Products:
 - 1) Walworth; Figure 3412.
 - 2) Milwaukee; Figure 510.
 - 3. Backwater Check Valve 2 inches to 8 inches:
 - a. Coated cast iron backwater check valve, integral offset type swing-check assembly, gasketed bolted access cover or threaded, ferrule, and cover.
 - b. Manufacturers and Products:
 - 1) J. R. Smith; Figure 7012.
 - 2) Josam; Series 67500.
 - 3) Zurn; Model Z-1095.
- H. Water Pressure Reducing Valves 1/2-inch Through 2-1/2 inches: See the Drawing.
- I. Pressure Reducing Valve, Natural Gas and Propane, High Pressure:
 - 1. Direct diaphragm, spring controlled cast-iron body, spring aluminum diaphragm and spring case, nitrile disc/diaphragm/O-rings, internal relief, NPT thread ends, 125-psig rated.
 - 2. Valve Body Size: 1/2-inch to 2 inches, as indicated.
 - 3. Inlet pressure of 5 psig to 125 psig, as indicated.
 - 4. Outlet Pressure: Set at 2 psig to 10 psig, as indicated.
 - 5. Valve Orifice Size: 1/4-inch to 1-3/16 inches, as indicated.
 - 6. Manufacturer and Product: Fisher; S201H.

2.06 MISCELLANEOUS PIPING SPECIALTIES

- A. Strainers for Water Service:
 - 1. Iron body, Y-pattern, 125-pound rated, with screwed bronze or bolted iron cap.
 - 2. Screen: Heavy-gauge stainless steel or monel, 30 mesh.

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- 3. Manufacturers and Products:
 - a. Crane; No. 988-1/2.
 - b. Mueller; No. 758.
- B. Flexible Connectors for Stainless Steel Gas Lines:
 - 1. Corrugated, Type 316 stainless steel hose, with 10-inch live length and Type 316 stainless steel male NPT pipe connectors at each end.
 - 2. Manufacturers and Product:
 - a. Flexonics; Braided Rex-Weld.
 - b. Kin-Line.
- C. Vacuum Breakers 2 inches and Smaller:
 - 1. Angle type, as required.
 - 2. Manufacturers:
 - a. Febco.
 - b. Watts.
- D. Water Hammer Arresters:
 - 1. Materials: ASSE 1010 certified, Type L copper tube, HHPP piston with two lubricated EPDM O-rings, FDA approved lubricant, rolled piston stop, wrought copper male thread adapter.
 - 2. Manufacturers and Products:
 - a. Sioux Chief Mfg. Co., Inc.; Series 650 and Series 660.
 - b. Precision Plumbing Products, Inc.
- E. Sleeves:
 - 1. Manufacturers and Products:
 - a. J. R. Smith; Figure 1720.
 - b. Josam; No. 26400.
- F. Flashing Sleeves for Roof Penetrations:
 - 1. Built-Up Bituminous Roofing: Fabricate of lead as specified in Section 07 62 00, Sheet Metal Flashing and Trim.
 - 2. Single-Ply Membrane Roofing: Pipe seals as specified in Section 07 70 01, Roof Specialties and Accessories.
- G. Insulating Dielectric Unions and Flanges:
 - 1. Galvanically compatible with piping to which attached and pressure ratings suitable for system working pressures.
 - 2. Unions 2 inches and Smaller: Screwed or solder-joint type.

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- 3. Unions 2-1/2 inches and Larger: Flanged type, complete with bolt insulators, dielectric gasket, bolts, and nuts.
- 4. Manufacturers:
 - a. Epco Sales, Inc., Cleveland, OH.
 - b. Capitol Insulation Unions.
- H. Joint Solder: 95-5 wire solder, ASTM B32, Grade 95 TA. Lead free, NSF certified. Do not use cored solder.
- I. Pipe Joint Sealer: Compound insoluble in water or Teflon tape; approved by NFS for use in potable water.
- J. Rubber Gaskets: ASTM C564.

2.07 MEASURING DEVICES

- A. Thermometer:
 - 1. Adjustable angle, organic spirit type, blue in color, with 9-inch case and scale range in degrees F, as shown.
 - 2. Furnish with 3-1/2-inch stem length and separable NPT lead-free brass thermowell.
 - 3. For locations above 6 feet off floor or grade.
 - 4. Manufacturers and Product:
 - a. Trerice Co.; Model BX9140304.
 - b. Weksler.
- B. Thermometer Dial Type:
 - 1. Compact dial type, 2-1/2-inch diameter, adjustable angle, zinc plated steel case with center back entry.
 - 2. Scale range in degrees F, as shown.
 - 3. Bimetal spiral spring sensing elements.
 - 4. Furnish with separable NPT lead-free brass thermowell.
 - 5. Provide at each water heater and tempering valve outlet, and at the return on each recirculating hot or tempered water system.
 - 6. Manufacturers and Product:
 - a. Watts, Bimetal Model LFTB-2-1/2.
 - b. Trerice Co.
 - c. Weksler.
- C. Pressure Gauges:
 - 1. Construction: 3-1/2-inch gauge size, 0 kPa to 690 kPa, 0 psi to 160 psi range, steel case, glass crystal, brass movement, and 1/4-inch NPT lower connection.

- 2. Furnish with 1/4-inch brass gauge cock.
- 3. Manufacturers and Products:
 - a. Ashcroft; Type 1008.
 - b. Marsh; J80.
 - c. Marshalltown.

PART 3 EXECUTION

3.01 GENERAL

- A. Refer to the Area Classification and Materials Selection Table in the General Section on the Drawings for installation material requirements.
- B. Install plumbing systems to meet applicable plumbing code.
- C. Field Obstructions:
 - 1. Drawings do not attempt to show exact details of piping. Provide offsets around obstructions.
 - 2. Do not modify structural components, unless approved by Engineer.
- D. Sleeves:
 - 1. Pipe sizes shown are nominal sizes, unless shown or specified otherwise.
 - 2. Provide piping passing through walls, floors, or ceilings with standard-weight pipe sleeves.
 - 3. Provide pipes passing through finished walls with chrome-plated canopy flanges.
 - 4. Dry pack sleeves in existing work in-place and provide finished appearance.
 - 5. Pack holes left by removal of existing piping with grout and finish to match adjacent surface.
- E. Provide unions in piping systems at connections to equipment.
- F. Provide shielded transition couplings, insulating dielectric unions and flanges between ferrous and nonferrous piping and where otherwise required for electrically insulated connection.
- G. Pipe air release valves, water-lubricated bearings, and other appurtenances having water effluent with copper tubing to nearest drain.
- H. Provide isolation valves and strainers at pressure regulators.

3.02 INSTALLATION

- A. Steel Pipe (Above Ground Only):
 - 1. Ream, clean, and remove burrs and mill scale from piping before making up.
 - 2. Seal joints with pipe joint sealer or Teflon tape.
 - 3. Steel pipe used for natural gas shall gas rated per Fuel Gas Code.
- B. Copper Tubing:
 - 1. Cut tubing square and remove burrs.
 - 2. Clean both inside of fittings and outside of tubing with steel wool and hydrochloric acid before soldering.
 - 3. Prevent annealing of fittings and hard-drawn tubing when making connections.
 - 4. Do not use mitered joints for elbows or notching of straight runs of pipe for tees.
 - 5. Underground shall be pit wrapped.
- C. PEX-A Polyethylene Piping:
 - 1. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings.
 - 2. Install in compliance with the PEX Piping Systems Design and Installation Manual, and Systems Installation Guide.
 - 3. PEX piping shall be installed per ASTM E84 requirements for plenum applications.
 - 4. Support and provide all required hangers and supporting strapping as required by manufacturer to provide a code compliant installation.
 - 5. Install in straight runs free of sags and kinks and provide bend supports at all 1/2-inch and 3/4-inch drops.
 - 6. All penetrations through wall plates shall be protected or shielded as required to prevent damage to piping.
 - 7. Tubing passing through metal studs shall use grommets or sleeves at the penetration.
 - 8. Provide supports, fixed anchor points, and hangers in compliance with the Piping Systems Design and Installation Manual and Piping Systems Installation Guide, current edition, to minimize expansion and contraction.
 - 9. Install piping at each fixture with out of the wall support bracket to secure piping and prevent excess movement when water stops or shut valves are operated.
 - 10. Where manifolds are used, install centered in access panels to permit servicing.

D. Rigid PVC or CPVC:

- 1. Cut, make up, and install in accordance with pipe manufacturer's recommendations.
- 2. Ream, clean, and remove burrs from cut ends before joining pipe.
- 3. Lay in trench by snaking pipe from one side to other.
- 4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and final use.
- 5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
- 6. Shield ends to be joined from direct sunlight prior to and during laying operation.
- 7. Use strap wrenches only for tightening threaded plastic joints. Do not over tighten fittings.
- E. Polyethylene Piping for Natural Gas (Below Ground):
 - 1. Join pipes, fittings, and flange connections by means of thermal buttfusion.
 - 2. Perform butt-fusion in accordance with pipe manufacturer's recommendations as to equipment and technique.
 - 3. Lay pipe snaking from one side of trench to other.
 - 4. Offset: As recommended by manufacturer for maximum temperature variation between time of solvent welding and during operation.
 - 5. Do not lay pipe when temperature is below 40 degrees F or above 90 degrees F when exposed to direct sunlight.
 - 6. Shield ends to be joined from direct sunlight prior to and during laying operation.
 - 7. Joint Fusion:
 - a. Measure and log each joint fusion by an electronic monitoring device (data logger) affixed to fusion machine capable of being retrieved electronically. Data to be logged shall include the following:
 - 1) Pipe size and dimensions.
 - 2) Machine model and size.
 - 3) Operator identification.
 - 4) Job identification number.
 - 5) Weld number.
 - 6) Fusion, heating, and drag pressure settings.
 - 7) Heater plate temperature.
 - 8) Time stamp showing when weld was performed.
 - 9) Heating and curing time of weld.
 - 10) Curing temperature readings and time stamps of readings.
 - 11) Error messages and warnings for out-of-range temperature or pressure settings.

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- b. In addition to logged items above, the following shall be logged or annotated on report:
 - Location of fused joint by pipeline station or by reference to pipe Shop Drawing.
 - 2) Ambient temperature and humidity.
 - 3) If internal bead was removed.
- F. Water System Balancing: Provide a qualified registered engineer or firm specializing in testing and balancing to adjust domestic water system. Balance system for required water flows at each plumbing fixture, terminal device, and recirculating hot water loop.
- G. Water Hammer Arresters:
 - 1. Install in piping systems where shown on the Drawings and adjacent to pieces of equipment where quick closing valves are installed.
 - 2. Install at all emergency safety showers and eyewashes.
 - 3. Size and install in accordance with PDI-WH201.
 - 4. Shock arresters to have access panels or to be otherwise accessible.
- H. Valves: Install in accordance with manufacturer's recommendations.
- I. Miscellaneous Piping Specialties: Install in accordance with manufacturer's recommendations.
- J. Measuring Devices: Install in accordance with manufacturer's recommendations.

3.03 SANITARY AND WASTE DRAINS AND VENTS PIPING

- A. Installation:
 - 1. Set piping above floor slab true and plumb.
 - 2. Set exposed risers as close to walls as possible.
 - 3. Slope drain lines at minimum 1 percent slope, unless otherwise noted. Vent lines shall be installed level or sloped, with no low spots.
 - 4. Where vent stacks pass through roof slab, fit with flashing sleeve secured to roof.
 - 5. Extend vents minimum 1-foot above roof.
 - 6. Provide cleanouts where shown and where required by code.

3.04 HVAC CONDENSATE PIPING

- A. Set piping true and plumb.
- B. Slope piping 1/8-inch per foot minimum.

3.05 WATER SUPPLY PIPING

- A. Water supply piping includes potable and nonpotable systems as indicated.
- B. Flush water piping systems clean of internal debris, clean faucet aerators, and adjust plumbing fixture valves for manufacturer's recommended flow.
- C. Do not run water piping through electrical rooms, stairwells, or immediately over or within a 3-foot horizontal clearance of electrical panels, motor starters, or environmental control panels.
- D. Provide exterior water piping with minimum 1-foot of cover or install below frost line, whichever is greater.
- E. Hose Valves and Hydrants: Attach handle with setscrew and provide manufacturer's recommended gravel fill around drain hole of post hydrants.
- F. Provide valve operators with position indicators, where indicated, to show position of valve disc or plug.
- G. Provide bypass with globe valve for emergency throttling around each reducing valve.
- H. Protect buried copper and steel pipe and fittings with a single wrap of coal-tar saturated felt in accordance with AWWA C203.
- I. Vacuum Breakers 2 inches and Smaller: Install minimum 6 inches above flood line of equipment they serve.
- J. Provide manual air vents at high points in domestic hot water system.

3.06 NATURAL GAS AND PROPANE PIPING

- A. Install in compliance with applicable local gas code.
- B. If gas is wet, slope piping 1/4-inch per foot downward in direction of flow. Provide drip traps at low spots.
- C. If gas is wet, install drip traps at end of runs, where pipe changes elevation.
- D. Provide dirt leg, ground union joint, and isolation valve adjacent to each flexible connector hose at each appliance connection.
- E. Label "NATURAL GAS, X PSIG", or "PROPANE, X PSIG" at intervals not to exceed 5 feet, indicating fuel type and pressure.

3.07 INSULATION

A. As specified in Sections 22 07 00, Plumbing Piping Insulation and 23 07 00, HVAC Insulation.

3.08 PIPE HANGERS AND SUPPORTS

- A. Install pre-engineered support equipment in accordance with manufacturer's recommendations.
- B. Hanger Rod Sizing and Spacing for:
 - 1. Steel Pipe:

Pipe Size	Max. Hanger Spacing (feet)	Min. Rod Size (inches)
1-inch and smaller	6	1/4
1-1/4 through 2-1/2 inches	8	1/4
3 and 4 inches	10	3/8
6 inches	12	3/8
8 inches	12	1/2

- 2. Copper Pipe:
 - a. Rod Size: Same as for steel pipe.
 - b. Spacing: 2 feet less per size than for steel pipe, except pipe 1-1/4 inches and smaller shall be supported every 6 feet.
- 3. Cast Iron Pipe:
 - a. Rod Size: Same as for steel pipe.
 - b. Spacing: Locate hanger rods at each pipe joint and change of direction, 10-foot maximum spacing.
- 4. Plastic Pipe:
 - a. Rod Size: Same as for steel pipe.
 - b. Spacing: As recommended by manufacturer and required by applicable plumbing code for flow and temperature in pipe.
 - c. No metal portion of hanger shall contact pipe directly.
- C. Attach Support Rods For Horizontal Piping:
 - 1. To steel beams with I-clamps.
 - 2. To concrete with inserts or with flanges fastened with flush shells.
 - 3. To wood with thickness of 2-1/2 inches or more with bolts or angle clips.
- D. Trapeze Hangers:
 - 1. Trapeze hangers may be used in lieu of individual hangers where horizontal piping is arranged with two or more parallel lines.
 - 2. Attach lines to horizontal with U-bolts or one-hole clamps.

E. Vertical Piping:

- 1. Support by channel type support system and pipe clamps on 10-foot maximum centers.
- 2. Copper and Plastic Piping: Isolate from channels and pipe clamps with pipe isolators.
- F. Insulated Piping: Furnish galvanized protection shield and oversized hangers under insulated piping.

3.09 INSTALLATION—CONCRETE ENCASED

- A. Where horizontal piping is encased in concrete such as a floor or equipment slab, rigidly mount pipe to rebar and subbase to prevent lateral movement, sagging, and uplifting during concrete installation and finishing. Provide at least two temporary strut supports wired to rebar and supported from the engineered fill or subbase below for each section of pipe.
- B. To account for building settling where construction joints occur, or where piping leaves concrete encasements at buildings, utility trenches, vaults, slabs and other structures, provide elastomeric foam insulation wrap around the pipe at the transition point.
 - 1. Minimum Wrap: five pipe diameters of 1/2-inch-thick
- C. Provide flexible piping joints to coincide with structure joints to prevent excessive pipe stress and breakage.

3.10 INTERIM CLEANING

- A. Prevent accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping during fabrication and assembly.
- B. Examine piping to assure removal of foreign objects prior to assembly.
- C. Conventional commercial cleaning methods of cleaning are acceptable if method and cleaning material does not corrode, deform, swell, or otherwise alter physical properties of material being cleaned.

3.11 TESTING

- A. General:
 - 1. Conduct pressure and leakage tests on newly installed pipelines.
 - 2. Provide necessary equipment and material, and make taps in pipe, as required.
 - 3. Engineer will monitor tests. Provide 24-hour advance notice of start of testing.
 - 4. Test Pressures: As specified herein and in Piping Schedule.
 - 5. Test Records:
 - a. Make records of each piping system installation during test to document the following:
 - 1) Date of test.
 - 2) Description and identification of piping tested.
 - 3) Test fluid.
 - 4) Test pressure.
 - 5) Remarks, including:
 - a) Leaks (type, location).
 - b) Repairs made on leaks.
 - 6) Certification by Contractor and signed acknowledgment by Engineer that tests have been satisfactorily completed.
- B. Testing New Pipe Connected to Existing Pipe: Isolate new pipe with grooved end pipe caps, spectacle blinds, or blind flanges.
- C. Preparation and Execution:
 - 1. Buried Pressure Piping:
 - a. An initial service leak test may be conducted with a partially backfilled trench and the joints left open for inspection, if field conditions permit, as determined by Engineer.
 - b. Expose joints for the acceptance test on buried pressure piping to be pneumatically tested or subjected to an initial service leak test.
 - c. Conduct final hydrostatic acceptance tests after trench has been completely backfilled.
 - 2. Exposed Piping: Conduct tests after piping has been completely installed including supports, hangers, and anchors, but prior to insulation.

- D. Hydrostatic Leak Tests:
 - 1. Equipment:
 - a. Provide the following:

Amount	Description
2	Graduated containers
2	Pressure gauges
1	Hydraulic force pump
	Suitable hose and suction pipe as required

- 2. Procedure:
 - a. Use water as the hydrostatic test fluid.
 - b. Provide clean test water of such quality as to minimize corrosion of the materials in the piping system.
 - c. Open vents at high points of the piping system to purge air pockets while the piping system is filling.
 - d. Venting during filling of system may also be provided by loosening flanges with a minimum of four bolts or by the use of equipment vents.
 - e. Test piping systems at test pressure specified in Piping Schedule.
 - f. Maintain hydrostatic test pressure continuously for 30 minutes minimum and for such additional time as necessary to conduct examinations for leakage.
 - g. Examine joints and connections for leakage.
 - h. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of weeping or leaking.
 - Correct visible leakage and retest to satisfaction of Engineer.
- 3. Buried Water Lines:

i.

- a. A limited amount of leakage is permissible according to formula specified.
- b. Conduct hydrostatic testing as follows:
 - 1) Pipe with Concrete Thrust Blocking: Do not make pressure test until a minimum of 5 days after thrust blocking is installed.
 - 2) If high-early strength cement is used for thrust blocking, time may be reduced to 2 days.
- c. Cement-Lined Piping: Slowly fill test section with water and allow to stand for 24 hours under slight pressure to allow cement lining to absorb water.
- d. Expel air from piping system prior to testing.

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- e. Apply and maintain specified test pressure with hydraulic force pump.
- f. Valve off the piping system when test pressure is reached.
- g. Conduct pressure test for 2 hours, reopening isolation valve only as necessary to restore test pressure.
- h. Accurately measure amount of water required to maintain test pressure by placing pump suction in a barrel or similar device, or by metering.
- i. Measurement represents leakage, defined as the quantity of water necessary to maintain the specified test pressure for the duration of the test period.
- j. Determine maximum allowable leakage in gallons per hour from the following formula:

$$L = \frac{ND(P)^{1/2}}{7400}$$

where:

- L = Allowable leakage, in gallons per hour
- N = N Number of joints in the length of pipe tested
- D = Nominal diameter of pipe, in inches
- P = Test pressure during the leakage test, in pounds per square inch
- k. Correct leakage greater than the allowable determined under this formula, and retest to satisfaction of Engineer.
- 4. Test Pressure for Water: 1-1/2 times system pressure.
- 5. Gravity Sewers and Drains:
 - a. Test by water or air exfiltration tests as prescribed by local or state plumbing codes and visually examine for leaks.
 - b. Repair leaks and retest system until no further leakage is evident.
- E. Pneumatic Leak Tests:
 - 1. Perform on compressed air, natural gas, and vacuum piping.
 - 2. Equipment:
 - a. Provide the following:

Amount	Description
1	Pneumatic compressor separator-dryer system capable of providing oil-free dry air and equipped with one or more full capacity safety relief valves set at a pressure of not more than 105 percent of the required primary test pressure
1	Calibrated test gauge

- 3. Procedure:
 - a. Perform pneumatic testing using accurately calibrated instruments and oil-free, dry air.
 - b. Perform tests only on exposed piping, after piping has been completely installed, including supports, hangers and anchors, and inspected for proper installation.
 - c. Test piping system at test pressure specified in Piping Schedule.
 - d. Protect test personnel and Owner's operating personnel from hazards associated with air testing.
 - e. Secure piping to be tested to prevent damage to adjacent piping and equipment in event of a joint failure.
 - f. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by test.
 - g. Apply maximum 25 psig preliminary pneumatic test to piping system prior to final leak testing, to locate major leaks.
 - h. Examine joints and connections for leakage with soap bubbles.
 - i. Correct visible leaks and retest.
 - j. Gradually increase pressure in system to not more than one-half of test pressure.
 - k. Thereafter increase pressure in steps of approximately 1/10 of maximum test pressure until required test pressure is reached.
 - 1. Maintain pneumatic test pressure continuously for minimum 10 minutes and for such additional time as necessary to conduct a soap bubble examination for leakage.
 - m. Piping system, exclusive of possible localized instances at pump or valve packing, shall show no evidence of leakage.
 - n. Correct visible leakage and retest to satisfaction of Engineer.
 - o. Following pneumatic testing, thoroughly purge lines that are to carry flammable gases with nitrogen to assure no explosive mixtures will be present in system during filling process.

3.12 CLEANING AND DISINFECTION

- A. Prior to final acceptance, following assembly and testing, flush pipelines with water, except for plant process air lines and instrument air lines, and remove accumulated construction debris and other foreign matter.
- B. Minimum Flushing Velocity: 2.5 feet per second.
- C. Insert cone strainers in the connections to attached equipment and leave until cleaning has been accomplished.
- D. Remove accumulated debris through drains 2 inches and larger or by dropping spools and valves.

- E. Immediately after draining flushed lines, dry piping with compressed air.
- F. Use compressed air to remove loose debris from plant process air and instrument air piping.
- G. Disinfect potable water pipelines before placing in service:
 - 1. Meet the requirements of AWWA C651, unless otherwise specified.
 - 2. Disinfecting Mixture:
 - a. A chlorine-water solution having a free chlorine residual of 40 ppm to 50 ppm.
 - b. Prepare by injecting one of the following:
 - 1) Liquid chlorine gas-water mixture.
 - 2) Dry chlorine gas.
 - 3) Calcium or sodium hypochlorite and water mixture.
 - c. Inject mixture into pipeline at a measured rate while freshwater is allowed to flow through the pipeline at a measured rate so the combined mixture of freshwater and chlorine solution or gas is of the specified strength.
 - d. Apply liquid chlorine gas-water mixture by means of a chlorinating device.
 - e. Feed dry chlorine gas through proper devices for regulating the rate of flow and providing effective diffusion of gas into water within pipe being treated.
 - f. Chlorinating devices for feeding solutions of chlorine gas or gas itself must prevent backflow of water into chlorine cylinder.
 - g. Calcium Hypochlorite: If this procedure is used, first mix dry powder with water to make a thick paste, then thin to approximately a 1 percent solution (10,000 ppm chlorine).
 - h. Sodium Hypochlorite: If this procedure is used, dilute liquid with water to obtain a 1 percent solution.
 - i. The following proportions of hypochlorite to water will be required:

Product	Quantity	Water						
Calcium Hypochlorite ¹ (65 - 70 percent C1)	1 lb	7.5 gal						
Sodium Hypochlorite ² (5.25 percent C1)	1 gal	4.25 gal						
¹ Comparable to commercial products known as HTH, Perchloron, and Pittchlor. ² Known as liquid laundry bleach, Clorox, and Purex.								

- H. Point of Application:
 - 1. Inject chlorine mixture into pipeline to be treated at the beginning of the line through a corporation stop or suitable tap in the top of pipeline.
 - 2. Control clean water from existing system or another source so it flows slowly into newly installed piping during chlorine application.
 - 3. Manipulate valves so the strong chlorine solution in the line being treated will not flow back into line supplying the water. Use check valves, if necessary.
- I. Retention Period:
 - 1. Retain treated water in pipeline for a minimum of 24 hours or long enough to destroy nonspore-forming bacteria.
 - 2. At the end of the retention period, the disinfecting mixture shall have strength of at least 10 ppm of chlorine.
 - 3. Operate valves, hydrants, and other appurtenances during disinfection to assure disinfecting mixture is dispersed into all parts of the pipeline including dead ends, new services, and similar areas that otherwise may not receive the disinfecting solution.
 - 4. Do not place concentrated quantities of commercial disinfectants in pipeline before filling with water.
 - 5. After chlorination, flush water from permanent source of supply until water through pipeline is equal chemically and bacteriologically to permanent source of supply.
- J. Disposal of Disinfecting Water:
 - 1. Dispose of disinfecting water in accordance with permits and regulations. Protect the public and receiving waters from harmful or toxic concentrations of chlorine.
 - 2. Do not allow disinfecting water to flow into a waterway without adequate dilution or other satisfactory method of reducing chlorine concentrations to a safe level.

3.13 PROTECTION OF INSTALLED WORK

- A. Protective Covers:
 - 1. Provide over floor and shower drains during construction, to prevent damage to drain strainers and keep foreign material from entering drainage system.
 - 2. Cover roof drains and emergency overflow drains during roofing process so roofing material and gravel do not enter drain piping.
 - 3. Remove at time of Substantial Completion.

END OF SECTION

PLUMBING PIPING AND ACCESSORIES 22 10 01 - 28

SECTION 22 30 00 PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Gas Association (AGA).
 - 2. American Society of Heating, Refrigerating & Air-Conditioning Engineers, Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. American Society of Mechanical Engineer's (ASME).
 - 4. American Society of Sanitary Engineering (ASSE):
 - a. 1013, Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Backflow Preventers.
 - b. 1015, Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Backflow Fire Protection Assemblies.
 - 5. American Water Works Association (AWWA):
 - a. C510, Double Check Valve Backflow Prevention Assembly.
 - b. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
 - c. C550, Protective Interior Coatings for Valves and Hydrants.
 - 6. ASTM International (ASTM):
 - a. A48/A48M, Standard Specification for Gray Iron Castings.
 - b. D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
 - 7. Canadian Standards Association (CSA):
 - a. B64.4, Backflow Preventers, Reduced Pressure Principle Type (RP).
 - b. B64.5, Backflow Preventers, Double Check Valve Type (DCVA).
 - 8. FM Global (FM).
 - 9. Food and Drug Administration (FDA).
 - 10. Foundation for Cross-Connection Control and Hydraulic Research at University of Southern California (FCCHR): Manual of Cross-Connection Control.
 - 11. International Code Council (ICC): International Plumbing Code (IPC).
 - 12. National Electrical Code (NEC).
 - 13. National Electrical Manufacturers Association, (NEMA): MG 1, Motors and Generators.

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- 14. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components Lead Content.
- 15. UL.

1.02 SUBMITTALS

A. Action Submittals: Manufacturer's product data.

1.03 SPECIAL GUARANTEE

A. Where note below, provide manufacturer's extended guarantee in writing with Owner named as beneficiary. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of products found defective during the stated period after date of Substantial Completion.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 WATER HEATERS

- A. Electric Water Heater (Residential):
 - 1. See the Drawing and supplement sheet.
- B. Instantaneous Tankless Gas Water Heating System (Commercial):
 - 1. See the Drawing and supplement sheet.

2.03 GAS VENT STACK

- A. For Gas-Fired Water Heaters:
 - 1. UL listed, Type B double wall, insulated gas vent pipe with rain cap.
 - 2. Galvanized steel outer jacket, aluminum inner sleeve.
 - 3. Insulating thimble.
 - 4. Pier section with cleanout where stack is offset.
 - 5. Manufacturer's standard fittings as required.

2.04 BACKFLOW PREVENTERS

- A. Reduced-Pressure Backflow Preventers (3/4-inch Through 2 inches):
 - 1. Description:
 - a. Regulatory Compliance: AWWA C511, CSA B64.4, FCCHR of USC Section 10, ASSE 1013, ICC (IPC).
 - b. Valve Body: Bronze.
 - c. End Connections: Threaded, NPT.
 - d. Maximum Working Pressure: 175 psi (350 psi test).
 - e. Temperature Range: 32 degrees F to 140 degrees F.
 - f. Shutoff Valve: Full port, resilient seated, bronze ball valve with bronze ball valve test cock.
 - g. Inlet Strainer: Bronze wye strainer, 40-mesh perforated, Type 304 stainless steel.
 - h. Accessories: Drainline air gap fitting.
 - 2. Sizes: See the Drawing.

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Install, arrange, and connect equipment as shown on the Drawings and in accordance with manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

- A. Startup:
 - 1. In accordance with Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
 - 2. Piping Systems: Verify that flushing, cleaning, and testing has been completed prior to startup.

3.03 SUPPLEMENTS

- A. Supplements listed below, following "End of Section," are a part of this Specification.
 - 1. Data Sheet: Electric Water heater (Residential).
 - 2. Data Sheet: Instantaneous Gas Water Heater (Commercial).
 - 3. Data Sheet: Backflow Preventers.

END OF SECTION



Commercial Electric Water Heaters

DURA-POWER[™]

Designed for use as a recovery heater having its own storage tank. Available in upright standard models (DEN) and lowboy models (DEL).

GLASSLINED TANK

• Thirteen sizes; 6 thru 119 gallon capacity. Tank interior is coated with glass specially designed by A. O. Smith for water heater use.

ELEMENTS

• Zinc plated copper sheaths for longer life. Medium watt density means lower surface temperature to minimize scale build-up and more surface to heat water. Element sizes from 1.5 to 6.1 KW. Maximum input KW (see chart).

STANDARD VOLTAGES

 120, 277 single phase and 208, 240 and 480V unbalanced three-phase delta; easily converted to single-phase at terminal block with limited exceptions.
Single element heaters, single-phase only.

TERMINAL BLOCK

 Factory-installed. Just bring the service to heater and connect to block. Terminal block not supplied on 120V & 277 volt models. (No junction box on DEL6-20)

CONTROLS

 Temperature control (adjustable through a range of 110° to 170°F on single element and 120° to 181°F on dual element) and manual reset high temperature cutoff per element CSA CERTIFIED AND ASME RATED T&P RELIEF VALVE

SIMPLIFIED CIRCUITRY, COLOR CODED FOR EASE OF SERVICE

ANODE ROD FOR MAXIMUM CORROSION PROTECTION

CABINET HAS BONDERIZED UNDERCOAT WITH BAKED ENAMEL FINISH

TOP INLET AND OUTLET OPENINGS

DRAIN VALVE (EXCLUDES DEL 6-20)

UL APPROVED FIELD CONVERSION PROGRAM

COMPLIANCE

 Meets the standby loss Requirements of the U.S. Department of Energy and current edition of ASHRAE/IES 90.1

LIMITED WARRANTY OUTLINE

 If the tank should leak any time during the first three years, under the terms of the warranty, A. O. Smith will furnish a replacement heater; installation, labor, handling and local delivery extra. THIS OUTLINE IS NOT A WARRANTY. For complete information consult the written warranty or A. O. Smith Water Products Company.



DEL-30







Commercial Electric Water Heaters







ANODE





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ROUGH-IN DIMENSIONS

Madela		No. of	Nominal	Rated	ļ	1	E	3		2	D)	Shipping Weight	
wodels	UEF	Elements	Capacity	Volume	Inches	mm	Inches	mm	Inches	mm	Inches	mm	lbs.	Kg.
DEL-6	N/A	1	6	6	15-1/2	394	14-1/4	362	11	279	N/A	N/A	35	15.9
DEL-10	N/A	1	10	10	18-1/4	464	18	457	12-1/2	318	N/A	N/A	54	24.5
DEL-15	N/A	1	15	15	26	660	18	457	20-1/2	521	N/A	N/A	58	26.3
DEL-20	N/A	1	20	19	22-1/4	565	21-3/4	552	15-3/8	391	N/A	N/A	73	33.1
DEL-30	0.92	2	36	33	32	813	24	610	24	610	8	203	118	53.5
DEL-40**	0.92	2	38	35	32	813	23	584	24	610	8	203	118	53.5
DEL-50	0.92	2	51	48	36	914	26-1/2	673	25	635	8	203	172	78
DEN-30	0.92	2	40	37	49-3/4	1264	20-1/2	521	53-1/4	1353	8	203	118	53.5
DEN-40	0.92	2	50	46	59	1499	20-1/2	521	51-1/4	1302	8	203	125	56.7
DEN-52	0.92	2	55	55	56-1/2	1435	24	610	48-1/2	1232	8	203	145	65.8
DEN-66	N/A	2	66	60	60-3/4	1543	21-3/4	552	N/A	N/A	8	203	176	79.8
DEN-80	N/A	2	80	76	59-3/8	1508	24	610	N/A	N/A	8	203	211	95.7
DEN-120	N/A	2	120	108	62-7/16	1586	29-3/8	746	N/A	N/A	8	203	326	147.9

	U.S Gallons/HR and Litres/HR at Temperature Rise Indicated													
Element Wattage (Upper/Lower)	Input KW	F°	36 F°	40 F°	54 F°	60 F°	72 F°	80 F°	90 F°	100 F°	108 F°	120 F°	126 F°	
		C°	20 C°	22.2 C°	30 C°	33.3 C°	40 C°	44.4 C°	50 C°	55.5 C°	60 C°	66.6 C°	70 C°	
6100/6100 ** 12	12.2	GPH	138	124	92	82	69	62	55	49	46	41	39	
	12.2	LPH	522	469	348	310	261	235	208	184	174	153	146	

*No side outlet available on DEL-6 Model

**Blanket model

Note: All 66, 80, 120 models can only be ordered 277V, 240V, or 480V



ELEMENT AVAILABILITY CHART (LIGHT-DUTY COMMERCIAL ELECTRIC)

Models & Elements	Voltage	Wiring					kW Input	Available				
	120V	-	1.5	2	2.5	3						
	208V	-	1.5	2	2.5	3						
6-Gallon Models Single-Element	240V	-	1.5	2	2.5	3						
	277V	-	1.5	2	2.5	3						
	480V	-		2	2.5	3						
	120V	-	1.5	2	2.5	3						
10-Gallon through	208V	-	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
20-Gallon Models	240V	-	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Single-Element	277V	-	1.5	2	2.5	3		4	4.5	5		6
	480V	-		2	2.5	3		4	4.5	5	5.5	6

6 gallon model not available above 3kW

6/10/15/20 gallon models all A6 circuit (2 wire) only

Madal			Element	Wattage		
wodei		120V	208V	240V	277V	480V
DEL 20	Min Watts	N/A	4500	4500	4500	4500
DEL-30	Max Watts	N/A	6000 (*)	6000 (*)	6000	6000
	Min Watts	N/A	4500	4500	4500	4500
DEL-40	Max Watts	N/A	6000 (*)	6000 (*)	6000	6000
	Min Watts	N/A	4000	4000	4000	4000
DEL-50	Max Watts	N/A	6000 (*)	6000 (*)	6000	6000
DEN 20	Min Watts	N/A	4500	4500	4500	4500
DEN-30	Max Watts	N/A	6000 (*)	6000 (*)	6000	6000
	Min Watts	3000 (*)	3000	3000	3000	3000
DEN-40	Max Watts	3000 (*)	6000 (*)	6000 (*)	6000	6000
	Min Watts	2500	2500	2500	2500	2500
DEN-32	Max Watts	3000 (*)	6000 (*)	6000 (*)	6000	6000

Additional limitations apply to 120V, 208V, and 240V - Simultaneous Operation are not available (*) for these voltages. 3 phase only on 240 6000 watt for simultaneous operation



RECOVERY CAPACITIES

Element					U. S.	Gallons/Hr a	nd Litres/H	r at Tempera	ature Rise In	dicated			
Wattage (Upper/	Input	F°	36	40	54	60	72	80	90	100	108	120	126
Lower)	kW	C°	20	22.2	30	33.3	40	44.4	50	55.5	60	66.6	70
Non-Simulat	aneous O	peration	•										
/1500	1 5	GPH	17	15	11	10	8	8	7	6	6	5	5
/1500	1.5	LPH	64	58	43	38	32	29	26	23	21	19	18
/2000	۔ ۱	GPH	23	20	15	14	11	10	9	8	8	7	6
/2000	2	LPH	85	77	57	51	43	38	34	31	28	26	24
/2500	2 5	GPH	28	25	19	17	14	13	11	10	9	8	8
/2500	2.5	LPH	107	96	71	64	53	48	43	38	36	32	30
2000/2000	2	GPH	34	30	23	20	17	15	14	12	11	10	10
5000/5000	5	LPH	128	115	85	77	64	58	51	46	43	38	37
4000/4000	4	GPH	45	41	30	27	23	20	18	16	15	14	13
4000/4000	4	LPH	170	153	114	102	85	77	68	61	57	51	49
4500/4500	4 5	GPH	51	46	34	30	25	23	20	18	17	15	14
4500/4500	4.5	LPH	192	173	128	115	96	86	77	69	64	58	55
5000/5000	5	GPH	56	51	38	34	28	25	23	20	19	17	16
3000/3000	J	LPH	213	192	142	128	107	96	85	77	71	64	61
6000/6000	6	GPH	68	61	45	41	34	30	27	24	23	20	19
8000/8000	0	LPH	256	230	170	153	128	115	102	92	85	77	73
Simulataneo	ous Operat	tion		-						0	u		
3000/3000	6	GPH	68	61	45	41	34	30	27	24	23	20	19
3000/3000	0	LPH	256	230	170	153	128	115	102	92	85	77	73
4000/4000	Q	GPH	90	81	60	54	45	41	36	32	30	27	26
4000/4000	0	LPH	341	307	227	205	170	153	136	123	114	102	97
4500/4500	0	GPH	101	91	68	61	51	46	41	36	34	30	29
4300/4300	9	LPH	384	345	256	230	192	173	153	138	128	115	110
5000/5000	10	GPH	113	101	75	68	56	51	45	41	38	34	32
5000/5000	10	LPH	426	384	284	256	213	192	170	153	142	128	122
6000/6000	12	GPH	135	122	90	81	68	61	54	49	45	41	39
0000/0000	12	LPH	511	460	341	307	256	230	205	184	170	153	146

Recovery capacities at 100° F rise equal: for non-simultaneous element operation = 4.1 gal. x kW of one element; for simultaneous element operation = 4.1 gal. x 2/3 kW of both elements. For other rises multiply element kW as previously explained by 410 and divide by temperature rise. Full load current for single phase = total watts/voltage.

SPECIFICATION

The water heaters(s) shall be Dura-Power[™] Model(s) No. _____ as manufactured by A. O. Smith or an approved equal. Heater(s) shall be rated at ____ volts, ______phase, 60 cycle AC, and listed by Underwriters' Laboratories. Models shall meet the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IES 90.1. Tank(s) shall be _____gallon capacity. Heater(s) shall have 150 psi working pressure and be equipped with extruded high density anode rod. All internal surfaces of the heater(s) exposed to water shall be glasslined with an alkaline borosilicate composition that has been fused-to-steel by firing at a temperature range of 1400°F to 1600°F. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch. The outer jacket shall be of backed enamel finish and shall enclose the tank with foam insulation. Electrical junction box with heavy duty terminal block shall be provided (except on 120V & 277V (no junction box on DEL-6 thru 20}). The drain valve shall be located in the front for ease of servicing. Heater tank shall have a three year limited warranty as outlined in the written warranty. Fully illustrated instruction manual to be included.

For technical information, call 800-527-1953. A. O. Smith Corporation reserves the right to make product changes or improvements without prior notice.



The new degree of comfort.®

Rheem[®] RTG Series High Efficiency Non-Condensing Tankless Gas Water Heaters

Easy Installation

- Industry Leading! 43' vent run capability
- Enhanced design up to 10% smaller to fit in even more places than before
- Enhanced design up to 22% lighter making one-person installs even easier

Ready for Retrofits

Specifications

- Industry Best! 1/2" side to side clearance allows you to safely work in spaces the competition can't
- 1/2" Gas line compatibility up to 24 ft (subject to local code)
- Universal Venting Compatibility with UBBINK, Metal Fab, and Rainbow venting for easier tankless to tankless replacements
 Kov Fastures

Key Features

- Rheem[®] Exclusive! Hot-start Programming[™] ensures the unit is in a ready state between back-to-back usage, minimizing any cold water bursts
- Built-in EcoNet® Wi-Fi technology for direct control from your device (on select models)
- LeakGuard[®] All-inclusive leak detection and prevention system that detects any leak that comes from the unit (on indoor Wi-Fi models)

			INDOOR			OUTDOOR						
Rheem Mode	el Number	RTG- 70DVLN-3	RTG- 84DVLN-3	RTG- 95DVLN-3	RTG- 70XLN-3	RTG- 84XLN-3	RTG- 95XLN-3					
Built-in Lea Model N	kGuard [™] umber			RTG- 95DVELN-3 (Wi-Fi Model)			RTG- 95XELN-3 (Wi-Fi Model)					
Gas Input	MAX	160,000	180,000	199,900	160,000	180,000	199,900					
Rate (BTU/h)	MIN	11,000	11,000	11,000	11,000	11,000	11,000					
Uniform Energy	Factor (UEF)			0.8	32							
Hot Water	MAX (35°F)	7.0	8.4	9.5	7.0	8.4	9.5					
Capacity –	45°F Rise	6.0	6.7	7.4	6.0	6.7	7.4					
Minute (GPM)	67°F Rise	4.1	4.5	5.0	4.1	4.5	5.0					
Number of B	athrooms ¹	2-3	3	3-4	2-3	3	3-4					
Temp. R	ange			100°F -	140°F							
Temp. Setting f	rom Factory			120	°F							
High Temp. Availa	Upgrade ble			N	D							
Freeze Pro	otection	-30°F Air Intake ² , -4°F Ambient										
Heat Exchang	er Material	Primary: Copper										
Minimum Acti	vation Flow	0.4 GPM										
Minimum Cont	inuous Flow			0.26 (GPM							
Maximum	Altitude	7,800 ft.										
Ultra Lov	v NOx	Meets 14 ng/J NOx requirements - SCAQMD Rule 1146.2 compliant										
Warra	nty	15 Year Heat Exchanger 5-Year Parts 1-Year Labor										
Heig	ht		24.2"		20.75"							
Wid	ih 		13.5"		13.5"							
Dep	th a t		10.27"		9.4"							
Weight	LDS.)	0	40.5			42						
Max Single	1. Allowed	3 0	5 CONCEI	VIRIC		IN/A						
(straight	pipe)		43 ft.			N/A						
Approved Manufac	Venting cturer		Ν	letal Fab, Rair	nbow, UBBIN	١K						
Manifold C (max. u	Controls nits)			6 Ur	iits ³							
Contr	ols	Buil	t-in digital di	splay	Externa	al Remote (Ir	ncluded)					
Power S	upply			120V	60Hz							
Max. Po Consum	ower	85W (Normal use), 0.7 Amps 132W (Antifreeze), 1.1 Amps 3.5W (Standby), 0.03 Amps ⁴										
Gas Conr	ection			3/4"	NPT							
Hot Water C	onnection			3/4"	NPT							
Cold Water C	Connection			3/4"	NPT							

Indoor DV Outdoor

RTG Series Models

Indoor & Outdoor Models 11,000-199,900 BTU/h Natural Gas and Liquid Propane Models*

*Swap P for N in model number for Liquid Propane model



Clearances									
Top / Bottom	12"								
Front	1/2"5								
Sides	1/2"								
Back / From Vent Pipe	0"								



¹ Based on simultaneous showers using 2.0 GPM flow rate pre-mixed with cold water line. Flow rates vary depending on temperature of incoming cold water and water heater set temperature. Refer to 9 zone ground water temperature map for accurate sizing. ² For indoor application, this is the temperature of outdoor intake air. ³ Manifolds with standard RJ11 communication cables. ⁴ If anti freeze is on and combustion is on, total W will be 217W (85+132). ⁵ Recommended 24* clearance for service.

All models are available in Natural Gas or Propane (LP). For Propane replace the N with P for LP model.





1

U.S. Ground Water Temperature Zone Map



Average Flow Rates (GPM) by Application

Low Flow Faucet	0.5
Bathroom Faucet	1
Kitchen Faucet	1.5
Shower	2
Dishwasher	2
Washing Machine	3

Equivalent Ft. of Elbows

Venting Materials Allowed: 3-in./5-in. (7.6-cm/12.7-cm) UL-approved

Category III Stainless Steel vent materials or water heater manufacturer-approved vent material (MetalFab, UBBINK, and Rainbow)

3"/5"

1.6 ft.

9 in.

Flow rates may vary.

90° Elbow

45° Elbow

Flow Rate Capacity Table by Zone (Gallons Per Minute - GPM)

Use the U.S. Ground Water Temperature Map to locate your zone. Then use the Flow Rate Capacity Table to determine model flow rate by zone. Flow rates calculated for tankless set temperature of 120°F with a mixed shower temperature of 105°F. Ground water temperatures vary seasonally.

MODEL #	Zone 1 37°F	Zone 2 42°F	Zone 3 47°F	Zone 4 52°F	Zone 5 57°F	Zone 6 62°F	Zone 7 67°F	Zone 8 72°F	Zone 9 77°F
RTG-95	4.0	4.3	4.6	4.9	5.3	5.7	6.3	6.9	7.7
RTG-84	3.6	3.8	4.1	4.4	4.8	5.2	5.7	6.3	7.0
RTG-70	3.2	3.4	3.7	3.9	4.2	4.6	5.0	5.6	6.2

Venting

SINGLE UNIT: MAX. EQUIVALENT VENT LENGTHS - STRAIGHT PIPE										
Number of 90 Elbows	Max Length 3" / 5" straight pipe									
0	43 ft. (13.1 m)									
1	41.5 ft. (12.6 m)									
2	38.5 ft. (12.2 m)									
3	34 ft. (11.7 m)									
4	28 ft. (11.3 m)									
5	20.5 ft. (10.8 m)									
6	11.5 ft. (10.4 m)									

Min. Vent Length Straight Pipe										
Number of 90° Elbows	Min. Length 3"/5" pipe									
1	1.0 ft (0.3 m)									

Hanging bracket is included with water heater.

Parts & Accessories

Recirculation Pump	Pipe Cover	Horizontal Vent Termination Twin Pipe System	Concentric Vent Termination Twin Pipe System	AllClear [®] Water Treatment System	Isolation Valve Kit	Manifold Cables
AP17920	RTG20330AJ	RTG20231-2	RTG20211	RTG20251	RTG20326	RCPN-AMP03- 0013111101-0003 (48")

In keeping with its policy of continuous progress and product improvement, Rheem reserves the right to make changes without notice.

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Engineering Specification

Job Name	Contractor
Job Location ————	Approval
Engineer	Contractor's P.O. No
Approval	Representative



Series LF909 Small Reduced Pressure Zone Assemblies LF909

¾**"-1**"

LF909M1

1¼"-2"

Series LF909 Reduced Pressure Zone assemblies provide superior cross-connection control protection of the potable water supply in accordance with national plumbing codes and containment control for water authority requirements. This series can be utilized in a variety of installations, including health hazard cross-connections in plumbing systems or for containment at the service line entrance. The series features Lead Free* construction to comply with Lead Free* installation requirements. With its exclusive design incorporating the "air-in/water-out" principle, the series provides maximum relief valve discharge during the emergency conditions of combined backsiphonage and backpressure with both checks fouled. Standardly furnished with full port, resilient-seated, and Lead Free* cast copper silicon alloy ball valve shutoffs. Sizes ¾" and 1" shutoffs have tee handles.

This series includes a flood sensor to detect excessive water discharges from the relief valve. The sensor is installed on the assembly exterior and does not alter assembly functions or certifications. The sensor relays a signal that triggers notification to facility personnel, helping to avoid the possibility of ruinous flooding and costly damage.

NOTICE

An add-on connection kit is required to activate the flood sensor. Without the connection kit, the flood sensor is a passive component that does not communicate with any other device. (For more information, download RP-IS-LF909S.)

Features

- Modular, compact design easing installation
- Replaceable seats
- Horizontal or vertical (up or down) installation on limited sizes only
- No special tools required for servicing
- Sensor on the relief valve for flood detection
- Flood alerts feature activated with add-on sensor connection kit, compatible with BMS and cellular communication



How It Operates

The unique relief valve construction incorporates two channels: one for air, the other for water. When the relief valve opens the right channel admits air to the top of the reduced pressure zone, relieving the zone vacuum. The left channel then drains the zone to atmosphere. (See diagram to the right.) Therefore, if both check valves foul, and simultaneous negative supply and positive backpressure develop, the relief valve uses the air-in/water-out principle to stop potential backflow.



NOTICE

Use of the flood sensor does not replicate the need to comply with all required instructions, codes, and regulations related to installation, operation, and maintenance of this product, including the need to provide proper drainage in the event of a discharge. Watts is not responsible for the failure of alerts due to connectivity or power issues.

NOTICE

The information contained herein is not intended to replace the full product installation and safety information available or the experience of a trained product installer. You are required to thoroughly read all installation instructions and product safety information before beginning the installation of this product.

Inquire with governing authorities for local installation requirements.

Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.



^{*}The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.

Specification

A Reduced Pressure Zone assembly shall be installed at each cross-connection to prevent backsiphonage and backpressure of hazardous materials into the potable water supply. The assembly shall consist of a pressure differential relief valve located in a zone between two positive seating check valves. Backsiphonage protection shall include provision to admit air directly into the reduced pressure zone via a separate channel from the water discharge channel, or directly into the supply pipe via a separate vent. The assembly shall be constructed using Lead Free* cast copper silicon materials. The Lead Free* reduced pressure zone assembly shall comply with state codes and standards, where applicable, requiring reduced lead content. The assembly shall include two tightly closing shutoff valves before and after the assembly, test cocks and a protective strainer upstream of the No. 1 shutoff valve. The assembly (specify Model LF909 for temperatures up to 140°F (60°C) or Model LF909HW for temperatures up to 210°F (99°C)) shall meet the requirements of ASSE Standard 1013; AWWA Standard C-511-92 CSA B64.4; FCCCHR of USC Manual Section 10. Listed by IAPMO (UPC). SBCCI (Standard Plumbing code). The assembly shall be a Watts LF909QT, and shall include strainer (-S) and sensor on the relief valve for flood detection (-FS).

Model/Option

FS	Sensor on relief valve for flood detection
QT	Quarter-turn ball valves
S	Bronze strainer
HW	Stainless steel check modules for hot and harsh water conditions

NOTICE

The installation of a drain line is recommended. When installing a drain line, an air gap is necessary.

Materials

Body: Lead Free* cast copper silicon alloy Check Seats: 909 Celcon® Relief Valve Seats: Stainless Steel 909 Test Cocks: Lead Free* cast copper silicon alloy

Standards

AWWA C-511-92 FCCCHR of USC Manual Section 10 IAPMO (UPC), SBCCI (Standard Plumbing code) Tested and Certified by NSF International

Approvals



Listed by IAPMO

Listed by SBCCI

Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California (QT and S models). Vertical "flow-up" approval only on ¾" and 1" sizes (Model LF909QT).

Pressure - Temperature

Temperature Range: 33°F – 140°F (0.5°C – 60°C) continuous; 180°F (82°C) intermittent

Maximum Working Pressure: 175 psi (12.1 bar)

Series LF909HW:

Temperature Range: 33°F – 210°F (0.5°C – 99°C) Maximum Working Pressure: 175 psi (12.1 bar)

Connections

 $\frac{3}{4}$ " – 1" 909-NPT Female threaded body connection 1 $\frac{1}{4}$ " – 2" 909-M1-NPT Male threaded body connection

Insulated Enclosure

The WattsBox insulated enclosure is available for this series. For more information download ES-WB at watts.com.



Dimensions – Weights

When installing a drain line, use Model 909AG air gaps on Series LF909 Small backflow preventers. Model 909EL elbows are for air gaps on backflow preventers in vertical installations.



Call customer service if you need assistance with technical details. Model 909AG Air Gaps

		909 D	RAIN	00	TLET		DIMENS	WEIGHT			
Iron Body		Siz	e		Size		A		В		
No.	Desc.	in.	n. mm		тт	in.	тт	in. mm		lb	kg
909AG-C	Air Gap	³ ⁄4, 1	19,25	1	25	3¼	83	41/8	124	1½	0.7
909EL-C	Elbow	³ ⁄4, 1	19,25			23/8	60	23/8	60	3/8	0.2
909AG-F	Air Gap	1¼-2 32-50		2	50	4% 111		6¾ 171		3¼	1.5
909EL-F	Elbow	1¼-2 32-50		-	-	3% 92		31/8	92	2	0.9







LF909, LF909M1

SIZE		DIMENSIONS														WEIGHT						
	A As		S	В			С		D		E		Es		L		Р	QT		QT-S		
	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	in.	тт	lb	kg	lb	kg
3/4"	14%	365	181/16	459	91/8	251	4	102	51/8	149	6¾	171	103/16	259	7 5⁄16	186	31/8	98	14	6.4	15.6	7.1
1"	15%	391	19%	498	91/8	251	4	102	51/8	149	7	178	11	279	7 ⁵ / ₁₆	186	31/8	98	15	6.8	17.5	7.9
1¼"M1	18½	470	237/16	595	12¾	324	51/2	140	7%	194	7½	191	12 ³ ⁄ ₁₆	310	10%	264	51⁄4	133	40	18.1	42.8	19.4
1½"M1	19	483	24%	619	12¾	324	5½	140	7%	194	71/2	191	125/8	321	10%	264	51⁄4	133	40	18.1	44.0	20.0
2"M1	19½	495	2515/16	659	123/4	324	51/2	140	7%	194	73/4	197	1315/16	354	103/8	264	51/4	133	40	18.1	47.4	21.5

Capacity

As compiled from documented Foundation for Cross-Connection Control and Hydraulic Research of the University of Southern California lab tests.





SECTION 22 40 00 PLUMBING FIXTURES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Americans with Disabilities Act (ADA).
 - 2. American Gas Association (AGA).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. American Society of Sanitary Engineering (ASSE): 1010, Performance Requirements for Water Hammer Arresters.
 - 5. ASTM International (ASTM): D4101, Standard Specification for Polypropylene Injection and Extrusion Materials.
 - 6. Food and Drug Administration (FDA).
 - 7. NSF International (NSF):
 - a. NSF/ANSI 61, Drinking Water System Components Health Effects.
 - b. NSF/ANSI 372, Drinking Water System Components Lead Content.
 - 8. Plumbing and Drainage Institute (PDI):
 - a. Code Guide 302 and Glossary of Industry Terms.
 - b. WH-201, Water Hammer Arrester Standard.
 - 9. UL.

1.02 SUBMITTALS

- A. Action Submittals: Catalog information and rough-in dimensions for plumbing fixtures, products, and specialties.
- 1.03 REGULATORY REQUIREMENTS
 - A. Comply with the Americans with Disabilities Act (ADA), and local and state requirements.

PART 2 PRODUCTS

2.01 GENERAL

- A. Components and Materials in Contact with Water for Human Consumption: Comply with the requirements of the Safe Drinking Water Act and other applicable federal, state, and local requirements. Provide certification by manufacturer or an accredited certification organization recognized by the Authority Having Jurisdiction that components and materials comply with the maximum lead content standard in accordance with NSF/ANSI 61 and NSF/ANSI 372.
 - 1. Use or reuse of components and materials without a traceable certification is prohibited.

2.02 MANUFACTURERS

- A. Fixture Trim:
 - 1. Supply Stops and Traps:
 - a. McGuire.
 - b. American Standard.
 - c. Kohler.
 - 2. Flush Valves: Sloan.
 - 3. Water Closet Seats:
 - a. Bemis.
 - b. Church.
 - c. Olsonite.
 - 4. Lavatory Supply, Tailpiece, and Trap Insulation:
 - a. McGuire.
 - b. Trap Wrap.
 - c. Truebro.
- B. Plumbing Fixtures:
 - 1. Water Closets, Lavatories, and Urinals:
 - a. American Standard.
 - b. Kohler.
 - c. Eljer.
 - 2. Service Sinks:
 - a. Kohler.
 - b. Eljer.
 - 3. Faucet Fittings:
 - a. Sinks:
 - 1) Chicago.
 - 2) T&S Brass.

PLUMBING FIXTURES 22 40 00 - 2

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- b. Lavatories:
 - 1) Chicago.
 - 2) Symmons.
- c.
- 4. Stainless Steel Sinks:
 - a. Elkay.
 - b. Just.
- C. Drainage Products:
 - 1. General:
 - a. Smith.
 - b. Wade.
 - c. Zurn.
- D. Plumbing Specialties:
 - 1. Shock Arresters:
 - a. Smith.
 - b. Sioux Chief.
 - c. Precision Plumbing Products.
 - 2. Trap Primers:
 - a. Precision Plumbing Products.
 - b. Smith.
 - c. Wade.
 - 3. Pressure/Temperature Relief Valves:
 - a. Cash-Acme.
 - b. Kunkle Valve.
 - c. Watts.
 - 4. Pressure Gauges:
 - a. Ashcroft.
 - b. Marsh.
 - c. Marshalltown.
 - 5. Thermometers:
 - a. Trerice.
 - b. Weksler.
 - 6. Automatic Washer Supplies:
 - a. Guy Gray.
 - b. Symmons.

2.03 GENERAL

- A. Fixture Trim: Provide plumbing fixture trim where applicable on fixtures.
- B. Plumbing Fixtures: Indicated by fixture number as shown on the Drawings.

- C. Drainage Products: Indicated by fixture number as shown on the Drawings.
- D. Plumbing Specialties: Indicated by fixture number as shown on the Drawings.
- E. Exposed fixture connections and piping shall be polished chrome-plated.

2.04 MATERIALS

- A. Fixture Trim:
 - 1. Supply Stop:
 - a. Flexible supply with heavy cast brass, loose key, 1/2-inch IPS by 3/8-inch outside diameter tubing angle stop to wall with escutcheon plate; chrome-plated finish.
 - b. Provide stop with stuffing box.
 - c. Manufacturer: McGuire Manufacturing Company, Inc.
 - 2. Trap:
 - a. Chrome-plated, 17-gauge, semicast P-trap with compression ring cast brass waste and vent connection and cleanout.
 - b. 1-1/2 inches for lavatories and drinking fountains.
 - c. 1-1/2 inches for sinks.
 - d. Manufacturer: McGuire Manufacturing Company, Inc.
 - 3. Water Closet and Urinal Flush Valves: Sloan Valve Co., Royal Continental, low flush, quiet action with screwdriver stop and vacuum breaker.
- B. Plumbing Fixtures: See the Drawing for fixture schedule.
- C. Drainage Products: See the Drawing for fixture schedule.
- D. Plumbing Specialties:
 - 1. Water Hammer Arresters:
 - a. Materials: ASSE 1010 certified, Type L copper tube, HHPP piston with two lubricated EPDM O-rings, FDA approved lubricant, rolled piston stop, wrought copper male thread adapter.
 - b. Manufacturer and Product: Sioux Chief Mfg. Co., Inc.; Series 650 and 660.
 - 2. ETP-1, Automatic Trap Priming System: See the Drawing.
 - 3. ETP-2, Automatic Trap Priming System: See the Drawing.
- E. Sealant: In accordance with Section 07 92 00, Joint Sealants.

PART 3 EXECUTION

3.01 PREPARATION

A. Drawings do not attempt to show exact details of fixtures. Changes in locations of fixtures, advisable in opinion of Contractor, shall be submitted to Engineer for review before proceeding with the Work.

3.02 INSTALLATION

- A. Fixture Trim: Install fixture trim where applicable on fixtures.
- B. Plumbing Fixtures, Mounting Heights:
 - 1. Standard rough-in catalogued heights, unless shown otherwise on the Drawings.
 - 2. Caulk fixtures in contact with finished walls with waterproof, white, nonhardening sealant which will not crack, shrink, or change color with age. See Section 07 92 00, Joint Sealants.
- C. Exact fixture location and mounting arrangement shall be as indicated on toilet room elevations and details as shown on the Drawings.
- D. Unless noted otherwise and as a minimum, fixtures shall be supported as indicated in PDI Code Guide 302.
- E. Safety Equipment:
 - 1. System Shutoff Valves:
 - a. Shutoff valves shall give visual indication of position (open or closed).
 - b. Shutoff valves shall be lockable valves and locked in open position.
 - 2. Each safety shower, eyewash, combination safety shower/eyewash shall have red safety signoff tag. After completing requirements listed below, Contractor and Owner shall sign red safety signoff tag. Requirements are as follows:
 - a. Visually check safety shower/eyewash piping for leaks.
 - b. Verify that upon operation, stay-open valves remain open.
 - c. Showerheads to be between 82 inches and 96 inches above standing surface.
 - d. Shower spray pattern, when valve is full open, shall be a minimum 20 inches in diameter at 60 inches above standing surface.
 - e. Water arcs from eyewash spray heads must cross. Test with eyewash gauge; Haws Drinking Faucet Co., Model 9015.
 - f. Minimum flow rates for safety showers shall be 20 gpm.

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- g. Minimum flow rates for eyewashes shall be 3 gpm.
- h. Tempered water shall be temperature indicated on the Drawings.
- F. Drainage Products:
 - 1. Floor Drains: Set top flush with floor. Provide membrane clamps where required.
 - 2. Cleanouts: Install where shown or required for purposes intended. Set cover flush with finished floor.
 - 3. Hub Drains: Set top of hub 2 inches above finished floor.
- G. Plumbing Specialties:
 - 1. Shock Arresters:
 - a. Install PDI-certified and rated shock arresters, sized and located in accordance with PDI WH-201 and as shown on the Drawings.
 - b. Install adjacent to equipment wherein quick closing valves are installed.
 - c. Install at each emergency safety shower.
 - d. Shock arresters to have access panels or to be otherwise accessible.
 - 2. Drain P-Trap Priming:
 - a. Pipe: Type K, soft copper.
 - b. Trap and prime floor drains and hub drains, unless shown otherwise on the Drawings. No attempt has been made to show trap primer valve locations or trap primer pipe routing.
 - c. Field route trap primer piping during installation of floor drains and hub drains, and install trap primer valves in mechanical rooms, janitor rooms, or other locations acceptable to Engineer.
 - d. Priming System: Complete with connection to serving **W1** cold water system.
 - 3. Trap Priming Valves:
 - a. Floor drain traps primed with priming valves, 1/2-inch copper to floor drain.
 - b. Two traps maximum primed from one priming valve or as recommended by manufacturer. Locate in mechanical spaces or janitor's rooms and as indicated on the Drawings.
 - c. Provide shutoff valve ahead of priming valves.
 - 4. Thermometers and Pressure Gauges:
 - a. Arrange devices to facilitate use and observation.
 - b. Install in orientation that will allow clear observation from ground level.
 - c. Provide pressure gauges with block valves.
 - d. Install thermometers in thermowells.

- H. Caulk penetrations of exterior walls with weatherproof sealant in accordance with Section 07 92 00, Joint Sealants.
- I. Adjust water flows in domestic water systems for reasonable water flows at each plumbing fixture, terminal device, and recirculation loop. Flush valve fixtures shall be adjusted for proper flush cycle time and water quantity.

3.03 FIELD QUALITY CONTROL

- A. Perform visual inspection for physical damage, blocked access, cleanliness, and missing items.
- B. Notify Owner and Engineer 48 hours prior to shower testing. Owner and Engineer reserve the right to witness all tempered water and safety shower testing.

END OF SECTION

SECTION 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Moving and Conditioning Association, Inc. (AMCA): 203, Field Performance Measurement of Fan Systems.
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): HVAC Applications Handbook.
 - 3. Associated Air Balance Council (AABC): National Standards for Field Management and Instrumentation Total System Balance.
 - 4. National Environmental Balancing Bureau (NEBB):
 - a. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - b. Procedural Standards for Measuring Sound and Vibration.
 - 5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): HVAC Testing, Adjusting, and Balancing Manual.

1.02 SUBMITTALS

- A. Informational Submittals:
 - 1. Documentation of experience record of testing authority.
 - 2. Documentation of current AABC or NEBB certifications for those technicians in responsible charge of the work under this Contract.
 - 3. Submit detailed test and balance procedures, including test conditions for systems to be tested, prior to beginning the Work.
 - 4. Written verification of calibration of testing and balancing equipment.
 - 5. Balancing Log Report following completion of system adjustments including test results, adjustments, and rebalancing procedures.

1.03 QUALITY ASSURANCE

- A. Air Balancing and Test Agency Qualifications:
 - 1. Certification by AABC of NEBB for testing, adjusting and balancing of HVAC systems.
 - 2. Corporately and financially independent organization functioning as an unbiased testing authority.
 - 3. Professionally independent of manufacturers, suppliers, and installers of HVAC equipment being tested.

- 4. Have a proven record of at least five similar projects.
- 5. Employer of engineers and technicians regularly engaged in testing, adjusting and balancing of HVAC equipment and systems.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Provide materials, tools, test equipment, computers and instrumentation required to complete the work included.
- B. Test Hole Plugs: Plug test holes in ducts with plugs made for that purpose and replace any insulation removed to specified conditions.
- C. Drives for Belt-Driven Fans:
 - 1. Furnish cast iron or flanged steel sheaves.
 - 2. Sheaves and belt combination shall be capable of providing 150 percent of motor horsepower.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Adjust and balance air and water systems in accordance with standard procedures and recognized practices of the AABC or SMACNA.
 - 1. Adjust and balance the following systems: Supply, return and exhaust air systems.

3.02 ADJUSTING AND BALANCING AIR SIDE

- A. Preparation:
 - 1. Prior to beginning the Work, perform the following activities:
 - a. Review Shop Drawings and installed system for adequate and accessible balancing devices and test points.
 - b. Recommend to Engineer dampers that need to be added or replaced in order to obtain proper air control.
 - c. Verify proper startup procedures have been completed on the system
 - d. Verify controls installation is complete and system is in stable operation under automatic control.
 - e. Verify test instruments have been calibrated to a recognized standard and are within manufacturer's recommended calibration interval before beginning the Work.

- B. General:
 - 1. When adjustments are made to a portion of a fan system, reread other portions of that same system to determine effects imposed by adjustments. Readjust as necessary.
 - 2. Lock and mark final positions of balancing dampers with permanent felt pen.
 - 3. Correct fan and airflow measurements for Site elevation.
- C. Equipment Data:
 - 1. Collect the following data and included in final report:
 - a. Type of unit.
 - b. Equipment identification number.
 - c. Equipment nameplate data (including manufacturer, model, size, type, and serial number).
 - d. Motor data (frame, hp, volts, FLA rpm, and service factor).
 - e. Sheave manufacturer, size, and bore.
 - f. Belt size and number.
 - g. Sheave centerline distance and adjustment limits.
 - h. Starter and motor overload protection data.
 - i. Include changes made during course of system balancing.
- D. Fan Systems:
 - 1. Measure fan system performance in accordance with AMCA 203.
 - 2. In each system at least one airpath from fan to final branch duct termination shall have dampers fully open. Achieve final air quantities by adjusting fan speed.
 - 3. Adjust Fan Air Volumes:
 - a. Adjust fan speeds and motor drives for required equipment air volumes, with allowable variation of plus 10 percent minus 0 percent.
 - b. After final adjustments, do not operate motor above nameplate amperage on any phase.
 - c. After final adjustments, do not operate fan above maximum rated speed.
 - d. Perform airflow test readings under simulated or actual conditions of full cooling, full heating, minimum outside air, full outside air and exhaust, and full return air.
 - e. Provide and make drive and belt changes on motors or fans as required to adjust equipment to specified conditions. Drives shall be able to deliver 150 percent of motor horsepower. Provide written notice to air handling unit manufacturer and Owner and Engineer if drive or belt changes were made.

- 4. Adjust outside air dampers, return air dampers, relief air dampers, exhaust air dampers, and motorized louvers for maximum and minimum air requirements.
- 5. Read and record static pressures at unit inlet and discharge, each filter set, coils, dampers, plenums, and mixing dual-duct or adjustable-volume boxes, on every supply, return, and exhaust fan for each test condition.
- 6. Read and record motor amperage on all phases for each test condition.
- E. Air Terminal Devices:
 - 1. Terminal Airflow Calibration: Calibrate and set the flow coefficients in terminal controller units to ensure controller readings are identical to measured values. This shall be a one-point calibration at maximum flow conditions. Record coefficient values.
 - 2. Test each terminal flow device at minimum and maximum flow conditions. Ensure terminal controller is under control at time of each test.
 - 3. If airflow of terminal device is derived from two or more flow streams, the individual air streams shall be measured and recorded independently for each test.
 - 4. In each terminal system at least one airpath from terminal to final duct termination shall have dampers fully open.
 - 5. Adjust air volumes on each terminal to quantity shown, with allowable variation of plus 10 percent minus 5 percent.
- F. Air Outlets and Inlets:
 - 1. In each system at least one air path from fan to final branch duct termination shall have dampers fully open.
 - 2. Adjust air volumes on supply diffusers and grilles, and on return and exhaust grilles, to the quantity shown, with allowable variation of plus or minus 10 percent.
 - 3. Adjust diffusers and grilles for proper deflection, throw, and coverage. Eliminate drafts and noise where possible.
 - 4. After final adjustments are made secure dampers to prevent movement and mark final positions with permanent felt pen.
- G. Building Static Pressure:
 - 1. Measure building static pressure relative to outside in perimeter entrances during normal system conditions that would yield widest range in internal building pressure.
 - 2. Adjust building static pressure control parameters to ensure perimeter entrances are positive to outdoors by 0.05-inch WC with entrance doors closed.

3. For multi-story buildings, test pressure conditions at ground, intermediate, and upper levels.

3.03 FIELD QUALITY CONTROL

- A. Performance Testing:
 - 1. Electric Heating Coil Testing:
 - a. Adjust system as required to achieve full output from coil.
 - b. Read and record amperages and voltages for all phases.
 - 2. Heating or Sensible Cooling Coil Testing:
 - a. Adjust system as required to achieve design flow conditions for both air and water sides of coil.
 - b. Measure and record airflow rate, water flow rate, entering air temperature, entering water temperature, leaving air temperature and leaving water temperature.
 - 3. Cooling or Dehumidification Coil Testing:
 - a. Adjust system as required to achieve design flow conditions for both air and water sides of coil.
 - b. Measure and record airflow rate, water flow rate, entering air dry bulb and wet bulb temperatures, entering water temperature, leaving air dry bulb and wet bulb temperatures and leaving water temperature.
- B. Balancing Log Report Requirements:
 - 1. Include narrative description for each system explaining TAB methodology and assumptions used. Clearly identify test conditions for tests performed. Include control setpoint.
 - 2. Log and record operational information from every test for each system, as necessary to accomplish services described.
 - 3. Include equipment data for units tested.
 - 4. Include reduced set of HVAC Drawings or system schematic diagrams with each element uniquely identified and indexed to balance log.
 - 5. Indicate recorded site values, and velocity and mass correction factors used to provide equivalent standard air quantities.
 - 6. Include separate section in log, if necessary, describing operating difficulties in air or water systems that could not be eliminated by specified procedures. Identify these problems by system and location within building; include outline or summary of condition and its effect on building, and describe corrective actions attempted and recommended.

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- C. Quality Control Verification:
 - 1. After adjustments have been completed and balance logs submitted, balancing and testing agency shall be available to demonstrate the following:
 - a. Air and water balancing procedures, vibration tests, and verification of test results.
 - b. Perform spot tests on a maximum of 20 percent of total diffusers and grilles, on two air handling fan devices per building, and on 10 percent of total water balance fittings, with measuring equipment used in original tests, at random points selected by Engineer.
 - c. Results of these spot tests shall agree with balance logs within plus or minus 10 percent. Where this accuracy cannot be verified, rebalance portions of system as requested by Engineer.
 - d. At completion of rebalance procedures, perform another spot test if required to verify results.

END OF SECTION

SECTION 23 07 00 HVAC INSULATION

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Society of Heating, Refrigerating & Air-Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 2. Association of the Nonwoven Fabric Industry (INDA). IST 80.6, Water Resistance (Hydrostatic Pressure).
 - 3. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C547, Standard Specification for Mineral Fiber Pipe Insulation.
 - c. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - d. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - e. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - g. G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 - h. G22, Standard Practice for Determining Resistance of Plastics to Bacteria.
 - 4. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - b. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - c. 259, Standard Test Method for Potential Heat of Building Materials.
 - 5. UL.

1.02 DEFINITIONS

A. Cold Air Ductwork: Designed to convey mechanically cooled air or return ducts in such systems.
B. Warm Air Ductwork: Designed to convey mechanically heated air or return ducts in such systems.

1.03 SUBMITTALS

- A. Action Submittals: Product description, list of materials and thickness for each service or equipment scheduled, locations, and manufacturer's installation instructions.
- B. Informational Submittals:
 - 1. Proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

1.04 QUALITY ASSURANCE

- A. Materials furnished under this specification shall be standard, cataloged products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.
- B. Provide materials by firms engaged in the manufacture of insulation products of the types and characteristics specified herein, whose products have been in use for not less than 5 years.
- C. UL listing or satisfactory certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Stamp or Label:
 - 1. Every package or standard container of insulation, jackets, cements, adhesives and coatings delivered to Project Site for use must have manufacturer's stamp or label attached, giving name of manufacturer, brand, and description of material.
 - 2. Insulation Packages and Containers: Marked "asbestos-free."

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Insulation Exterior: Cleanable, grease-resistant, nonflaking, and nonpeeling.
 - B. Insulation: Conform to referenced publications and specified temperature ranges and densities in pounds per cubic foot.

- C. Insulation for Fittings, Flanges, and Valves: Premolded, precut, or jobfabricated insulation of same thickness and conductivity as used on adjacent piping.
- D. Fire Resistance:
 - 1. Insulation, Adhesives, Vapor Barrier Materials and Other Accessories, Except as Specified Herein: Noncombustible.
 - 2. Do not use fugitive or corrosive treatments to impart flame resistance.
 - 3. Flame proofing treatments subject to deterioration resulting from the effects of moisture or high humidity are not acceptable.
 - 4. Provide materials including facings, mastics, and adhesives, with fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke, developed as per tests conducted in accordance with ASTM E84 (NFPA 255) methods.
- E. Materials exempt from fire-resistant rating:
 - 1. Nylon anchors.
 - 2. Treated wood inserts.
- F. Materials exempt from fire-resistant rating when installed in outside locations, buried, or encased in concrete:
 - 1. Polyurethane insulation.
 - 2. PVC casing.
 - 3. Fiberglass-reinforced plastic casing.

2.02 PIPE INSULATION

- A. Type P1—Fiberglass (ASTM C547, Type 1
 - 1. Fiberglass, UL-rated, preformed, sectional rigid, minimum 4 pounds per cubic foot (pcf) density, K factor 0.23 maximum at 75 degrees F mean, with factory-applied all-service jacket (ASJ).
 - 2. All-service Jacket:
 - a. Composed of reinforced kraft paper and aluminum foil laminate.
 - b. Provide self-sealing lap to facilitate closing longitudinal and end joints.
 - 3. Manufacturers and Products:
 - a. CertainTeed; Preformed Pipe Insulation.
 - b. Johns Manville; Micro-Lok HP.
 - c. Owens/Corning; Fiberglas Pipe Insulation.
 - d. Knauf; Crown Pipe Insulation.

- B. Type P1A—Fiberglass, ASTM C547, Type 2, 650 Degrees F, Maximum; Class 3, 850 Degrees F, Maximum:
 - 1. Fiberglass, minimum 5 pcf density, K factor 0.34 maximum at 300 degrees F mean, with factory-applied all-weather jacket (AWJ) for temperatures ambient to 850 degrees F.
 - 2. Manufacturers and Products:
 - a. CertainTeed; Preformed Pipe Insulation.
 - b. Johns Manville; Micro Lok.
 - c. Knauf; Rocksil Mattress.
 - d. Owens/Corning; Fiberglas Pipe Insulation.
- C. Type P2—Calcium Silicate (ASTM C533, 1,200 Degrees F, Maximum):
 - 1. Calcium silicate, minimum 12 pcf density, K factor 0.46 maximum at 300 degrees F mean, without factory-applied jacket.
 - 2. Manufacturers and Products:
 - a. Owens/Corning Fiberglass; Kaylo 10.
 - b. Johns Manville; Thermo-12 Gold.
 - c. Calsilite; 1,200-degree thermal insulation.
- D. Type P3—Elastomeric (ASTM C534, Minus 40 Degrees F to 220 Degrees F):
 - 1. Flexible, closed cell elastomeric.
 - 2. Nominal 6 pcf density, K factor 0.27 maximum at 75 degrees F mean.
 - 3. Water vapor transmission 0.1 perm-inch, or less.
 - 4. Manufacturers and Products:
 - a. Armacell; AP Armaflex.
 - b. Nomaco; K-Flex LS.
- E. Type P4—Cellular Glass:
 - 1. Cellular glass, closed cell, rigid, nominal 8 pcf density, maximum K factor 0.33 at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures to 900 degrees F.
 - 2. Manufacturer and Product: Pittsburgh-Corning; Foamglas.

2.03 DUCT INSULATION

- A. Type D1—Blanket (ASTM C553, Type 1, Class B3):
 - 1. Fiberglass, nominal 1 pcf density blanket, K factor 0.31 maximum at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures to 250 degrees F.
 - 2. Manufacturers and Products:
 - a. CertainTeed; Duct Wrap.

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- b. Johns Manville; Microlite.
- c. Owens/Corning Fiberglass; Soft R.
- d. Knauf; Ductwrap.
- B. Type D2—Board:
 - 1. Fiberglass, minimum 2.75 pcf density board, K factor 0.23 maximum at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures from 0 degree F to 450 degrees F.
 - 2. Manufacturers and Products:
 - a. CertainTeed; CertaPro Commercial Board.
 - b. Knauf; Duct Slab.
 - c. Owens/Corning Fiberglass; TIW.
 - d. Johns Manville; 1000 Series Spin-Glass.
- C. Type D3—Liner (ASTM C1071, Type 1):
 - 1. Fiberglass, nominal 1.5 pcf density liner, K factor 0.25 maximum at 75 degrees F mean, black composite coated surface exposed to airstream to prevent erosion of glass fibers, for temperatures to 250 degrees F.
 - 2. Liquid water repellency rating not less than 4 when tested in accordance with INDA IST 80.6.
 - 3. Potential heat value not exceeding 3,500 Btu/lb when tested in accordance with NFPA 259 and meeting the classification of "Limited Combustible" as defined by NFPA 90A.
 - 4. Maximum rated velocity not less than 6,000 fpm when tested in accordance with ASTM C1071.
 - 5. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C1139, ASTM G21, and ASTM G22.
 - 6. Manufacturers and Products:
 - a. CertainTeed; Toughgard.
 - b. Johns Manville; Linacoustic (rectangular), Spinacoustic (Round).
 - c. Knauf; Acoustic Duct Liner.
- D. Type D4—Ceramic Fiber (to 2,300 degrees F):
 - 1. UL-listed, 2-hour fire-rated, 6 pcf density, inorganic foil encapsulated ceramic fiber blanket.
 - 2. Manufacturer and Product: Thermal Ceramics; Firemaster.
- E. Type D5—Flexible Elastomeric (ASTM 534, Type I for tubular materials and Type II for sheet materials):
 - 1. Closed-cell, sponge- or expanded-rubber materials.
 - 2. Manufacturers and Products:
 - a. Aeroflex USA Inc.; Aerocel.

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- b. Armacell LLC; AP Armaflex.
- c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

2.04 EQUIPMENT INSULATION

- A. Type E1—Elastomeric (ASTM C534):
 - 1. Flexible, closed-cell elastomeric, nominal 6 pcf density, K factor 0.27 maximum at 75 degrees F mean.
 - 2. Manufacturers and Products:
 - a. Armstrong; Armaflex II.
 - b. Nomaco; Therma-Cel.
- B. Type E2—Board:
 - 1. Fiberglass, minimum 2.75 pcf density board, K factor 0.23 maximum at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures from 100 degrees F to 850 degrees F.
 - 2. Manufacturers and Products:
 - a. CertainTeed; CertaPro Commercial Board.
 - b. Knauf; Duct Slab.
 - c. Owens/Corning Fiberglass; TIW.
 - d. Johns Manville; 1000 Series Spin-Glass.

2.05 INSULATION FINISH SYSTEMS

- A. Type F1—PVC:
 - 1. Polyvinyl chloride (PVC) jacketing, white, for straight run piping and fitting locations, temperatures to 150 degrees F.
 - 2. Manufacturers and Products:
 - a. Johns Manville; Zeston.
 - b. Ceel-Co; 550.
- B. Type F2—Paint:
 - 1. Acrylic latex paint, white, and suitable for outdoor use.
 - 2. Manufacturer and Product: Armstrong; WB Armaflex finish.
- C. Type F3—Aluminum:
 - 1. Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100 or 3105 to ASTM B209 with H-14 temper, minimum 0.016-inch thickness, with smooth mill finish.

- 2. Moisture Barrier: Provide factory applied moisture barrier, consisting of 40-pound kraft paper with 1-mil-thick low-density polyethylene film, heat and pressure bonded to inner surface of the aluminum jacketing.
- 3. Fitting Covers: Material as for aluminum roll jacketing, premolded, one or two piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
- 4. Manufacturer and Product:
 - a. RPR Products; INSUL-MATE.
 - b. ITW, Pabco-Childers.

PART 3 EXECUTION

3.01 APPLICATION OF PIPING INSULATION

- A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.
- B. Apply insulation over clean, finish painted, and dry surfaces.
- C. Install insulation after piping system has been pressure tested and leaks corrected.
- D. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
- E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces of scraps abutting each other.
- F. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- G. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Seal open ends of insulation with mastic. Sectionally seal all butt ends of chilled water and condensate drain piping insulation at fittings with white vapor barrier coating.
- H. Cover valves, flanges, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job-fabricated units. Finish cold pipe fittings with white vapor barrier coating and hot piping with white vinyl acrylic mastic, both reinforced with glass cloth.
- I. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.

- J. Install protective metal shields and foamglass inserts where pipe hangers bear on outside of insulation.
- K. Insulation on piping that is to be heat traced shall be installed after installation of heat tape.
- L. Insulate valve bodies, flanges, and pipe couplings.
- M. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
- N. Do not insulate flexible pipe couplings and expansion joints.
- O. Do not allow insulation to cover nameplates or code inspection stamps.
- P. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
- Q. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.
- R. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.
- S. Placement:
 - 1. Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.
 - 2. Insulate valves and fittings with sleeved or cut pieces of same material.
 - 3. Seal and tape joints.
- T. Insulation at Hangers and Supports: Install under piping, centered at each hanger or support.
- U. Vapor Barrier:
 - 1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
 - 2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
 - 3. Do not use staples and screws to secure vapor sealed system components.

3.02 INSTALLATION OF DUCTWORK INSULATION

- A. General: Install insulation products in accordance with the manufacturer's written instructions and in accordance with recognized industry practices.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulation. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation and protect it to prevent puncture and other damage. Tape all punctures.
- E. Seal longitudinal and circumferential joints with FSK tape, and finish with fiberglass mesh fabric embedded in vapor barrier mastic.
- F. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated.
- G. Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.
- H. Refer to Section 23 31 13, Metal Ducts and Accessories, for installation of internal duct liner.

3.03 INSTALLATION OF EQUIPMENT INSULATION

- A. Application Requirements: Insulate where external surface temperature of equipment is below ambient temperature in the space, including surfaces that have a recognized possibility for condensation.
- B. Install equipment thermal insulation products in accordance with manufacturer's written instructions and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- C. Install insulation materials with smooth and even surfaces and on clear and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.
- D. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- E. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.

- F. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.
- G. Avoid using scrap pieces of insulation where larger sheets will fit.

3.04 INSTALLATION OF INSULATION FINISH SYSTEMS

- A. Use a continuous friction type joint to hold jacket in-place, providing positive weatherproof seal over entire length of jacket.
- B. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
- C. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
- D. Do not use screws or rivets to fasten the fitting covers.
- E. Install removable prefabricated aluminum covers on exterior flanges and unions.
- F. Caulk and seal all exterior joints to make watertight.

3.05 PIPING INSULATION REQUIREMENTS

- A. Refrigeration Suction:
 - 1. Type P3, elastomeric.
 - 2. 1/2-inch thickness for pipe sizes up to 1-inch.
 - 3. 3/4-inch thickness for pipe sizes over 1-inch.
- B. Refrigeration Hot Gas Reheat:
 - 1. Type P3, elastomeric.
 - 2. 3/4-inch thickness.
- C. Condensate Drain:
 - 1. Type P3, elastomeric.
 - 2. 1/2-inch thickness for pipe sizes up to 2-5/8 inches ID.
 - 3. 3/4-inch thickness for pipe sizes over 2-5/8 inches ID.
- D. Stack:
 - 1. Type P1A.
 - 2. 2-inch thickness for temperatures up to 700 degrees F.
 - 3. 3-inch thickness for temperatures over 700 degrees F.

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- E. Pipe Hangers:
 - 1. Type P1, Fiberglass: UL-rated, preformed rigid pipe insulation inserts of thickness equal to adjoining insulation, 10 inches in length, with factory-applied, vinyl-coated and embossed vapor barrier jacket with self-sealing lap.
 - 2. Type P3, Elastomeric: Rigid insulation section with 9-inch-long, 16-gauge galvanized steel saddle.

3.06 DUCTWORK INSULATION REQUIREMENTS

- A. Mechanically Cooled and Heated Supply and Return Air; (Concealed):
 - 1. Type D1, blanket.
 - 2. 2-inch thickness.
- B. Mechanically Cooled and Heated Supply and Return Air; (Within 30 Feet of Air Handling Unit):
 - 1. Type D3, liner.
 - 2. 1-1/2-inch thickness.
- C. Mechanically Cooled and Heated Supply and Return Air, and Outside Air (run in attic with ceiling insulation): Increase specified insulation thickness by 1/2-inch.
- D. Mechanically Cooled and Heated Supply Air, Return Air, and Outside Air (outdoors):
 - 1. Type D3, liner.
 - 2. 2-inch thickness.
- E. Outside Air Intake:
 - 1. Type D1, blanket.
 - 2. 1-1/2-inch thickness.
- F. Mechanically Cooled and Heated Supply Air (within 10 feet of fan-powered terminal unit discharge):
 - 1. Type D3, liner.
 - 2. 1-1/2-inch thickness.
- G. Unheated Supply Air:
 - 1. Type D3, liner.
 - 2. 1-inch thickness.

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- H. Sheet Metal Plenums:
 - 1. Type D3, liner.
 - 2. 1-1/2-inch thickness.
- I. Air Distribution Devices: Refer to Section 23 37 00, Air Outlets and Inlets, for requirements.

3.07 INSULATION FINISH REQUIREMENTS

- A. Piping, Duct, and Equipment Insulation (Concealed Areas): Factory finish.
- B. Piping Insulation (Exposed to View, Indoors):
 - 1. Type F1, PVC.
 - 2. Type F3, aluminum.
- C. Ductwork Insulation (Exposed to View, Indoors): Factory finish.
- D. Equipment Insulation (Exposed to View, Indoors): Type F2, paint (for use with Type P3, elastomeric).
- E. Piping Insulation (Outdoors):
 - 1. Type F2, paint (for use with Type P3, elastomeric).
 - 2. Type F3, aluminum.
- F. Ductwork Insulation (Outdoors): Type F4, ceramic.
- G. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

3.08 FIELD QUALITY CONTROL

A. Test factory-applied materials assembled. Field-applied materials may be tested individually.

END OF SECTION

SECTION 23 09 00 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI): INCITS 4, Information Systems - Coded Character Sets - 7-Bit American National Standard Code for Information Interchange (7-Bit ASCII).
 - 2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
 - a. Handbook Fundamentals.
 - b. Guideline 3, Reducing Emission of Fully Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems.
 - c. 135, Data Communication Protocol for Building Automation and Control Networks.
 - 3. American Society of Mechanical Engineers (ASME): B19.3, Safety Standard for Compressors for Process Industries.
 - 4. American Water Works Association (AWWA): C704, Propeller-Type Meters for Waterworks Applications.
 - 5. Electronic Industries Alliance (EIA):
 - a. TIA-232-F, Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.
 - b. 485, Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multi-point Systems.
 - 6. Federal Communications Commission (FCC).
 - International Organization for Standardization (ISO): 8802-3, Information Technology - Telecommunication and Information Exchange Between Systems - Local and Metropolitan Area Networks -Specific Requirements - Carrier Sense Multiple Access with Detection (CSMA/CD) Access Method and Physical Layer Specifications.
 - 8. National Electrical Manufacturers' Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - 9. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code.
 - b. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 10. UL: 916, Standard for Safety Energy Management Equipment.

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1.02 DEFINITIONS

- A. The terms "HVAC Control System," "Automatic Temperature Control System," "Building Automation System," and "Environmental Management and Control System" shall be considered equivalent and used interchangeably for the purposes of this Contract.
- B. Algorithm: A software procedure for solving a recurrent mathematical or logical problem.
- C. Analog: A continuously varying signal or value (temperature, current, velocity, etc.).
- D. Binary: A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level.
- E. Control Wiring:
 - 1. Wiring, high or low voltage other than power wiring required for proper operation of mechanical systems.
 - 2. Includes conduit, wire and wiring devices to install complete control system including motor control circuits, interlocks, thermostats, PE and EP switches and like devices.
 - 3. Includes wiring from DDC cabinet to all sensors and points defined in the Points List summary or specified herein and required to execute sequence of operation.
 - 4. Includes necessary power wiring to HVAC control devices, digital controllers including terminal units and actuators.
- F. Control Process: Software required to complete control loop from input signal to interlock logic and process calculation to final output signal control.
- G. Deadband: Temperature range over which no heating or cooling energy is supplied, such as 72 degrees F to 78 degrees F; as opposed to single point changeover or overlap, or a range from set point over which no control action is taken.
- H. Direct Digital Control (DDC): Consists of microprocessor-based controllers with control logic performed by software. Analog-to-digital (A/D) converters transform analog values into digital signals that microprocessor can use.
- I. Power Wiring: Line voltage wiring to mechanical equipment. Line voltage wiring that also serves as control circuit, such as line voltage thermostat or involves interlocking with damper shall be considered control wiring.

- J. Abbreviations that may be used in this section:
 - 1. AC: Air Conditioning.
 - 2. ATC: Automatic Temperature Control.
 - 3. BAS: Building Automation System.
 - 4. CHWS/R: Chilled/Hot Water Supply/Return.
 - 5. CMOS: Complementary Metal Oxide Semiconductor.
 - 6. DDC: Direct Digital Control.
 - 7. DX: Direct Expansion.
 - 8. EP: Electro-Pneumatic
 - 9. EEPROM: Electronic Erasable Programmable Read Only Memory.
 - 10. EMCS: Environmental Management and Control System.
 - 11. HCP: HVAC Control Panel.
 - 12. HGS/R: Hot Glycol Supply/Return.
 - 13. HMI: Human-Machine Interface.
 - 14. HOA: Hand-Off-Auto (Switch).
 - 15. HVAC: Heating, Ventilation, and Air Conditioning.
 - 16. IP: Current (I) Pressure (P), as in IP transducer.
 - 17. LCD: Liquid Crystal Display.
 - 18. LED: Light Emitting Diode.
 - 19. PE: Pneumatic-Electric
 - 20. PLC: Programmable Logic Controller.
 - 21. RAM: Random Access Memory.
 - 22. RTD: Resistance Temperature Detectors.
 - 23. VAV: Variable Air Volume.
 - 24. W3: Nonpotable Water.

1.03 SYSTEM DESCRIPTION

- A. General Requirements:
 - 1. Provide control wiring, power wiring, conduit, hardware, and electrical work associated with the HVAC control system.
 - 2. Provide control wiring between HVAC control panel contacts and field control devices, such as duct smoke detectors and motor starter control coil contacts.
 - 3. Provide controls necessary for entire system to have fail-safe operation.
 - 4. Control sequences and functions including alarms, monitoring and resetting functions, and operational sequences shall not be limited to point schedules and sequences of operation.
 - 5. Provide sequences and functions as required to deliver a fully functioning HVAC system.

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- B. Control System Types:
 - 1. The following control system types may be used in this Project:
 - a. Electric/Electronic Control System (ELECTRIC):
 - 1) System using simple electric or electronic control devices.
 - 2) User interface at control device.
 - b. Standalone DDC Control System (STANDALONE DDC):
 - 1) Microprocessor-based DDC Control System utilizing standalone DDC controllers.
 - 2) No information sharing between controllers.
 - 3) User interface at DDC controller.
 - 2. Provide control system(s) of architecture defined in Control Type Schedule, below:

Control Type Schedule								
Location	System	Control Type						
All	Where operating sequences call for simple thermostatic or interlock control	ELECTRIC						
Ticketing Building	All	STANDALONE DDC						
Toilet Building	All	STANDALONE DDC						

- C. Performance Requirements: Design control system and equipment to perform under the following conditions:
 - 1. Temperature, Ambient:
 - a. Summer maximum 92 DB/77.4 WB degrees F.
 - b. Winter minimum 54.7 DB degrees F.
 - c. Based on ASHRAE Handbook Fundamentals weather data for the City of Pensacola, FL.
 - 2. Temperature, Indoor:
 - a. Air-conditioned Areas: Summer maximum 75 degrees F; Winter minimum 70 degrees F.
- D. Refer to Section 01 61 00, Common Product Requirements, for additional environmental performance requirements.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature that includes make, model, dimensions, weight of equipment, and electrical schematics, for all control system components.
 - 2. Complete system power, interlock, control, and data transmission wiring diagrams no smaller than 11 inches by 17 inches.
 - 3. Complete drawings and schematics of proposed control system, including panel power requirements.
 - 4. System operating sequences to be programmed, in exact English language.
 - 5. Complete points list.
 - 6. Interfaces with HVAC equipment.
 - a. Schematic diagram of each equipment item.
 - b. Indicate location of each control item in equipment.
 - c. Show equipment manufacturer controls where installed.
 - 7. Panel face layout drawings.
 - 8. Damper actuator sizing calculations, in schedule form.
 - 9. Automatic control valve sizing calculations, in schedule form.
- B. Informational Submittals:
 - 1. Table identifying which member of Contractor's team is responsible for furnishing and setting in-place power wiring and control wiring of each item or component of HVAC equipment.
 - 2. Recommended procedures for protection and handling of equipment and materials prior to installation.
 - 3. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 4. Confirmation that control system Supplier has received, and coordinated with all approved HVAC equipment submittals.
 - 5. Experience and qualifications of control system Supplier's proposed representative who will supervise installation, adjustment, and calibration of control systems.
 - 6. Performance test plan and schedule.
 - 7. Test Results:
 - a. Functional and performance test documentation.
 - 8. Operation and Maintenance Data. In addition, include the following detailed information:
 - a. Operation and maintenance instructions for control system as furnished and installed, including control of associated mechanical and electrical equipment.

- b. Record of system adjustments and calibration methods.
- c. Performance test results.

1.05 QUALITY ASSURANCE

- A. Materials, devices, appliances, and equipment used shall be indicated as acceptable by established standards of UL.
- B. Codes and Standards: Meet requirements of applicable standards and codes, except when more detailed or stringent requirements are indicated by Contract Documents, including requirements of this section.
 - 1. UL: Products shall be UL 916-PAZX listed.
 - 2. National Electrical Code NFPA 70.
 - 3. Federal Communications Commission Part J.
- C. Qualifications of HVAC Controls System Supplier:
 - 1. Minimum of 15 years' experience in design, installation, and maintenance of fully electronic building automation systems.
 - 2. Minimum of 10 years' experience in design, installation, and maintenance of computer based, direct digital control, facility automation systems.
 - 3. Minimum of 5 years' experience as manufacturer's authorized representative in design, installation, and maintenance of manufacturer's system and products.
 - 4. Capable of furnishing factory-trained technicians, competent to provide instruction, routine maintenance, and emergency service onsite within 4 hours after receipt of request.
 - 5. Factory trained certified engineering and commissioning staff, and complete offsite training facilities.
 - 6. Necessary facilities to provide Owner with complete maintenance, periodic inspection, and service contract. Refer to Paragraph, Maintenance.
- D. FCC Regulation: Electronic equipment shall conform to requirements of FCC Regulation, Part 15, Section 15, Governing Radio Frequency Electromagnetic Interference, and be so labeled.
- E. Compatibility:
 - 1. System shall have documented history of compatibility by design for minimum of 15 years. Future compatibility shall be supported for no less than 10 years.

- 2. Compatibility shall be defined as:
 - a. Ability to upgrade existing field panels to current level of technology, and extend new field panels on previously installed network.
 - b. Ability for any existing field panel microprocessor to be connected and directly communicate with new field panels without bridges, routers, or protocol converters.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 01 61 00, Common Product Requirements.
- B. Corrosion Protection:
 - 1. Control panels, enclosures, and other equipment containing electrical or instrumentation and control devices, including spare parts, shall be protected from corrosion through use of corrosion-inhibiting vapor capsules.
 - 2. Prior to shipment, capsules shall be provided within shipping containers and equipment as recommended by capsule manufacturer.
 - 3. During construction period, capsules shall be replaced in accordance with capsule manufacturer's recommendations.

1.07 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials.
 - 1. Spare parts shall be available for at least 5 years after Substantial Completion.
- B. Tools:
 - 1. For each building, furnish one complete set of special tools recommended by manufacturer for maintenance, dismantling, or repair of each separate type of equipment item.
 - 2. Furnish toolbox for storage of special tools. Identify purpose by means of stainless steel or solid plastic nametag attached to box.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified shall be products of the following manufacturers, unless indicated otherwise:
 - 1. Allen Bradley.
 - 2. Siemens Building Technologies.
 - 3. Johnson Controls.
 - 4. The Trane Company.
 - 5. Honeywell.
 - 6. Invensys.
 - 7. Alerton Technologies.
 - 8. Delta Controls.
 - 9. Automated Logic Corporation.
 - 10. Andover.
 - 11. Mitsubishi

2.02 MATERIALS

- A. General:
 - 1. Products used in this installation shall be new, currently under manufacture, and shall have been applied in similar installations for minimum of 2 years.
 - 2. System shall not be used as test Site for new products, unless explicitly approved by Owner's representative, in writing.
- B. Control Components:
 - 1. Control range to obtain specified capacities.
 - 2. Sensitivity to maintain control points close enough to set point for acceptable offset, without cycling equipment more frequently than recommended by manufacturer.
 - 3. Field or computer adjustable to actual set point, ranges. Adjustable to other settings that will provide proper operation of entire control system.
- C. Controls Interfacing:
 - 1. Interface controls properly with factory supplied components of mechanical systems. Coordinate special control interfacing requirements.
 - 2. For equipment that requires special interfacing with control system, provide equipment with integral controls or provide accessory devices required for operation of total mechanical system.

- 3. Coordinate interfaces with electrical work as necessary.
- 4. Provide electric, electronic, and mechanical devices as required to properly interface with prewired control panels furnished with HVAC equipment and with other mechanical and electrical components.

2.03 LABELING

- A. All products, namely electrical materials, devices, appliances, and equipment used, shall be indicated as acceptable by established standards of UL and Factory Mutual (FM).
- B. Valid label affixed to item shall provide indication of product acceptance by required agencies.
- C. HVAC control panels and control components that consist of multiple components shall bear UL listing mark on unit.

2.04 SERVICE CONDITIONS

- A. Refer to Section 01 61 00, Common Product Requirements, Section 26 05 02, Basic Electrical Requirements, and Electrical Drawings for classification of areas as hazardous, corrosive, wet, indoor dry, and dust-tight.
- B. Use materials and methods, and enclose devices in NEMA enclosure types suitable for classification indicated, and as required by NFPA 70.
- C. Exhaust ductwork shall be considered same classification as area served.
- D. Instruments within 3 feet of ducts conveying air from spaces classified as Class I, Division 1 or Division 2 (in accordance with NFPA 70) shall be suitable for same area classification as space exhausted.

2.05 ELECTRICAL COMPONENTS AND ACCESSORIES

- A. Electrical components shall be provided in accordance with requirements of Division 26, Electrical.
- B. Wiring:
 - 1. In accordance with Section 26 05 05, Conductors, and NFPA 70.
 - 2. Insulation shall be rated 600 volts, minimum.

2.06 FIELD COMPONENTS AND INSTRUMENTS

A. Refer to HVAC controls detailed specification, Section 23 09 13, HVAC Controls, Field Components, and Instruments.

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2.07 ACCESSORIES

- A. Corrosion-inhibiting vapor capsules as manufactured by:
 - 1. Northern Instruments; Model Zerust VC.
 - 2. Hoffman; Model A-HCI.
- B. Lifting Lugs: Provide suitably attached for equipment assemblies and components weighing over 100 pounds.
- C. Equipment Identification Plates:
 - 1. Provide 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8 or 1/4-inch high engraved or die-stamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.
 - 2. Provide adjacent to the following control devices, and for equipment whose function is not readily apparent.
 - a. Night low limit thermostats.
 - b. Manual override timers.
 - c. START/STOP switches.
 - d. Humidistats.
 - e. Emergency STOP switches.
 - f. Special purpose devices.
 - g. HVAC control panels.
- D. Anchor Bolts: Type 316 stainless steel sized by equipment manufacturer or 1/2-inch minimum diameter (whichever is larger), and as specified in Section 05 50 00, Metal Fabrications.

2.08 EQUIPMENT FINISH

- A. Provide materials and equipment with manufacturer's standard finish system. Provide manufacturer's standard finish color, except where specific color is indicated.
- B. If manufacturer has no standard color, provide gray finish as approved by Owner.

PART 3 EXECUTION

- 3.01 SEQUENCES OF OPERATION
 - A. Reference the Drawings.

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC 23 09 00 - 10

3.02 INSTALLATION

A. General:

- 1. Install systems and materials in accordance with manufacturer's instructions, rough-in drawings, and equipment details.
- 2. Changes in location or installation of control devices or equipment shall be approved by Engineer before proceeding with the Work.
- 3. Mount devices requiring manual reset and all other user serviceable control devices in readily accessible locations.
- B. Wiring:
 - 1. General:
 - a. Install electric wire, cable, fittings, and conduit associated with systems specified in this section, in accordance with requirements of NFPA 70.
 - b. Install control and interlock wiring separate from power wiring.
 - c. Number code or color code conductors, excluding those used for individual zone controls, appropriately for future identification and servicing of control system.
 - d. Provide wire markers on each conductor in panel and at load connections. Identify circuit with control wire number.
 - e. Restrain wiring in control panels by plastic ties or ducts.
 - f. Hinge wiring shall be secured at each end so that any bending or twisting will be around longitudinal axis of wire and bend area shall be protected with sleeve.
 - g. Arrange wiring neatly, cut to length, and remove surplus wiring. Provide abrasion protection for any wire bundles that pass through holes or across edges of sheet metal.
 - h. Use manufacturer's recommended tool with proper sized anvil for crimp terminations. No more than two wires may be terminated in single crimp lug and no more than two lugs may be installed on single screw terminal.
 - i. Wiring shall not be spliced or tapped except at device terminals or terminal blocks.
 - j. Properly support and run wiring in a neat manner.
 - k. Run wiring parallel or at right angles to building structure.
 - 2. Concealment:
 - a. Generally conceal wiring from view, except in mechanical rooms and areas where other conduit and piping are exposed; install exposed wiring and conduit to be as unobtrusive as possible.
 - b. Install line voltage control wiring, wiring exposed to view, surface-mounted wiring, and wiring concealed within walls in conduit, in accordance with Division 26, Electrical.

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- c. Install exposed and concealed low voltage control wiring systems in conduit.
- d. Wiring within enclosures shall be neatly bundled and anchored to prevent obstruction to devices and terminals.
- e. Conduit shall be sized to suit the number, type, and size of conductors as specified in Section 26 05 05, Conductors.
- C. End-User Accessible Control Components:
 - 1. Do not mark room thermostats.
 - 2. Mount user adjustable control components (room thermostats, humidistats, temperature sensors, humidity sensors, etc.) level and in accordance with applicable accessibility requirements of local Building Code.
- D. Control Dampers:
 - 1. Verify correctness of installation.
 - 2. Verify proper control action.
 - 3. Adjust limit switch settings.
 - 4. Adjust opening and closing speeds, and travel stops.
 - 5. Stroke control dampers by means of associated control output.
- E. DDC Controllers:
 - 1. Verify control wiring for correctness.
 - 2. Verify power wiring.
 - 3. Calibrate and adjust manual and auto control actions of controllers.
 - 4. Tune control loop.
 - 5. Stroke associated final element through controller output.
 - 6. Verify set points and alarm functions.
- F. HVAC Control Panel (HCP) Equipment:
 - 1. Mount HCPs level, plumb, and securely to wall or column. Verify that adequate clearance is provided to allow for full front panel swing.
 - 2. Provide field terminations and conduit knockouts for control/instrumentation wiring.
 - 3. Field termination wiring shall have designated instrument tag.
 - 4. Panel cutouts shall be cut, punched, or drilled and smoothly finished with round edges.
 - 5. Provide separate conduit entry for each power feeder circuit.
 - 6. Signals requiring grounding shall be grounded within panel.
 - 7. Field end of conductor shield/drain wires shall be folded back and placed under heat-shrink tubing without being grounded.

- 8. Panel end of conductor shield/drain wires shall be covered with clear tubing at panel and grounded.
- 9. Calibrate instrumentation provided on control panels.
- 10. Provide labels for internal panel material (such as, terminal blocks, power supplies, relays, PLC racks).

3.03 TRAINING

- A. Provide training of Owner's personnel to enable them to operate HVAC equipment in available modes, to adjust set points, and to interpret alarm signals.
- B. Training sessions shall be prepared in advance, and arranged for clear, effective transfer of information in minimum time.

3.04 ADJUSTING AND CALIBRATING

- A. Control system shall be adjusted and calibrated by qualified manufacturer's representative.
- B. Calibrate control devices at time of installation to ensure measuring and reading accuracy.
- C. Adjustment Record:
 - 1. Prepare complete record of system adjustments for each control system.
 - 2. Indicate deviations from specified temperatures.
 - 3. Include copy of completed record in each copy of Operation and Maintenance Manual.

3.05 CLEANING AND TOUCHUP PAINTING

A. Touchup scratches, scrapes, or chips in exterior surfaces with finish matching type, color, consistency, and type of surface of original finish.

END OF SECTION

SECTION 23 09 00.01 HVAC CONTROLS SEQUENCE OF OPERATION, GENERAL CONTROL TYPES

1.01 GENERAL CONTROL TYPES

- A. Motorized Damper Control:
 - 1. When AC-1 is commanded to start, open MD-1. Close damper on unit shutdown.
 - 2. When AC-4 is commanded to start, open MD-2.Close damper on unit shutdown.
- B. Occupied/Unoccupied Control:
 - 1. Modes shall be determined by 7-day facility operation schedule.
 - 2. Provide momentary contact manual after-hours override switch at room temperature sensor.
 - 3. Initially set after-hours override duration for 1-hour.

END OF SECTION

SECTION 23 09 00.02 HVAC CONTROLS SEQUENCE OF OPERATION, AIR HANDLING UNITS

1.01 AIR HANDLING UNITS

- A. Constant Volume, Direct Expansion, 100 percent Outside Air Unit, AC-1.
 - 1. General: This sequence describes the required operation of a constant volume air handling unit (AHU). The unit is a 100 percent outside air unit with no recirculation of air.
 - 2. Unoccupied: When the facility is unoccupied, AC-1, EF-3, EF-4, and EF-6 will stop in unison.
 - 3. Occupied: When the facility is occupied, AC-1, EF-3, EF-4, and EF-6 shall run continuously in unison.
- B. Variable Refrigerant Volume, Wall mounted, mini split system, AC-2.
 - 1. General: This sequence describes the required operation of AC-2. This unit will run off of a thermostat with 2 modes based on facility occupation.
 - 2. Unoccupied: When the facility is unoccupied, AC-2 will modulate to condition the space at the client's predetermined unoccupied schedule setpoint. AC-2 will be the sole climate control when not occupied.
 - 3. Occupied: When the facility is occupied, AC-2 will modulate to condition the space at the client's predetermined occupied schedule setpoint in tandem with AC-1
- C. Variable Refrigerant Volume, Multi Position Air Handler, AC-3.
 - 1. General: This sequence describes the required operation of AC-3. This unit will run off of a thermostat with 2 modes based on facility occupation.
 - 2. Unoccupied: When the facility is unoccupied, AC-3 will modulate to condition the space at the client's predetermined unoccupied schedule setpoint.
 - 3. Occupied: When the facility is occupied, AC-3 will modulate to condition the space at the client's predetermined occupied schedule setpoint.
- D. Variable Refrigerant Volume, Multi Position Air Handler, AC-4.
 - 1. General: This sequence describes the required operation of AC-4. This unit will run off of a thermostat with 2 modes based on facility occupation.

- 2. Unoccupied: When the facility is unoccupied, AC-4 will modulate to condition the space at the client's predetermined unoccupied schedule setpoint.
- 3. Occupied: When the facility is occupied, AC-4 will modulate to condition the space at the client's predetermined occupied schedule setpoint.
- E. Variable Refrigerant Volume, Multi Position Air Handler, AC-5.
 - 1. General: This sequence describes the required operation of AC-5. This unit will run off of a thermostat with 2 modes based on facility occupation.
 - 2. Unoccupied: When the facility is unoccupied, AC-5 will modulate to condition the space at the client's predetermined unoccupied schedule setpoint.
 - 3. Occupied: When the facility is occupied, AC-5 will modulate to condition the space at the client's predetermined occupied schedule setpoint.

END OF SECTION

SECTION 23 09 13 HVAC CONTROLS, FIELD COMPONENTS, AND INSTRUMENTS

PART 1 GENERAL (NOT USED)

PART 2 PRODCUTS (NOT USED)

PART 3 EXECUTION

- 3.01 INSTALLATION
 - A. Control Dampers: Install at locations indicated on the Drawings and in accordance with manufacturer's instructions.
 - B. EF-2 and EF-5:
 - 1. Install at locations indicated on the Drawings and in accordance with manufacturer's instructions.
 - 2. Fans to be thermostatically controlled. When mechanical rooms are less than 80F the fans will not be powered. When mechanical rooms are 80F or greater the fans will be energized.

END OF SECTION

CONTROL DAMPERS 23 09 13.01						CONTROL DAMPERS					
SYMBOL									TAG		
SPECIFICATION TYPE							SERVES		AC-3		
SERVES									AXLES		PLATED STEEL
CONSTRUCTION	ONSTRUCTION AXLES								BLADE		GALV
MATERIALS	BLADE							MATERIAL	FRAME		GALV
	FRAM							SEALS	JAMB		
	SEALS	JAMB								BLADE	SILICONE
		BL	ADE						MAT TEMP	DEG F	250
PERFORMANCE	MAX. TEMP		DEG. F.						MAX PRESSURE	IN WG	4
	MAX. PRESSU	MAX. PRESSURE						PERFORMANC	MAX VELOCITY	FPM	3,000
	MAX. VELOCITY		FPM						MAX LEAKAGE @ 1 IN WG	CFM / SF	4
	MAX LEAKAGE @ 1	IN W.G.	CFM/SF					ΝΟΜΙΝΙΑΙ	WIDTH	IN	-
	PRESS. DROP @ 1,500 FPM		IN W.G.					DIMENSIONS	HEIGHT	IN	-
NOMINAL	IOMINAL LENGTH INCH DIMENSIONS HEIGHT INCH		INCHES						DIAMETER	IN	6
DIMENSIONS			INCHES					ACTUATOR	TYPE		SPRING RETURN
ACTUATOR DATA	FAILS							DATA	VOLTAGE		115
	RANGE							MANUFACTUF	DAMPER		GREENHECK
	TYPE								ACTUATOR		BELIMO
	VOLTS OR PRESS.							MODEL NO.	DAMPER		VCDR-53
MANUFACTURER	DAMPER								ACTUA	TOR	CMB24-L-125D
ACTUATOR							REMARKS				
MODEL NO.	DAMPER										
	ACTUATOR			L							
ABBREVIATIONS: STL: GALVANIZED STEEL 316 SST: STAINLESS STEEL, TYPE 316											
ALUM: ALUMINUM			PVC: POLYVINYL CHLORIDE								
304 SST	EPDM: ETHYLENE PROPYLENE DIENE MONOMER										
APPLICABLE REMARKS:											
A:											
B:											
C:											
с. F											

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SECTION 23 23 00 REFRIGERANT PIPING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 760, Performance Rating of Solenoid Valves for Use with Volatile Refrigerants.
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): 15, Safety Standard for Refrigeration Systems.
 - 3. American Society of Mechanical Engineers (ASME):
 - a. B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - b. B31.5, Refrigeration Piping and Heat Transfer Components.
 - 4. American Welding Society (AWS):
 - a. A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding.
 - b. BRH, Brazing Handbook.
 - 5. ASTM International (ASTM): B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 6. National Electrical Manufacturers Association (NEMA).
 - 7. UL.

1.02 DEFINITIONS

- A. ACR: Air conditioning and refrigeration.
- B. NRTL: National Recognized Testing Laboratory.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings in 1/4-inch scale for refrigerant piping showing pipe and tube sizes, flow capacities location, elevations, fittings, accessories, and piping connections.
 - 2. Manufacturer's data on refrigerant piping, piping products, thermostatic expansion valves, solenoid valves, hot-gas bypass valves, filter dryers, strainers, pressure regulating valves and accessories.

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- B. Informational Submittals:
 - 1. Welding certificates.
 - 2. Field quality control; test report.
- C. LEED Submittals:
 - 1. Documentation required indicating compliance with Fundamental Refrigerant Management—EA Prerequisite 3.
 - 2. Documentation required indicating compliance with Enhanced Refrigerant Management—EA Credit 4.
- 1.04 QUALITY ASSURANCE
 - A. Safety Code Compliance: Comply with applicable portions of ASHRAE 15.
 - B. Brazing: Comply with applicable requirements of ASME B31.5 pertaining to brazing of refrigerant piping for shop and Project Site locations.
 - C. Installer: A firm with at least 5 years of successful installation experience on projects with refrigerant piping similar to that required for this Project.
- 1.05 DELIVERY, STORAGE, AND HANDLING
 - A. Refrigerant piping shall be cleaned, dehydrated, and sealed when delivered.
 - B. Store piping in clean and protected area with end caps in place.

PART 2 PRODUCTS

- 2.01 MATERIALS
 - A. Material and dimensional requirements for field assembled refrigerant piping, valves, fittings and accessories shall conform to ASHRAE 15 and ASME B31.5, except as hereinafter specified.
 - B. Piping, 3 inches and Smaller: Copper, Type ACR tube, ASTM B280, copper No. 122, hard-drawn temper. Brazed joints required.
 - C. Fittings for Copper Tube: Wrought-copper/bronze solder-joint fittings in accordance with ASME B16.22.
 - D. Pipe Insulation: Refer to Section 22 07 00, Plumbing Piping Insulation.

2.02 MISCELLANEOUS PIPING PRODUCTS

- A. Brazing Materials:
 - 1. Except as otherwise indicated, provide 15 percent silver alloy brazing material for copper to copper and copper to brass fittings.
 - 2. Comply with AWS A5.8M/A5.8 for brazing filler materials.
- B. Refrigerant Specialties:
 - 1. Refrigerant Suction Line Filter-Dryer:
 - a. Provide steel shell, corrosion-resistant finish filter-dryer, with molded felt core with 10-micron particle retention, in size and working pressure indicated, with copper connectors, and access valve (not applicable for heat pump system).
 - b. Operating Temperature Rating: 240 degrees F.
 - c. Working Pressure: 500 psi.
 - d. Provide size recommended by refrigeration equipment manufacturer.
 - 2. Refrigerant Liquid Line Dryer:
 - a. Provide refrigerant liquid line filter-dryer for all units.
 - b. Operating Temperature Rating: 240 degrees F.
 - c. Working Pressure: 500 psi.
 - d. For heat pumps, provide biflow directional types (not required if included with air-conditioning equipment).
 - e. Provide size recommended by refrigeration equipment manufacturer.
- C. Refrigerant Valves:
 - 1. Globe and Check Valves: Listed and labeled by an NRTL.
 - a. Shutoff Valves:
 - Forged brass, packed, back seating winged seal cap, 300 degrees F (140 degrees C) temperature rating 500 psi working pressure.
 - 2) Maximum Opening Pressure: 0.5 psig.
 - 3) Valve required only if shutoff service valves are not included with package air-conditioning equipment.
 - b. Manufacturers:
 - 1) Henry Technologies.
 - 2) Parker Hannifin Corp.
- 2. Solenoid Valve: Listed and labeled by an NRTL.
 - Two-Way Solenoid Valves: Forged brass, designed to conform to AHRI 760, normally closed, Teflon valve seat, NEMA 1 solenoid enclosure, 24 volts, 60-Hz, UL Listed, 1/2-inch conduit adapter, 250 degrees F (121 degrees C) temperature rating 500 psi working pressure.
 - b. Provide valve only if recommended by air-conditioning equipment manufacturer.
 - c. Manual Operator: Provide optional manual operator to open valve.
 - d. Manufacturers:
 - 1) Alco Controls Div.; Emerson Electric Co.
 - 2) Automatic Switch Co.
 - 3) Parker Hannifin Corp.
- 3. Thermostatic Expansion Valve:
 - a. Body Bonnet and Seal Cap: Forged brass or steel.
 - b. Diaphragm, Piston, Closing Spring and Seat Insert: Stainless steel.
 - c. Capillary and Bulb: Copper tubing filled with refrigerant.
 - d. Suction Temperature: 40 degrees F.
 - e. End Connections: Socket or flare.
 - f. Working Pressure: 700 psig.
 - g. Manufacturers:
 - 1) Henry Technologies.
 - 2) Parker Hannifin Corp.
 - 3) Danfoss Group Global.
- 4. Safety Relief Valve:
 - a. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
 - b. Seat Disk: Polytetrafluoroethylene.
 - c. Working Pressure: 500 psig.
 - d. Operating Temperature: 240 degrees F, maximum.
 - e. Manufacturers:
 - 1) Henry Technologies.
 - 2) Parker Hannifin Corp.
 - 3) Danfoss Group Global.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPING SYSTEM

- A. Install piping products in accordance with manufacturer's written instructions, applicable requirements of ASME B31.5, ASHRAE 15, and in accordance with recognized industry practices to ensure products serve intended function.
- B. Install dryers on liquid and suction lines.

- C. Refrigerant Piping:
 - 1. Cut pipe accurately to measurements established at Site and work into place without springing or forcing.
 - 2. Install piping with sufficient flexibility to adequately provide for expansion and contraction as a result of temperature fluctuation inherent in its operation.
 - 3. Where pipe passes through building structure, pipe joints shall not be concealed, but located where they may be readily inspected.
 - 4. Run pipe to be insulated as shown and as required with sufficient clearance to permit application of insulation.
 - 5. Run piping as shown on the Drawings, taking care to avoid interference with other piping, conduit or equipment. Except where specifically indicated otherwise, run piping plumb, and straight and parallel to walls and ceilings.
 - 6. Trapping of lines shall not be permitted, except where indicated.
 - 7. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
 - 8. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
 - 9. Install piping free of sags and bends.
 - 10. Install fittings for changes in direction and branch connections.
 - 11. Install refrigerant piping in protective conduit where installed belowground.
 - 12. Install accumulator in suction line near condensing unit.
 - 13. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.
 - 14. Slope refrigerant piping as follows:
 - a. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - b. Install horizontal suction lines with a uniform slope downward to compressor.
 - c. Install traps and double risers to entrain oil in vertical runs.
 - d. Liquid lines may be installed level.
- D. Pipe Sleeves:
 - 1. Provide pipe sleeves of suitable size for pipe and tubing that penetrate building structure.
 - 2. Secure sleeves in position and location before and during construction. Space between pipe and sleeves, or between insulation and pipe sleeves, shall be not less than 1/4-inch between outside of pipe or insulation, and inside wall of sleeves.

- 3. Sleeves for uninsulated pipes shall have ends flush with finished wall surfaces; provide pipe or tubing as above with outside perimeter of pipe caulked to sleeve.
- 4. Extend sleeves for insulated pipes 1/2-inch from wall faces and caulk to sleeve on both sides.
- 5. Seal terminal ends of pipe insulation with mastic.
- 6. Extend sleeves for lines passing through floors 3 inches above finished floor slab and caulk to slab.
- E. Braze cap (seal) ends of piping when not connected to mechanical equipment.

3.02 SOLDER JOINTS

A. Solder joints shall not be used for joining refrigerant piping systems.

3.03 BRAZED JOINTS

- A. Braze copper piping with silver solder complying with AWS A5.8M/A5.8.
- B. Brazed Joints:
 - 1. Construct joints according to AWS *Brazing Handbook* Chapter "Pipe and Tube".
 - 2. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
 - 3. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
- C. Inside of tubing and fittings shall be free of flux.
- D. Clean parts to be joined with emery cloth and keep hot until solder has penetrated full depth of fitting and extra flux has been expelled.
- E. Cool joints in air and remove flame marks and traces of flux.
- F. During brazing operation, prevent an oxide film from forming on inside of tubing by slowly flowing dry nitrogen to expel air.
- G. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion valve bulb.

3.04 EQUIPMENT CONNECTIONS

A. Connect refrigerant piping to mechanical equipment in the manner shown, and comply with equipment manufacturer's instructions where not otherwise indicated.

REFRIGERANT PIPING 23 23 00 - 6

3.05 FIELD QUALITY CONTROL

A. General:

- 1. Notify Engineer at least 48 hours before testing is performed.
- 2. Furnish equipment required for tests.
- 3. Group as many systems together as possible when testing in order to consolidate number of test inspections.
- B. Leak Test:
 - 1. Prior to initial operation, clean and test refrigerant piping in accordance with ASME B31.5.
 - 2. Perform initial test with dry nitrogen to 300 psig minimum using soap solution to test joints.
 - 3. Evacuate system after initial test and charge system with refrigerant or dry nitrogen, 20 percent refrigeration mixture to 600 psig minimum.
 - 4. Upon completion of initial system test, test factory, as well as field, refrigerant piping joints with electronic-type leak detector to acquire a leak-tight refrigerant system.
 - a. If leaks are detected, remove entire refrigerant charge for the system, replace defective pipe or fitting, and retest entire system as specified above.
- C. Evacuation, Dehydration, and Charging:
 - 1. After system is found to be without leaks, evacuate system using reliable gauge and vacuum pump capable of pulling a vacuum of at least 1-mm Hg absolute (29.88-inch Hg gage).
 - 2. Evacuate system with vacuum pump until temperature of 35 degrees F (2 degrees C) is indicated on vacuum dehydration indicator.
 - 3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
 - 4. Maintain vacuum on system for minimum of 12 hours after closing valve between vacuum pump and system. If system holds vacuum for 12 hours it is ready for charging.
 - 5. Break vacuum with refrigerant gas or dry nitrogen gas, allowing pressure to build up to 2 psi (15 kPa).
 - 6. Install new filter-dryer core in charging line.
 - 7. Repeat evacuation procedure and complete charging of system; provide full operating charge.

3.06 ADJUSTING

- A. General:
 - 1. Adjust thermostatic expansion valve to obtain proper evaporator superheat.
 - 2. Adjust high-pressure and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.
 - 3. Adjust setpoint temperature of air-conditioning or chilled-water controllers to system design temperature.
 - 4. Perform following adjustments according to manufacturer's written instructions before operating refrigeration system:
 - a. Open shutoff valves in condenser water circuit.
 - b. Verify compressor oil level is correct.
 - c. Open compressor suction and discharge valves.
 - d. Open refrigerant valves, except bypass valves that are used for other purposes.
 - e. Check open compressor-motor alignment and verify lubrication for motors and bearings.
- B. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 31 13 METAL DUCTS AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air Movement and Control Association (AMCA): 500, Test Methods for Louvers, Dampers and Shutters.
 - 2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook.
 - 3. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
 - 4. Association of the Nonwoven Fabrics Industry (INDA): IST 80.6, Water Resistance (Hydrostatic Pressure).
 - 5. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A90/A90M, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - c. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - d. A176, Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.
 - e. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - f. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - g. A568/A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
 - h. A653/A653M, Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - i. A700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment.
 - j. A924/A924M, Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process.

- k. A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- 1. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- m. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- n. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
- o. C916, Standard Specification for Adhesives for Duct Thermal Insulation.
- p. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- q. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.
- r. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- s. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
- 6. National Air Duct Cleaners Association (NADCA): General Specifications for the Cleaning of Commercial Heating, Ventilation and Air Conditioning Systems.
- 7. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - b. 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - c. 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - d. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - e. 259, Standard Test Method for Potential Heat of Building Materials.
 - f. 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- 8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. Duct Construction Standards.
 - b. Guidelines for Seismic Restraints of Mechanical Systems.
 - c. Fibrous Glass Duct Construction Standards.

- d. Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.
- e. HVAC Air Duct Leakage Test Manual.
- 9. UL:
 - a. 181, Standard for Safety Factory-Made Air Ducts and Connectors.
 - b. 214, Standard for Tests for Flame-Propagation of Fabrics and Films.
 - c. 555, Standard for Safety Fire Dampers.
 - d. 555S, Standard for Safety Smoke Dampers.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. CFM: cubic feet per minute.
 - 2. FPM: feet per minute.
 - 3. PCF: pounds per cubic foot.
 - 4. WC: water column.
- B. Sealing Requirements: For the purpose of duct systems sealing requirements specified in this section, the following definitions apply:
 - 1. Seams: Joining of two longitudinally (in direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on perimeter are deemed to be joints.
 - 2. Joints, duct surface connections including:
 - a. Girth joints.
 - b. Branch and subbranch intersections.
 - c. Duct collar tap-ins.
 - d. Fitting subsections.
 - e. Louver and air terminal connections to ducts.
 - f. Access door, and access panel frames and jambs.
 - g. Duct, plenum, and casing abutments to building structures.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Rectangular, Rigid Round, and Oval Ductwork:
 - 1) Schedules of duct systems, materials, joints, sealing, gage and reinforcement.
 - 2) SMACNA Figure Numbers for each shop fabricated item.
 - 3) Reinforcing details and spacing.
 - 4) Seam and joint construction details.

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- 5) Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- b. Ductwork Accessories:
 - 1) Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, and finishes, including the following items:
 - a) Fittings and volume control damper installation (both manual and automatic) details.
 - b) Duct liner.
 - c) Sealing materials.
 - d) Dampers; include leakage, pressure drop, and maximum back pressure data.
 - e) Duct-mounted access panels and doors.
 - f) Flexible ducts.
 - g) Sheet metal fasteners.
- B. Informational Submittals:
 - 1. Record Drawings: Include duct systems routing, fittings details, and installed accessories and devices.

1.04 QUALITY ASSURANCE

- A. Industry Standards:
 - 1. Unless otherwise indicated or specified, sheet metal ductwork shall be constructed and installed in accordance with SMACNA Duct Construction Standards relevant to ductwork system being provided. These standards are herein referenced as the SMACNA Manual, unless otherwise indicated.
 - 2. Comply with ASHRAE Fundamentals Handbook recommendations, except as otherwise indicated.
 - 3. NFPA Compliance: NFPA 90A and NFPA 90B.
- B. Manufacturers: Firms regularly engaged in manufacture of ductwork products of types, materials, and sizes required, whose products have been satisfactorily used in similar service for not less than 5 years.
- C. Suppliers of duct and fitting components shall provide on request the following information:
 - 1. Laboratory performance data for duct, including leakage rate, bursting strength, collapse strength, seam strength, and pressure loss.

- 2. Laboratory performance data for fittings, including zero-length dynamic losses.
- D. Installer shall be a firm with at least 3 years' experience of successful installation on ductwork systems similar to that required for this Project.
- E. Changes or alterations to layout or configuration of duct system shall be:
 - 1. Specifically approved in writing by Engineer.
 - 2. Proposed layout shall provide original design results, without increasing system total pressure.

1.05 EXTRA MATERIALS

- A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:
- B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect ductwork from dirt, water, and debris. During storage on Job Site, keep ends of ductwork covered to prevent foreign objects and water from entering ductwork.
- B. If fabricated sound-lined ductwork ductboard gets wet during installation, remove and dispose of ductwork from the Site.
- C. Deliver sealant materials to Site in original unopened containers labeled with manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.
- D. Store and handle sealant materials in compliance with manufacturers' recommendations to prevent deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.
- E. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

PART 2 PRODUCTS

2.01 SCHEDULES

A. Ductwork Schedule: Refer to the Drawings.

2.02 GENERAL

- A. Specified components of this ductwork system, including facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.
- B. Internally Lined Ductwork: Duct sizes indicated for internally lined ducts are the clear inside dimensions, and shall be increased in both dimensions by twice the thickness of the liner.
- C. Ductwork Interior Surfaces:
 - 1. Smooth.
 - 2. No sheet metal parts, tabs, angles, or other items may project into air ducts, unless otherwise specified.
 - 3. Seams and joints shall be external.
 - 4. For ductwork that is required to be reinforced, Contractor may use either external or internal reinforcing.

2.03 SHEET METAL MATERIALS

- A. Construct metal duct systems from galvanized steel.
- B. Where no specific ductwork materials are indicated in Specifications or on the Drawings, galvanized steel sheet metal shall be basis of Contract.
- C. Galvanized Steel Ductwork:
 - 1. Comply with ASTM A653/A653M and ASTM A924/924M.
 - 2. Product Name: Steel Sheet, Zinc Coated (Galvanized Steel).
 - 3. Sheet Designation: CS Type B.
 - 4. Applicable Specification: ASTM A653/A653M.
 - 5. (Zinc) Coating Designation: G90.
 - 6. Coating designation in accordance with Test Method A, ASTM A90/A90M. and ASTM A924/A924M.
 - 7. Provide mill-phosphatized finish for ducts exposed to view and for ducts scheduled to be painted.
 - 8. Provide sheet metal packaged and marked as specified in ASTM A700.
- D. Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.04 DUCT SEALING MATERIALS

- A. General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
- B. Adhesives, Cements, Sealant, and Installation Accessories: As recommended by duct manufacturer for application.
- C. Solvent-Based Sealants:
 - 1. Ultraviolet light resistant.
 - 2. Mildew resistant.
 - 3. Flashpoint: Greater than 70 degrees F, SETA CC.
 - 4. Manufacturers and Products:
 - a. Hardcast, Inc.; Versagrip 102.
 - b. Rectorseal; AT-33.
 - c. Childers CP-140.
- D. Water-Based Sealants:
 - 1. Listed by manufacturer as nonflammable in wet and dry state.
 - 2. Manufacturers and Products:
 - a. Foster; Series 32.
 - b. Childers; CP-145A, 146.
 - c. Rectorseal; Airlok 181.

2.05 DUCTWORK FASTENERS

- A. General:
 - 1. Rivets, bolts, or sheet metal screws.
 - 2. Ductwork fasteners shall be same metal as duct being supported, unless otherwise noted.
- B. Self-Drilling Screws:
 - 1. Galvanized Steel Ductwork System: Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated carbon steel with zinc electroplated finish.

2.06 DUCTWORK PRESSURE CLASS

A. Construct duct systems to pressure classifications indicated in the Ductwork Schedule.

B. Where no specific duct pressure designations are indicated in Specifications or on the Drawings, 2-inch WC pressure class shall be basis of Contract.

2.07 RECTANGULAR DUCTWORK

- A. Fabricate rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, and Rectangular Industrial Duct Construction Standards, unless specified otherwise.
- B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20-gauge or less, with more than 10 square feet of unbraced panel area, as indicated in SMACNA Manual, unless they are lined or are externally insulated.

2.08 RECTANGULAR DUCTWORK FITTINGS

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible and Rectangular Industrial Duct Construction Standards.
- B. Elbows:
 - 1. Fit square-turn elbows with vane side rails.
 - 2. Shop fabricate double-blade turning vanes of same material as ductwork.
 - 3. Fabricate with equal inlet and outlet.
 - 4. Rectangular radius elbows with inside radius of 3/4 of duct width in direction of turn.
 - 5. Manufacturers and Products:
 - a. Elgen; All-Tight.
 - b. Duro-Dyne; Type TR.

2.09 RECTANGULAR DUCTWORK BRANCH CONNECTIONS

A. Branch duct connections to rectangular duct mains shall be made using factory fabricated fittings with spot welded tap to main duct connections or with factory fabricated, field installed taps, with spin-in or mechanical fastened tap to main duct connections.

2.10 RECTANGULAR DUCTWORK INSULATION LINER

A. Location: Provide ductwork with internal insulation liner where indicated on the Drawings or in Ductwork Schedule.

B. Material:

- 1. Fiberglass, nominal 1.5 pcf density liner, K factor 0.25 maximum at 75 degrees F mean.
- 2. Black composite coating on surface exposed to airstream to prevent erosion of glass fibers, for temperatures to 250 degrees F.
- 3. Liquid water repellency rating not less than 4.0 when tested in accordance with INDA IST 80.6.
- 4. Potential heat value not exceeding 3,500 Btu per hour per pound when tested in accordance with NFPA 259 and meeting classification of "Limited Combustible" as defined by NFPA 90A.
- 5. Maximum rated velocity not less than 6,000 fpm when tested in accordance with ASTM C1071.
- 6. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C1139.
- 7. Manufacturers and Products:
 - a. CertainTeed; Toughgard.
 - b. JohnsManville; Linacoustic RC.
 - c. Knauf; Duct Liner M.
- C. Thickness: Minimum 1-inch(es) or greater thickness where indicated on the Drawings or Ductwork Schedule.
- D. R-Value: Minimum 4.2 hours foot squared degrees F per Btu or greater, where indicated on the Drawings or Ductwork Schedule.
- E. Liner Adhesive: In accordance with NFPA 90A and ASTM C916.
- F. Mechanical Fasteners:
 - 1. Same material as ductwork, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct.
 - 2. Provide fasteners that do not damage liner when applied as recommended by manufacturer, that do not cause leakage in duct, and will indefinitely sustain 50-pound tensile dead load test perpendicular to duct wall.
 - 3. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8-inch into airstream.
 - 4. Adhesive for Attachment of Mechanical Fasteners: In accordance with Fire Hazard Classification of duct liner system.
- G. Liner Application:
 - 1. Ductwork liner shall be applied at time of ductwork manufacture in an approved sheet metal workshop.

- 2. Adhere single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
- 3. Apply coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
- 4. Butt transverse joints without gaps and coat joint with adhesive.
- 5. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
- 6. Longitudinal Joints:
 - a. Shall not occur except at corners of ducts, unless size of duct and standard liner product dimensions make longitudinal joints necessary.
 - b. Apply adhesive coating on longitudinal seams in ducts exceeding 2,500 fpm air velocity.
- Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter, at 3 inches from transverse joints, and at intervals not exceeding 18 inches longitudinally.
- 8. Secure transversely oriented liner edges facing airstream with metal nosing that are either channel or "Z" profile or are integrally formed from duct wall at the following locations:
 - a. Fan discharge.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts.
- 9. Seal insulation edges.
- 10. Repair abrasions or tears with mastic.

2.11 DOUBLE WALL DUCTWORK

- A. General:
 - 1. Double wall duct system consisting of outer sheet metal pressure shell, internal sheet metal liner, with insulating material in annular space.
 - 2. Location: Provide where indicated on the Drawings or in Ductwork Schedule.
- B. Construction:
 - 1. Outer shell gauge shall be based upon actual outer shell dimensions.
 - 2. Inner liner secured to outer shell with mechanical fasteners that maintain metal liner distance from duct without compressing insulation.
 - 3. Inner liner: Same material as outer pressure shell, unless indicated otherwise.

C. Insulation:

- 1. Void space between liner and outer pressure shell shall be filled with fiberglass insulation, material and installation in accordance with Article Rectangular Ductwork Insulation Liner.
- 2. Thickness: Minimum 1-inch(es) or greater thickness where indicated on the Drawings or Ductwork Schedule.
- 3. R-Value: Minimum 4.2 hours foot squared degrees F per Btu or greater, where indicated on the Drawings or Ductwork Schedule.
- D. Liner Terminations:
 - 1. Terminate internal liner with duct build-outs (metal hat sections) where double wall ductwork connects to single wall ductwork or to any uninsulated component.
 - 2. Secure build-outs to duct wall with bolts, screws, rivets, or welds.
 - 3. Terminate liner at fire dampers at connection to fire damper sleeve.

2.12 RIGID ROUND DUCTWORK

- A. Construct rigid round ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible and Round Industrial Duct Construction Standards, unless specified otherwise.
- B. Basic Round Diameter: As used in this Article, is inside diameter of size of round duct.
- C. Where space limitations prevent use of round duct or where shown on the Drawings, provide ductwork of flat oval construction hydraulically equivalent to round ductwork.
- D. Fabricate round ducts with spiral seam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams.
- E. Snaplock seams may only be used for duct systems of construction pressure classification less than 2-inch WC.

2.13 RIGID ROUND DUCTWORK FITTINGS

A. Construct rigid round ductwork fittings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible and Round Industrial Duct Construction Standards, unless otherwise specified.

- B. 90-Degree Tees, Laterals, and Conical Tees: Fabricate to conform to SMACNA manual with metal thicknesses specified for longitudinal seam straight duct.
- C. Diverging Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
- D. Elbows:
 - 1. Fabricate in stamped (die-formed), pleated, or segmented (gored) construction 1.5 times elbow diameter. Two piece segment elbows are not allowed, except with turning vanes.
 - 2. Segmented Elbows: Fabricate with welded construction.
 - 3. Round Elbows 8 inches and Smaller:
 - a. Stamped elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees configuration.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 3-1/2 inches and 4-1/2 inches) elbows with segmented construction.
 - 4. Round Elbows 9 inches Through 14 inches:
 - a. Segmented or pleated elbows for 30, 45, 60, and 90 degrees.
 - b. Fabricate nonstandard bend angle configurations or nonstandard sized (for example, 9-1/2 inches and 10-1/2 inches) elbows with segmented construction.

2.14 ROUND DUCTWORK BRANCH CONNECTIONS

- A. Branch duct connections (taps) to round duct mains shall be made using factory fabricated fittings.
- B. Field installed taps are not acceptable.

2.15 ROUND DUCTWORK INSULATION LINER

- A. Location: Provide round ductwork with internal insulation liner where indicated on the Drawings or in Ductwork Schedule.
- B. Material:
 - 1. Fiberglass, nominal 4.0-pcf density, K factor 0.23 maximum at 75 degrees F mean.
 - 2. Black composite coating on surface exposed to air stream, to prevent erosion of glass fibers.
 - 3. Suitable for temperatures up to 250 degrees F.
 - 4. Noise Reduction Coefficient: Minimum 0.75 for 1.0-inch thickness, in accordance with ASTM C423.

- 5. Liquid water repellency rating not less than 4.0 when tested in accordance with INDA IST 80.6.
- 6. Potential heat value not exceeding 3,500 Btu per hour per pound when tested in accordance with NFPA 259 and meeting classification of "Limited Combustible" as defined by NFPA 90A.
- 7. Maximum rated velocity not less than 6,000 fpm when tested in accordance with ASTM C1071.
- 8. Resistant to microbial growth using a "no growth criteria" when tested in accordance with ASTM C1139.
- 9. Manufacturers and Products:
 - a. CertainTeed.
 - b. Johns Manville; Spiracoustic Plus.
 - c. Knauf.
- C. Thickness: Minimum 1.0-inch or greater thickness where indicated on the Drawings or Ductwork Schedule.
- D. R-Value: Minimum 4.3 hour foot squared degrees F per Btu, or greater, where indicated on the Drawings or Ductwork Schedule.
- E. Liner Application:
 - 1. Install liner in accordance with manufacturer's instructions.
 - 2. In Straight Duct Sections: Apply at time of ductwork manufacture in an approved sheet metal workshop, or field install.
 - 3. In Duct Fittings: Apply at time of ductwork manufacture in an approved sheet metal workshop only.
 - 4. Install single layer of indicated thickness of duct liner. Multiple layers of insulation to achieve indicated thickness is prohibited.
 - 5. Fastening: Interference fit.
 - 6. Seal insulation edges.
 - 7. Repair abrasions or tears with mastic.

2.16 A: FIBERGLASS DUCTBOARD

- A. Fabricate in accordance with SMACNA Fibrous Glass Duct Construction Standards.
- B. One-inch-thick fiberglass ductboard with exterior vapor barrier.
- C. UL 181 Listed for 5,000 fpm velocity, with a factory applied, thermosetting, biocide treated acrylic polymer coating to airstream side.
- D. K equals 0.23 at 75 degrees F mean, and NRC of 0.80 as tested on Type A mounting.

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- E. Manufacturers and Products:
 - 1. Manville; Micro-Aire or Superduct.
 - 2. Owens-Corning; Type 1400-FR.

2.17 ROUND FIBERGLASS DUCT

- A. Fiberglass Thickness: 1-inch.
- B. One-piece construction with premolded slip joints, 6-foot sections.
- C. Scrim reinforced aluminum jacket on outside and acrylic coating on inside.
- D. K equals 0.23 at 75 degrees F mean and NRC of 0.80 as tested on Type A mounting.
- E. Fittings:
 - 1. Sheet metal wrapped with R-8 with FSK duct wrap, or fabricated as follows:
 - a. Miter and saddle cuts made with bandsaw.
 - b. Reducers cut with alligator notcher designed specifically for that purpose.
 - c. Gores: Glue with Miracle PF-96 or construction adhesive and seal with Therm-Lok closure.
- F. Manufacturer and Product: Manville; Super Round.

2.18 FIBERGLASS DUCTBOARD FITTINGS

- A. Round takeoffs from rectangular fiberglass duct shall be made with Twist-Lok fittings.
- B. Manufacturers:
 - 1. General Environment.
 - 2. Flexmaster.
 - 3. Gensco.

2.19 INSULATED FLEXIBLE DUCT

- A. Fabricate in accordance with:
 - 1. UL 181, Class 1.
 - 2. NFPA 90A and NFPA 90B.

- B. Construction:
 - 1. Outer Jacket: Fire retardant reinforced metalized vapor barrier jacket with reinforced cross-hatched scrim having a permeance of not greater than 0.1 perm when tested in accordance with ASTM E96/E96M, Procedure A.
 - 2. Inner Liner: Tri-laminate of aluminum foil, fiberglass, and aluminized polyester.
 - 3. Reinforcing: Galvanized steel wire helix, mechanically locked to and encapsulated by inner liner fabric.
 - 4. Insulation:
 - a. Factory insulated with fiberglass insulation.
 - b. R-value: 6.0 minimum at a mean temperature of 75 degrees F.
 - 5. Internal Working Pressure: Rating shall be minimum 4-inch WC positive and 5-inch WC negative, with bursting pressure of at least 2-1/2 times working pressure.
 - 6. Air Velocity Rating: 4,000 fpm, minimum.
- C. Environment: Suitable for continuous operation at temperature range of minus 20 degrees F to plus 200 degrees F.
- D. Manufacturers and Products:
 - 1. Flex-Master; Type 5M.
 - 2. Thermaflex; Type M-KC.
 - 3. Hart & Cooley; Type F216.

2.20 HIGH TEMPERATURE FLEXIBLE DUCTWORK

- A. Metal flexible ductwork for high heat applications.
- B. Fully interlocked, stainless steel, 0.012-inch thickness.
- C. Manufacturer and Product: Flexonics; RT-6.

2.21 DUCTWORK HANGERS AND SUPPORTS

- A. General:
 - 1. Attachments, hangers, and supports for ductwork shall be in accordance with SMACNA Manual referenced for type of duct system being installed.
 - 2. Duct hanging system shall be composed of three elements; upper attachment to building, hanger itself, and lower attachment to duct.
 - 3. Wire hangers are not acceptable.

- 4. Hanger Spacing:
 - a. Ducts Up to 60 inches in Largest Dimension: 10 feet, maximum.
 - b. Ducts Over 61 inches in Largest Dimension: 8 feet, maximum.
- B. Construction Materials: Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:
 - 1. Galvanized Steel Ductwork:
 - a. Indoors: Carbon steel, zinc electroplated.
 - b. Outdoors: Carbon steel, hot-dipped galvanized after fabrication.
- C. Building Attachments:
 - 1. Concrete inserts, powder-actuated fasteners, or structural steel fasteners appropriate for building materials.
 - 2. Do not use powder-actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
 - 3. Upper Attachment (Concrete):
 - a. Drive pin fastener and expansion nail anchor may be used for ducts up to 18-inch maximum dimension.
 - b. Threaded stud fastener may be used for ducts up to 36-inch maximum dimension.
 - c. Concrete attachments shall be made of steel.
- D. Duct Fasteners: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials and conforming to requirements of Article Ductwork Fasteners.
- E. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36/A36M, hot-dipped galvanized after fabrication.

2.22 DUCTWORK FLEXIBLE CONNECTIONS

- A. General:
 - 1. Factory fabricated metal-edged fabric flexible connectors for commercial or industrial applications.
 - 2. Sheet metal permanently secured to fabric with double fabric fold, double metal crimp.
 - 3. Comply with NFPA 90A and NFPA 90B requirements.
 - 4. Airtight and waterproof.

- B. Materials:
 - 1. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
 - 2. Metal Edges: Construct from same material as ductwork, unless otherwise noted.
 - 3. Fabric:
 - a. Comply with NFPA 701 or UL 214 (except teflon coated).
 - b. Woven polyester or nylon for most applications.
 - c. Woven fiberglass for high temperature applications.
 - d. Coating: Vinyl, Neoprene, Hypalon, Silicone, or Teflon.
- C. Construction:
 - 1. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA Manual.
 - 2. Standard Metal Edged Connectors: Strip of fabric 3 inches wide attached to two strips of 3-inch-wide sheet metal.
 - 3. Wide Metal Edged Connectors: Strip of fabric 4 inches wide attached to two strips of 4-inch-wide sheet metal.
 - 4. Extra Wide Metal Edged Connectors: Strip of fabric 6 inches wide attached to two strips of 6-inch-wide sheet metal.
- D. Manufacturers:
 - 1. Ductmate; PROflex, Commercial.
 - 2. Ventfabrics.
 - 3. Duro-Dyne.

2.23 CEILING ACCESS DOORS

- A. Size: 24 inches by 24 inches.
- B. Finish in primer finish suitable for field painting.
- C. Manufacturers:
 - 1. Inryco Milcor.
 - 2. Krueger.

2.24 DUCT INSPECTION DOORS

- A. General:
 - 1. Insulated, gasketed, and at least 15 inches by 15 inches when duct dimensions are large enough.

- 2. On ductwork where largest side dimension is less than 16 inches, furnish inspection doors at least 8 inches by 8 inches.
- 3. Complete with necessary hardware and either Amerlock 10 or Ventlock No. 100 latches, and Ventlock Series No. 100 hinges.
- 4. Fabricated of same material as ductwork
- B. Round Spin-in Type Access Doors:
 - 1. Size: 18-inch and 24-inch diameter will be acceptable in lieu of comparable size square or rectangular access doors specified herein.
 - 2. Complete with insulation, spin-in frame, inner door, attachment cable, gaskets, three latches, and pull ring.
 - 3. Manufacturer and Product: Flexmaster; Inspector Series.
- C. Manufacturers:
 - 1. Ventlok.
 - 2. Duro-Dyne.
 - 3. Flexmaster.

2.25 MANUAL DAMPERS

- A. Butterfly Manual Dampers:
 - 1. Fabricate from two gauges heavier than duct in which installed, of same material as ductwork
 - 2. Align operating handle with damper blade.
 - 3. Provide 2-inch standoff bracket for insulated duct systems.
 - 4. Damper Manufacturers:
 - a. Ruskin.
 - b. American Warming and Ventilating.
 - 5. Operator Manufacturers:
 - a. Accessible Ductwork: Ventlok; Type 620 or 635.
 - b. Accessible Insulated Ductwork: Ventlok; Type 639.
 - c. Concealed Ductwork: Ventlok; Type 677 with extended operating rod and concealed regulator with plain cover.
- B. Manual Opposed-Blade Balancing Dampers:
 - 1. Externally operated gang airfoil, damper blades.
 - 2. Fabricate from same material as ductwork.
 - 3. Stainless steel or nylon sleeve bearings.
 - 4. Construction shall have interlocking edges and maximum 10-inch blade width.

- 5. Manufacturers and Products:
 - a. Ruskin; CD102.
 - b. American Warming and Ventilating; Model VC-31.

2.26 CONTROL DAMPERS

A. Refer Section 23 09 13, HVAC Controls, Field Components, and Instruments, for requirements.

2.27 EXTERNAL DUCT INSULATION

A. Refer to Section 22 07 00, Plumbing Piping Insulation.

2.28 MISCELLANEOUS ACCESSORIES

- A. Louver and Grille Blank-Off Sections:
 - 1. Fabricate from 20-gauge sheets of same material as louver/grille.
 - 2. Line with sound attenuation/insulating material.
 - 3. Shop-prime and paint outside face of blank-off section with two coats of flat black exterior paint.
- B. Auxiliary Drain Pans:
 - 1. Dimensions: Minimum 6 inches larger in both dimensions than equipment it is serving and 2 inches high, minimum.
 - 2. Construction: 16-gauge stainless steel with welded joints. Pans shall be watertight and have hemmed edges.
 - 3. Drain Connection:
 - a. Minimum 1-inch IPS or as shown on the Drawings.
 - b. Locate at lowest point of drain pan.
 - c. In lieu of drain connection, float switch may be installed. Float switch shall shut down air handling equipment upon sensing water.
- C. Accessories Hardware:
 - 1. Instrument Test Holes:
 - a. Cast metal, material to suit duct material, including screw cap and gasket and flat mounting gasket.
 - b. Size to allow insertion of pitot tube and other testing instruments.
 - c. Provide in length to suit duct insulation thickness.
 - 2. Flexible Duct Clamps:
 - a. Stainless steel band with cadmium-plated hex screw to tighten band with worm-gear action.
 - b. Provide in sizes from 3 inches to 18 inches to suit duct size.

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3. Adhesives: High strength, quick setting, neoprene based, waterproof and resistant to gasoline, and grease.

2.29 DUCTWORK IDENTIFICATION

- A. Painted Identification Materials:
 - 1. Stencils: Standard metal stencils, prepared for required applications with letter sizes generally comply with recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch high letters for ductwork and not less than 3/4-inch-high letters for access door signs and similar operational instructions.
 - 2. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray can form and grade.
 - 3. Identification Paint: Standard identification enamel of colors indicated or in accordance with ASME A13.1 for colors for systems not identified herein.
- B. Plastic Duct Markers
 - 1. General: Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color code:
 - a. Black text on yellow background: Odorous Air.
 - b. For other hazardous exhausts, use colors and designs recommended by ASME A13.1.
- C. Nomenclature: Include the following:
 - 1. Direction of air flow.
 - 2. Duct service (supply, return, exhaust).
- D. Manufacturers:
 - 1. W.H. Brady, Co.
 - 2. Seton Identification Products.
 - 3. Craftmark.
 - 4. Brimar Industries, Inc.

PART 3 EXECUTION

3.01 GENERAL INSTALLATION

- A. Miscellaneous:
 - 1. Install sheet metal ductwork and flexible ductwork in accordance with SMACNA Manual, NFPA 90A, and NFPA 90B.
 - 2. Install ductwork using manufacturer's recommended adhesives, cement, sealant, and insulation accessories.
 - 3. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth.
 - 4. Interface Between Ductwork and Louvers: At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be installed, sloped, and connected to louver so water entering ductwork system positively drains back to and out of louver.
- B. Ductwork Location:
 - 1. Locate ductwork runs vertically and horizontally, unless otherwise indicated.
 - 2. Avoid diagonal runs wherever possible.
 - 3. As indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment.
 - 4. In general, install as close to bottom of structure as possible.
 - 5. For ductwork concealed above ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.
 - 6. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
 - 7. Ductwork that must transition and drop below piping or other ductwork shall be transitioned back to bottom of structure immediately adjacent to obstruction.
- C. Penetrations:
 - 1. Provide duct sleeves or prepared openings for duct mains, duct branches, and ducts passing through roofs, walls and ceilings.
 - 2. Clearances:
 - a. For uninsulated ducts, allow 1-inch clearance between duct and sleeve, except at grilles, registers, and diffusers.
 - b. For insulated ducts, allow 1-inch clearance between insulation and sleeve, except at grilles, registers, and diffusers.
 - 3. Closure Collars:
 - a. Minimum 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed.

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- b. Fit collars snugly around ducts and insulation.
- c. Same gauge and material as duct.
- d. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier.
- e. Use fasteners with maximum 6-inch centers on collars.
- 4. Packing: Mineral fiber in spaces between sleeve or opening and duct or duct insulation.
- D. Concealment:
 - 1. Wherever possible in finished and occupied spaces, conceal ductwork from view by locating in mechanical shafts, hollow wall construction, or above suspended ceiling.
 - 2. Do not encase horizontal runs in solid partitions, except as specifically shown.
 - 3. Limit clearance to 1-inch where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any.
- E. Coordination with Other Trades:
 - 1. Coordinate duct installation with installation of accessories, dampers, coil frames, equipment, controls, and other associated work of ductwork system.
 - 2. Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on the Drawings.
 - 3. Coordinate ductwork layout with suspended ceiling, lighting and sprinkler head layouts and similar finished work.
 - 4. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.
- F. Shower Room and Toilet Room Exhaust Ductwork:
 - 1. Joints and Seams: Seal watertight.
 - 2. Slope branch ducts downward to grille.
- G. Fume Hood, Laboratory, and Chlorine Room Exhaust Ductwork:
 - 1. Seal joints and seams with chemical-resistant mastic.
 - 2. Rivet butt joints with minimum of eight pop rivets.

3.02 RECTANGULAR DUCTWORK

- A. General:
 - 1. Where possible, install ductwork so seams and joints will not be cut for installation of grilles, registers, or ceiling outlets.

- 2. If cutting of seams or joints is unavoidable, reinforce cut portion to original strength.
- B. Low Pressure Taps:
 - 1. Use bell mouth or conical fittings with integral locking quadrant damper. Spin-in fitting shall be sealed at duct tap with a gasket or sealed with sealant as specified for medium pressure ductwork.
 - 2. Determine location of spin-in after outlet location is determined.
 - 3. Fitting shall be securely attached to shaft to prevent damper from rotating around shaft.
- C. Fittings:
 - 1. Use bell-mouth or conical tee fittings for round duct takeoffs from rectangular mains.
 - 2. Use 45-degree entry fittings conforming to SMACNA requirements for rectangular takeoffs from rectangular or round mains.
 - 3. Make offsets with maximum angle of 45 degrees.
 - 4. Use fabricated fittings for changes in directions, changes in size and shape, and connections.
- D. Rectangular Ductwork Transverse Joints:
 - 1. Install each run with a minimum of joints.
 - 2. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
 - 3. Mechanical Joint Option:
 - a. Construct transverse joints with Ductmate 25/35 duct connector systems, Ductmate W.D.C.I. Heavy/Lite duct connector systems, or Ductlok J/E duct connector system. Slip-on duct flange connectors shall have integral sealant pocket with permanently flexible sealant.
 - b. When using Ductmate W.D.C.I. Heavy/Lite system, construct ductwork in accordance to the Ductmate W.D.C.I. Heavy J and Light H Assembly Manual and Duct Construction Standards.
 - c. When using Ductlok J/E duct connector system, construct ductwork in accordance with Ductlok's Rectangular Duct Construction Manual for Low, Medium, and High Pressure.
 - d. For longitudinal seams, use Pittsburgh lock seam sealed internally with permanently elastic sealer such as Ductmate 5511M mastic.
 - e. Conform to SMACNA Class A sealing requirements.

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3.03 RIGID ROUND OR OVAL DUCTWORK

- A. General: Except where interrupted by fittings, install round ducts in lengths as long as possible to minimize joints.
- B. Rigid Round or Oval Ductwork Joints:
 - 1. Rigid round ductwork joints shall be in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible or Round Industrial Duct Construction Standards, unless otherwise specified.
 - 2. Single and Double Wall Supply and Return System Joints:
 - a. Less than 36 inches: Slip coupling.
 - b. 36 Inches and Larger: Flanged connector, Van Stone, or welded companion flange type.
 - 3. Single and Double Wall Exhaust and Return System Joints:
 - a. Spiral Seam Duct: Welded flanged connector.
 - b. Longitudinal Seam Duct: Van Stone flange connector.

3.04 FIBERGLASS DUCTBOARD

- A. Grooves shall be modified ship-lap.
- B. Closure to be Therm-Lok or fiberglass fabric mesh and mastic.

3.05 INSULATED FLEXIBLE DUCT

- A. Installation:
 - 1. Where shown, between branch duct and ceiling diffusers and grilles.
 - 2. Without sags, kinks, sharp offsets, or elbows.
 - 3. As straight and taut as possible.
- B. Connection: Connect flexible ductwork to round collars, air distribution devices, and terminal units in accordance with flexible duct manufacturer's recommendations.
- C. Length: Maximum length of low-pressure flexible duct (construction pressure class up to 2-inch WC) to be 8 feet.
- D. Flexible ductwork shall not pass through wall, floor, or fire resistant rated assembly.

3.06 DUCTWORK HANGERS AND SUPPORTS

A. Install ductwork with support systems in accordance with SMACNA Manual, unless otherwise noted.

METAL DUCTS AND ACCESSORIES 23 31 13 - 24

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- B. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape and to prevent buckling.
- C. Install additional bracing on ductwork as required, to prevent ballooning or breathing.
- D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- E. Support vertical ducts at maximum interval of 16 feet and at each floor.
- F. Upper attachments to structures shall have allowable load not exceeding 1/4 of failure (proof test) load, but are not limited to specific methods indicated.
- G. In new construction, install concrete insert prior to placing concrete.

3.07 FLEXIBLE CONNECTIONS

- A. Flexible Collars and Connections:
 - 1. Use between fans and ducts.
 - 2. For round ducts, securely fasten flexible connections by zinc-coated steel clinch-type draw bands.
 - 3. For rectangular ducts, lock flexible connections to metal collars.

3.08 DAMPERS

- A. General:
 - 1. Inspection:
 - a. Inspect areas to receive dampers.
 - b. Notify Engineer of conditions that would adversely affect installation or subsequent utilization of dampers.
 - c. Do not proceed with installation until unsatisfactory conditions are corrected.
 - 2. Install dampers at locations indicated on the Drawings and in accordance with manufacturer's installation instructions.
 - 3. Install square and level.
 - 4. Handle damper using sleeve or frame. Do not lift damper using blades or jack-shaft.
 - 5. Damper blades and hardware shall operate freely without obstruction.
 - 6. Damper blades and hardware that bind within frame or obstructed by adjacent construction will not be acceptable.
 - 7. When installed, damper frames shall be gasketed or caulked to eliminate leakage between duct and damper frames.
 - 8. Head and sill shall have stops.

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- 9. Suitable for installation in mounting arrangement shown.
- 10. Do not compress or stretch damper frame into duct or opening.

B. Manual Dampers:

- 1. Provide balancing dampers for grilles and diffusers as indicated on the Drawings in branch duct as near main as possible.
- 2. Add or remove balancing dampers as requested by air balancing firm for necessary control of air.
- C. Back Draft Dampers:
 - 1. Install dampers square and free from racking with blades running horizontally.
 - 2. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.
- D. Fire Dampers:
 - 1. At ceiling grille and diffuser fire dampers, provide thermal blankets where required by local authorities.
 - 2. Install 1-1/2-hour rated, unless otherwise indicated, at locations shown and in accordance with SMACNA Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.

3.09 ACCESS DOORS

- A. Ductwork: Install access doors in ductwork, in accordance with manufacturer's instructions, at each:
 - 1. Volume damper.
 - 2. Automatic damper.
 - 3. Coil, on both upstream and downstream side.

3.10 EXTERNAL DUCT INSULATION

A. Refer to Section 22 07 00, Plumbing Piping Insulation.

3.11 MISCELLANEOUS ACCESSORIES

- A. Auxiliary Drain Pans:
 - 1. Under equipment for which pan is shown on the Drawings and under all horizontal air handling units located above ceilings and piping located in ceiling space directly above computer facility areas; furnish and install auxiliary drain pans.

- 2. Route drain lines to nearest floor or hub drain independent of any other drain.
- 3. Slope drain pans toward drain connection to promote drainage.
- B. Louver and Grille Blank-Off Sections: Attach airtight to louver or grille and install to allow for easy removal.
- C. Inspection Plates and Test Holes:
 - 1. Where required in ductwork for balance measurements.
 - 2. Test holes shall be airtight and noncorrosive with screw cap and gasket.
 - 3. Extend cap through insulation.

3.12 DUCT SEALING

- A. Seal duct seams and joints as follows:
 - 1. In accordance with SMACNA requirements as indicated on Ductwork Schedule.
 - 2. In accordance with the following:
 - a. Pressure Classification Less than 2-Inch WC: Transverse joints only.
- B. If no specific duct sealing requirements are specified, requirements of SMACNA manual shall govern.
- C. Seal externally insulated ducts prior to insulation installation.
- D. Provide additional duct sealing as required to comply with Article Ductwork Leakage Testing.
- E. Seal all audible leaks.

3.13 DUCTWORK LEAKAGE TESTING

- A. General:
 - 1. Tests shall be conducted on completed ductwork systems.
 - 2. Testing of partial installations or limited sections of ductwork will not be acceptable.
 - 3. All ductwork leakage test procedures and results shall be submitted to Engineer for review.
 - 4. Engineer shall retain the right to witness some or all ductwork leakage testing procedures.
 - 5. Contractor shall notify Engineer in writing at least 5 working days prior to ductwork testing.

- B. Leakage Criteria:
 - 1. Assemble and install ductwork with maximum leakage limited as follows:
 - 2. Constant Volume Systems:
 - a. Supply Ductwork:
 - 1) Operating Pressure: 0- to 2-inch WC.
 - a) Allowable Leakage: 2 percent of design airflow.
 - b. Return Ductwork:
 - 1) Operating Pressure: All.
 - 2) Allowable Leakage: 2 percent of design airflow.
- C. Leakage Testing Method:
 - 1. Contractor shall be responsible for providing all necessary test fans and calibrated measuring devices to accomplish ductwork leakage test and to demonstrate that ductwork systems leakage rate is less than maximum rate specified.
 - 2. Pressure testing shall be accomplished using a pressure blower with a calibrated orifice and manometer.
 - 3. Blower shall maintain system design static pressure during test.
 - 4. Perform testing in accordance with procedures given in SMACNA HVAC Air Duct Leakage Test Manual.

3.14 BALANCING OF AIR SYSTEMS

A. Perform air balancing in accordance with requirements of Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.15 PROTECTION OF INSTALLED WORK

- A. Open ends of installed ductwork systems shall be covered to prevent dust, foreign objects and water from entering ductwork.
- B. Ductwork systems shall not be used for air conveyance until adequate air filtration devices are installed in air handling equipment, to prevent ingress of construction dust.

3.16 CLEANING

- A. Ductwork shall be cleaned of rust, dust, and debris, both internally and externally, before placing in operation.
- B. Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.

C. If duct systems are found to contain construction debris at time of construction completion Contractor shall provide complete ductwork system cleaning in accordance with NADCA Standards.

3.17 SUPPLEMENTS

- A. The supplements listed below, following "End of Section," are a part of this Specification:
 - 1. Section 23 31 13.01, Schedules for HVAC: See the Drawing for schedules.

END OF SECTION

SECTION 23 34 00 HVAC FANS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Acoustical Society of America (ASA): S2.19, Mechanical Vibration— Balance Quality Requirements of Rigid Rotors—Part 1, Determination of Permissible Residual Unbalance.
 - 2. Air Movement and Control Association International (AMCA):
 - a. 99, Standards Handbook.
 - b. 201, Fans and Systems.
 - c. 203, Field Performance Measurement of Fan Systems.
 - d. 204, Balance Quality and Vibration Levels for Fans.
 - e. 210, Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
 - f. 300, Reverberant Room Method for Sound Testing of Fans.
 - g. 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - 3. American Bearing Manufacturers Association (ABMA): 9, Load Ratings and Fatigue Life for Ball Bearings.
 - 4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 5. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - c. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - d. D3363, Standard Test Method for Film Hardness by Pencil Test.
 - e. D4167, Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. National Electrical Manufacturers Association (NEMA).
 - 7. National Fire Protection Association (NFPA): 45, Standard on Fire Protection for Laboratories Using Chemicals.
 - 8. Occupational Safety and Health Act (OSHA).
- 9. Society for Protective Coatings (SSPC):
 - a. SP 3, Power Tool Cleaning.
 - b. SP 5, White Metal Blast Cleaning.
 - c. SP 6, Commercial Blast Cleaning.
 - d. SP 10, Near-White Blast Cleaning.
- 10. UL: 507, Safety Standard for Electric Fans.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. AC: Alternating Current.
 - 2. CISD: Chemical Industry, Severe-Duty.
 - 3. dB: Decibel.
 - 4. DWDI: Double Width, Double Inlet.
 - 5. FRP: Fiberglass Reinforced Plastic.
 - 6. hp: Horsepower.
 - 7. ODP: Open Drip Proof.
 - 8. SWSI: Single Width, Single Inlet.
 - 9. TEFC: Totally Enclosed, Fan Cooled.
 - 10. UV: Ultra Violet
 - 11. XP: Explosion Proof.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Provide following for specified products:
 - a. Identification as referenced in Contract Documents.
 - b. Manufacturer's name and model number.
 - c. Descriptive specifications, literature, and drawings.
 - d. Dimensions and weights.
 - e. Fan sound power level data (reference 10 to power minus
 - 12 watts) at design operating point.
 - f. Fan Curves:
 - 1) Performance Curves Indicating:
 - a) Relationship of flow rate to static pressure for various fan speeds.
 - b) Brake horsepower curves.
 - c) Acceptable selection range (surge curves, maximum revolutions per minute).
 - d) Static pressure, capacity, horsepower demand and overall efficiency required at duty point, including drive losses.

- 2) For variable air volume applications, indicate operating points at 100, 80, 60 and 40 percent of design capacity on fan curves including data to indicate effect of capacity control devices such as inlet vanes on flow, pressure, and brake horsepower.
- g. Capacities and ratings.
- h. Construction materials.
- i. Fan type, size, class, drive arrangement, discharge, rotation, and bearings.
- j. Wheel type, diameter, maximum revolutions per minute for fan class, operating revolutions per minute, and tip speed.
- k. Motor data, including service factor and operating horsepower.
- 1. Fan shaft first critical speed.
- m. Belt service factor.
- n. Drive assembly horsepower rating.
- o. Sheave horsepower rating.
- p. Power and control wiring diagrams, including terminals and numbers.
- q. Factory run test and vibration test reports.
- r. Vibration isolation.
- s. Factory finish system.
- t. Color selection charts where applicable.
- 2. "Or-equal" Equipment:
 - a. Where submitted equipment results in change to fan inlet or outlet ductwork configuration shown on the Drawings, submit system effect factor calculations indicating increased static pressure requirements as described in AMCA 201.
 - b. Where submitted equipment results in change to ductwork and equipment configuration shown on the Drawings, submit detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement to equipment furnished.
- B. Informational Submittals:
 - 1. Recommended procedures for protection and handling of products prior to installation.
 - 2. Manufacturer's installation instructions.
 - 3. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements, for the following:
 - a. Motors specified to be premium efficient type.
 - b. FRP fans.
 - 4. Test reports.
 - 5. Operation and maintenance data including as-built version of equipment schedules.

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C. LEED Submittals:

- 1. Equipment and materials for Ticketing Building and Toilet Building.
- 2. Engineer reserves right to reject products and assemblies based on incomplete or noncompliance with LEED certification requirements.
- 3. Documentation required indicating compliance with Optimize Energy Performance—EA Credit 1.
- 4. Documentation required indicating compliance with Minimum IAQ Performance—EQ Prerequisite 1.
- 5. Documentation required indicating compliance with Low-Emitting Materials, Adhesives and Sealants—EQ Credit 4.1.

1.04 QUALITY ASSURANCE

- A. Performance Ratings: Tested in accordance with AMCA 210.
- B. Sound Ratings: Tested in accordance with AMCA 300.
- C. Fabrication: In accordance with AMCA 99.

PART 2 PRODUCTS

2.01 EQUIPMENT SCHEDULES

A. Some specific equipment requirements are listed in Equipment Schedule. Refer to the Drawings.

2.02 GENERAL

- A. Acoustical Levels: Equipment selections shall produce sound power levels in each octave band no greater than shown in Equipment Schedule.
- B. Fan Drives:
 - 1. Drive assembly shall be sized for a minimum 140 percent of fan motor horsepower rating.
 - a. Capable of providing 150 percent of motor horsepower.
 - 2. Drive Adjustment:
 - 3. Fan Shafts: First critical speed of at least 125 percent of fan maximum operating speed.
 - 4. Provide speed test openings at shaft locations.
 - 5. Motors:
 - a. Motors 20 hp or Smaller:
 - 1) Variable pitch V-belt sheaves allowing at least 20 percent speed variation.

- 2) Final operating point shall be at approximate sheave midpoint.
- 6. Weather Cover: For outdoor applications, factory fabricated drive assembly of same material as fan housing, unless specified otherwise.
- 7. Belt and Shaft Guards:
 - a. Easily removable and to enclose entire drive assembly, meeting federal, OSHA and State of Florida requirements.
 - b. Guard faces of expanded metal having minimum 60 percent free area for ventilation.
 - c. Bright yellow finish.
- C. Finishes:
 - 1. Carbon Steel Parts: Factory finish as follows, unless indicated otherwise.
 - a. Parts cleaned and chemically pretreated with phosphatizing process.
 - b. Alkyd enamel primer.
 - c. Air dry enamel topcoat.
 - 2. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
 - 3. Stainless Steel Parts: Finished smooth and left unpainted.
 - 4. Fiberglass Parts: Finished in accordance with Paragraph Fiberglass Material.

2.03 CABINET FAN

- A. General:
 - 1. Factory-assembled, ceiling, wall or inline mounted, centrifugal cabinet fan; including housing, fan wheel, drive assembly, motor and accessories.
 - 2. Bearing AMCA Certified Ratings Seal for sound and air performance.
- B. Housing:
 - 1. Material: Minimum 20-gauge galvanized steel.
 - 2. Construction:
 - a. Minimum 14-gauge blower and motor support frame.
 - b. Lined with minimum 1/2-inch acoustical insulation.
 - c. Outlet duct collar with integral reinforced aluminum backdraft damper, with nylon bushings.
 - d. Motor mounted on resilient vibration isolators.
 - e. Motor and blower removable from unit without cabinet disassembly.
 - f. Removable cabinet access panels.

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- g. Air Inlet: Field convertible for bottom or end air inlet configuration.
- h. Predrilled universal mounting brackets, adjustable.
- C. Wheel: Centrifugal forward curved type, galvanized steel or plastic construction.
- D. Shaft, Bearings, Drive:
 - 1. Shafts: Turned, ground and polished carbon steel.
 - 2. Bearings: Grease lubricated, precision antifriction ball, sealed type.
 - 3. Drives:
 - a. In accordance with Paragraph Fan Drives.
 - b. Factory set to specified fan revolutions per minute.
 - c. Type: Direct.

E. Electrical:

- 1. Integral wiring box.
- 2. Factory-installed disconnect receptacle.
- F. Accessories: Provide as scheduled in Equipment Schedule.
- G. Manufacturers and Products:
 - 1. Greenheck.

2.04 CORROSION PROTECTION COATING

- A. General:
 - 1. Factory-applied corrosion protection coating for application to fan components and accessories, where required by this section.
 - 2. Quality Control:
 - a. Verify dry film thickness before final baking.
 - b. Finished coating system shall be free from voids, checks, cracks, and blisters.
 - 3. Surface Cleaning: Clean parts to be coated as follows:
 - a. Immerse parts in heated cleaning solution to remove lubricants, machining oils, and residual factory contamination.
 - b. Follow with immersion in potable water bath to neutralize and remove cleaning solution.
 - c. Chemical Pretreatment: Immerse parts in heated chemical solution, iron phosphate for steel, clear/yellow chromate for aluminum.

- B. Baked Enamel:
 - 1. Material: Alkyd modified urea-melamine single component baking enamel.
 - 2. Surface Preparation: Clean surface to SSPC SP 3.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Oven baked at a metal temperature not to exceed 300 degrees F.
 - 5. Finished Thickness: 1-mil to 2-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Impact Resistance: 10-inch pounds, ASTM D2794 test method.
 - b. Pencil Hardness: 2H, ASTM D3363 test method.
 - c. Service Temperature: Maximum 230 degrees F, continuous.
- C. Baked Polyester:
 - 1. Material: Polyester.
 - 2. Surface Preparation: Sandblast surface to SSPC SP 5.
 - 3. Application: Electrostatic spray.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Finished Thickness: 1.5-mil to 2.5-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
 - d. Pencil Hardness: 2H, ASTM D3363 test method.
 - e. Service Temperature: Maximum 230 degrees F, continuous.
- D. Air-Dry Epoxy:
 - 1. Material: Two-part catalyzed epoxy.
 - 2. Surface Preparation: Clean surface to SSPC SP 3.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Air dry.
 - 5. Finished Thickness: 4-mil to 6-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,500-hour duration, ASTM B117 test method.
 - b. Pencil Hardness: H-2H, ASTM D3363 test method.
 - c. Service Temperature: Maximum 150 degrees F, continuous.
- E. Baked Epoxy:
 - 1. Material: Epoxy.
 - 2. Surface Preparation: Sandblast surface to SSPC SP 10.

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- 3. Application: Electrostatic spray.
- 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
- 5. Finished Thickness: 2.5-mil to 3.5-mil dry film thickness.
- 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
 - d. Pencil Hardness: 2H, ASTM D3363 test method.
 - e. Service Temperature: Maximum 230 degrees F, continuous.
- F. Air Dry Phenolic:
 - 1. Material:
 - a. Phenolic resin, Heresite VR-500 Series "Or-equal."
 - b. For outdoor applications, apply an UV resistant topcoat, Heresite UC-5500 "Or-equal."
 - 2. Surface Preparation: Sandblast surface to SSPC SP 6.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Air dry.
 - 5. Finished Thickness: 4-mil to 6-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 500-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 500-hour duration, ASTM D2247 test method.
 - c. Service Temperature: Maximum 180 degrees F, continuous.
- G. Baked Phenolic:
 - 1. Material: Phenolic resin, Heresite P-403 "Or-equal."
 - 2. Surface Preparation: Sandblast surface to SSPC SP 5.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Finished Thickness: 5-mil to 7-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - c. Impact Resistance: 100-inch pounds, ASTM D2794 test method.
 - d. Pencil Hardness: 2H, ASTM D3363 test method.
 - e. Service Temperature: Maximum 250 degrees F, continuous.

- H. Baked Epoxy Phenolic:
 - 1. Material:
 - a. Baking cross-linked epoxy-phenolic.
 - b. For outdoor applications, apply an UV-resistant topcoat.
 - 2. Surface Preparation: Sandblast surface to SSPC SP 5.
 - 3. Application: Electrostatic or conventional compressed air spray equipment.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Finished Thickness: 6-mil to 8-mil dry film thickness.
 - 6. Performance: Coating shall meet or exceed following criteria:
 - a. Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - b. Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - c. Impact Resistance: 160-inch pounds, ASTM D2794 test method.
 - d. Pencil Hardness: 3H, ASTM D3363 test method.
 - 7. Service Temperature: Maximum 350 degrees F, continuous.

2.05 MOTORS

- A. General:
 - 1. Provide integral self-resetting overload protection on single-phase motors.
 - 2. Motors for fans specified for use with variable frequency drives shall be inverter duty type.
 - 3. Motors shall not operate into service factor in any case.
- B. Motor requirements shall be as follows, unless designated otherwise on Equipment Schedule:
 - 1. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - 2. Winding Thermal Protection: None.
 - 3. Space Heater: No.
 - 4. Number of Speeds: Single.
 - 5. Number of Windings: One.
 - 6. Motor Efficiency: Energy efficient.
 - 7. Shaft Type: Solid, carbon steel.
 - 8. Mounting: As required for fan arrangement.
 - 9. Service Factor: 1.15.

2.06 ACCESSORIES

- A. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear engraved or diestamped black enamel filled equipment identification number and letters indicated in this Specification and as shown on the Drawings.
- B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

2.07 SOURCE QUALITY CONTROL

- A. General:
 - 1. Fan shall operate at single stable point as indicated by fan curve. Fans having two potential operating points are not acceptable.
 - 2. Fan and motor combination shall be capable of delivering 110 percent of scheduled air quantity and static pressure. Motor shall not operate into motor service factor in any listed case.
 - Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA 203, Appendix L.
- B. Testing Provisions:
 - 1. Provide tachometer access holes large enough to accept standard tachometer drive shaft.
 - 2. Center punch fan shaft to accommodate tachometer readings.
- C. Acoustical Levels:
 - 1. Perform noise tests in accordance with AMCA 300 and AMCA 301.
 - 2. Fan sound power levels (dB, Reference 10⁻¹² Watts) shall be no greater than scheduled values.
- D. Balancing:
 - 1. Unless noted otherwise, each fan wheel shall be statically and dynamically balanced to ASA S2.19 Grade G6.3.
 - 2. Fans controlled by variable frequency drives shall be dynamically balanced at speeds 25 percent, 50 percent, 75 percent, and 100 percent of design revolutions per minute.

- E. Vibration Test:
 - 1. Each fan furnished with 5-horsepower or larger motor shall have factory run vibration test, including vibration signatures taken on each bearing in horizontal, vertical, and axial direction.
 - 2. Vibration reading as measured at scheduled rotational speed shall not exceed the following values when fan is rigidly mounted:
 - a. Belt Drive (except Vane Axial): 0.15-inch per second peak velocity.
 - b. Belt Drive Vane Axial: 0.08-inch per second peak velocity.
 - c. Direct Drive: 0.08-inch per second peak velocity.
 - 3. Written records of run test and vibration test shall be made available upon request.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fans level and plumb.
- B. Secure roof-mounted fans to roof curbs with cadmium-plated steel Type 316 stainless steel hardware.
- C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.
- D. Scroll Drains: Pipe drain connection through running trap to floor drain.
- E. Labeling:
 - 1. Label fans in accordance with Article Accessories.
 - 2. Mark exhaust fans serving fume hoods with arrows to indicate proper direction of rotation, in accordance with NFPA 45.
- F. Service Access: Locate units to provide access spaces required for motor, drive, bearing servicing, and fan shaft removal.
- G. Equipment Support and Restraints:
 - 1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.
 - 2. Seismic Restraint Snubbers: Install with sufficient clearance so unit isolators are not restricted for proper free isolation, but do limit movement in all directions.

- H. Connections:
 - 1. Refer to Section 23 31 13, Metal Ducts and Accessories.
 - 2. Isolate duct connections to fans.
 - 3. Install ductwork adjacent to fans to allow proper service and maintenance.

3.02 FIELD QUALITY CONTROL

- A. Functional Tests:
 - 1. Verify blocking and bracing used during shipping are removed.
 - 2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.
 - 3. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 4. Verify cleaning and adjusting are complete.
 - 5. Disconnect fan drive from motor; verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.
 - 6. Reconnect fan drive system; align and adjust belts and install belt guards.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify manual and automatic volume control and fire and smoke dampers in connected ductwork are in fully open position.
- B. Performance Tests:
 - 1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated revolutions per minute.
 - b. Measure and record motor voltage and amperage.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.

3.03 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

D. Balancing:

- 1. Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- 2. Replace fan and motor sheaves as required to achieve design airflow.

E. Vibration Testing:

- 1. Perform field testing on rotating equipment, where specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC, to determine actual operating vibration.
- 2. If vibration limits described therein are exceeded, rebalance equipment in-place until design tolerances are met.
 - a. Vibration readings as measured at actual rotational speed shall not exceed the following values:
 - 1) Belt Drive, Flexibility Mounted: 0.25-inch per second peak velocity.
 - 2) Belt Drive, Rigidly Mounted: 0.16-inch per second peak velocity.

3.04 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. On completion of installation, internally clean fans according to manufacturers' written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

END OF SECTION

SECTION 23 34 05 ODOR CONTROL FANS

PART 1 GENERAL

1.01 EQUIPMENT NUMBERS

A. Odor Control Fan(s): EF-1, EF-3, and EF-4.

1.02 GENERAL

- A. Like items of equipment provided hereunder shall be the end products of one manufacturer to achieve standardization for operation, maintenance, spare parts, and manufacturers' services.
- B. Air flow balancing requirements: Conform to requirements of Section 23 05 93 Testing, Adjusting and Balancing for HVAC and Odor Control.

1.03 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Acoustical Society of America (ASA): S2.19, Mechanical Vibration— Balance Quality Requirements of Rigid Rotors—Part 1, Determination of Permissible Residual Unbalance.
 - 2. Air Movement and Control Association International (AMCA):
 - a. 99, Standards Handbook.
 - b. 99-0401 Classifications of Spark Resistant Construction.
 - c. 201, Fans and Systems.
 - d. 203, Field Performance Measurement of Fan Systems.
 - e. 210, Laboratory Methods of Testing Fans for Rating.
 - f. 300, Reverberant Room Method for Sound Testing of Fans.
 - g. 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - h. 99-2408, Operating Limits for Centrifugal Fans.
 - 3. American Bearing Manufacturers Association (ABMA): 9, Load Ratings and Fatigue Life for Ball Bearings.
 - 4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE): HVAC Applications Handbook.
 - 5. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.

- b. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
- c. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
- d. D3363, Standard Test Method for Film Hardness by Pencil Test.
- e. D4167, Standard Specification for Fiber-Reinforced Plastic Fans and Blowers.
- f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- 6. National Electrical Manufacturers Association (NEMA).
- 7. Occupational Safety and Health Act (OSHA).
- 8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): Seismic Restraint Manual: Guidelines for Mechanical Systems.
- 9. Society for Protective Coatings (SSPC):
 - a. SP 3, Power Tool Cleaning.
 - b. SP 5, White Metal Blast Cleaning.
 - c. SP 6, Commercial Blast Cleaning.
 - d. SP 10, Near-White Blast Cleaning.
- 10. UL: 507, Electric Fans.
- 11. Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

1.04 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. AC: Alternating Current.
 - 2. CISD: Chemical Industry, Severe-Duty.
 - 3. dB: Decibel.
 - 4. FRP: Fiberglass Reinforced Plastic.
 - 5. hp: Horsepower.
 - 6. ICCES: International Code Council Evaluation Services
 - 7. SWSI: Single Width, Single Inlet.
 - 8. TEFC: Totally Enclosed, Fan Cooled.
 - 9. UV: Ultraviolet.
 - 10. XP: Explosion Proof.

1.05 SUBMITTALS

- A. Action Submittals:
 - 1. Provide for all products specified, as follows:
 - a. Identification as referenced in Contract Documents.
 - b. Manufacturer's name and model number.

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- c. Descriptive specifications, literature, and drawings.
- d. Dimensions and weights.
- e. Fan sound power level data (reference 10 to power minus 12 Watts) at design operating point.
- f. Fan Curves:
 - 1) Performance curves at design point indicating:
 - a) Curve showing relationship of flow rate to static pressure.
 - b) Brake horsepower curves.
 - c) Acceptable selection range (surge curves, maximum revolutions per minute).
 - d) Static pressure, capacity, horsepower demand and overall efficiency required at the duty point, including any estimated drive losses.
 - e) Fan wheel revolutions per minute and tip speed.
- g. Construction materials, including statement of resins and reinforcing proposed for use.
- h. Fan type, wheel type, wheel diameter, wheel maximum safe speed, size, class, drive arrangement, discharge, rotation, and bearing type.
- i. Vibration isolation.
- j. Factory finish system.
- k. Color selection charts where applicable.
- 1. Corrosion protection coating product data.
- m. Fan shaft first critical speed.
- n. Drive assembly horsepower rating.
- 2. Equipment anchorage and support drawings or cut sheets indicating size, material, spacing, embedment and edge distances of anchors and other relevant information. The Drawings should reflect the results of the calculations submitted below.
- 3. "Or-equal," approved Equipment:
 - a. Where submitted equipment results in change to fan inlet or outlet ductwork configuration shown on the Drawings, submit system effect factor calculations indicating increased static pressure requirements as described in AMCA 201.
 - b. Where submitted equipment results in change to ductwork and equipment configuration shown on the Drawings, submit detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement to equipment furnished.
- B. Informational Submittals:
 - 1. Recommended procedures for protection and handling of products prior to installation.

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- 2. Manufacturer's installation instructions.
- 3. Factory Test reports: Factory run test, dynamic balancing, performance test, sound test.
- 4. Operation and maintenance data including as-built version of equipment drawings and schedules.
- 5. Support and anchorage calculations stamped by an Engineer licensed in the State of project location. Anchorage, bracing and support design criteria and calculations shall conform to the manufacturer's requirements as well as design criteria indicated on the Structural General Notes on the Drawings and any other referenced standards. Provide ICC-ES reports and special inspection requirements for anchors to be drilled and installed into completed concrete or masonry. Anchor calculations shall indicate edge distance, embedment, concrete thickness and strength, and other conditions assumed in the design calculations. Verify field conditions prior to installation of the anchors and bracing.

1.06 QUALITY ASSURANCE

- A. Performance Ratings: Fan performance in accordance with AMCA 210.
- B. Sound Ratings: Rated in accordance with AMCA 300.
- C. Fabrication: In accordance with AMCA 99.

1.07 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:

Item	Quantity
Fan/motor shaft coupling	One per fan size
Fan shaft seal	One per fan size
Special tools required to maintain or dismantle	One complete set

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

- 2.01 EQUIPMENT SCHEDULES
 - A. Some specific equipment requirements are listed in Equipment Schedules as shown on the Drawings.

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2.02 PERFORMANCE REQUIREMENTS

- A. Fan shall operate at single stable point as indicated by fan curve. Duty point shall be at least 10 percent below the crest of the fan curve.
- B. Fan shall operate at a speed not greater than 90 percent of the maximum safe speed at selected design point.
- C. Fan and motor combination shall be capable of operating at 105 percent of Supplier's selected speed at design point. Motor shall not operate into motor service factor over the published range of flow at this higher speed.
- D. Where inlet box is used, provide fan curves inclusive of inlet box losses.

2.03 NAMEPLATES

A. Units shall include factory installed permanently attached nameplate displaying unit model and serial number.

2.04 OPERATING LIMITS

A. Fans designated to meet a specified fan class shall comply with requirements of AMCA 99-2408.

2.05 ACOUSTICAL LEVELS

A. Equipment selections shall produce sound power levels in each octave band no greater than shown in Equipment Schedule.

2.06 FINISHES

- A. Carbon Steel Parts (including vibration isolation, unitary base, and seismic control devices): Factory finished in accordance with Article Corrosion Protection Coating.
- B. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
- C. Stainless Steel Parts: Finished smooth and left unpainted.
- D. Fiberglass Parts: Finished in accordance with Paragraph Fiberglass Material.

2.07 CORROSION PROTECTION COATING

- A. General:
 - 1. Provide factory-applied corrosion protection coating on fan steel components.

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- 2. Coating system shall be baked enamel, air-dry epoxy, or baked epoxy.
- 3. Color shall be factory standard otherwise noted.
- 4. Quality Control:
 - a. Verify dry film thickness before final baking.
 - b. Finished coating system shall be free from voids, checks, cracks, and blisters.
- 5. Surface Cleaning:
 - a. Clean parts to be coated as follows:
 - 1) Immerse parts in heated cleaning solution to remove lubricants, machining oils, and residual factory contamination.
 - 2) Follow with immersion in potable water bath to neutralize and remove cleaning solution.
 - 3) Chemical Pretreatment: Immerse parts in heated chemical solution, iron phosphate for steel, clear/yellow chromate for aluminum.
- B. Baked Enamel:
 - 1. Material: Alkyd modified urea-melamine single component baking enamel.
 - 2. Surface Preparation: Clean surface to SSPC-SP 3.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Oven baked at a metal temperature not to exceed 300 degrees F.
 - 5. Finished Thickness: 1-mil to 2-mil dry film thickness.
 - 6. Performance:
 - a. Coating shall meet or exceed following criteria:
 - 1) Impact Resistance: 10-inch pounds, ASTM D2794 test method.
 - 2) Pencil Hardness: 2H, ASTM D3363 test method.
 - 3) Service Temperature: Maximum 230 degrees F, continuous.
- C. Air-Dry Epoxy:
 - 1. Material: Two-part catalyzed epoxy.
 - 2. Surface Preparation: Clean surface to SSPC-SP 3.
 - 3. Application: Standard air-pressurized spray equipment.
 - 4. Curing: Air dry.
 - 5. Finished Thickness: 4-mil to 6-mil dry film thickness.
 - 6. Performance:
 - a. Coating shall meet or exceed following criteria:
 - 1) Salt Spray Test: Minimum 1,500-hour duration, ASTM B117 test method.
 - 2) Pencil Hardness: H-2H, ASTM D3363 test method.
 - 3) Service Temperature: Maximum 150 degrees F, continuous.

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- D. Baked Epoxy:
 - 1. Material: Epoxy.
 - 2. Surface Preparation: Sandblast surface to SSPC-SP 10.
 - 3. Application: Electrostatic spray.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Finished Thickness: 2.5-mil to 3.5-mil dry film thickness.
 - 6. Performance:
 - a. Coating shall meet or exceed following criteria:
 - 1) Salt Spray Test: Minimum 1,000-hour duration, ASTM B117 test method.
 - 2) Humidity Resistance: Minimum 1,000-hour duration, ASTM D2247 test method.
 - 3) Impact Resistance: 100-inch pounds, ASTM D2794 test method.
 - 4) Pencil Hardness: 2H, ASTM D3363 test method.
 - 5) Service Temperature: Maximum 230 degrees F, continuous.

2.08 MOTORS

A. Motors shall not operate into service factor in any case.

2.09 SOURCE QUALITY CONTROL

- A. General:
 - 1. Factory run test and wheel dynamic balance for each fan.
 - 2. Factory test, performance test, and sound test for each fan.
- B. Acoustical Levels: Fan sound power levels (dB, Reference 10⁻¹² Watts) shall be no greater than scheduled values.
- C. Balancing: Unless noted otherwise, each fan wheel shall be statically and dynamically balanced to ASA S2.19 Grade G6.3.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install fans level and plumb.
- B. Scroll Drains: Pipe drain connection through P-trap to drain location as indicated on the Drawings.
- C. Labeling: Label fans in accordance with Article Accessories.

- D. Service Access: Locate units to provide access spaces required for motor, bearing servicing, and fan wheel/shaft removal.
- E. Equipment Support and Restraints:
 - 1. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.
 - 2. Seismic Restraint Snubbers: Install with sufficient clearance so unit isolators are not restricted for proper free isolation but do limit movement in all directions.
- F. Connections: Connect fan housing grounding connection to suitable ground.

3.02 FIELD QUALITY CONTROL

- A. Functional Tests:
 - 1. Verify blocking and bracing used during shipping are removed.
 - 2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.
 - 3. Verify proper thermal-overload protection is installed for motors, starters, and disconnect switches.
 - 4. Verify that cleaning and adjusting are complete.
- B. Performance Tests:
 - 1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated revolutions per minute.
 - b. Measure and record motor voltage and amperage.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.
 - 3. Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
 - 4. Test each fan to verify design air flow rates as specified.
 - 5. Adjust fan speed as required to achieve design airflow.
 - 6. Document the fan operating speed and static pressure at each fan inlet and discharge at the design flow rate.

3.03 ADJUSTING

A. Lubricate bearings.

ODOR CONTROL FANS 23 34 05 - 8 B. Balancing: Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.04 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. On completion of installation, internally clean fans according to manufacturers' written instructions. Remove foreign material and construction debris.

3.05 SUPPLEMENTS

- A. The supplement listed below, following "End of Section," is a part of this Specification.
 - 1. Schedule: See the Drawing for schedule.

END OF SECTION

SECTION 23 37 00 AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 880, Air Terminals.
 - 2. ASTM International (ASTM): C636/C636M, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - 3. UL.

1.02 DEFINITIONS

- A. NC: Noise Criteria; background sound rating method for indoor sound.
- B. VAV: Variable air volume.
- C. WC: Water column.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Manufacturer's data and descriptive literature for products specified.
 - b. Furnish the following information for each type of diffuser, register, and grille furnished.
 - 1) NC sound data.
 - 2) Static pressure loss data.
 - 3) Throw data.
 - 2. Samples: Finish color samples.

PART 2 PRODUCTS

- 2.01 EQUIPMENT SCHEDULES
 - A. Refer to the Drawings.

2.02 CEILING DIFFUSERS

- A. Louvered Face Diffusers CD-1, CD-2, CD-3, and CD-4:
 - 1. Construction: Refer to Equipment Schedule.
- B. Perforated Face Diffusers RD-1:
 - 1. Construction: Refer to Equipment Schedule.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Refer to architectural reflected ceiling plans for coordination of locations of ceiling-mounted air outlets and inlets with ceiling grids and lighting. Where locations of devices shown on mechanical drawings do not agree with locations that are shown on architectural reflected ceiling plans, reflected ceiling plans shall take precedence. If air outlets or inlets are shown on mechanical drawings, but are not shown on architectural reflected ceiling plans, devices shall be located as near as possible to locations shown on mechanical drawings when coordinating with ceiling.
- B. Install diffusers, grilles, and registers tight on their respective mounting surfaces, level, plumb, and true with room dimensions.
- C. Provide appropriate frame to adapt to mounting surface. Provide a 24-inch by 24-inch lay-in ceiling module for diffusers, registers, and grilles in lay-in ceilings.
- D. Support air inlets and outlets where installed in metal suspension systems for acoustical tile and lay-in panel ceilings as specified in ASTM C636/C636M and applicable building code.

END OF SECTION

SECTION 23 60 00 CENTRAL COOLING EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
 - a. 365, Commercial and Industrial Unitary Air-Conditioning Condensing Units.
 - b. 370, Sound Performance Rating of Large Air-Cooled Outdoor Refrigerating and Air-Conditioning Equipment.
 - c. 550/590, Performance Rating of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle.
 - d. 560, Absorption Water Chilling and Water Heating Packages.
 - 2. American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE):
 - a. 15, Safety Standard for Refrigeration Systems.
 - b. 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. American Society of Mechanical Engineers (ASME): BPVC Section VIII, Rules for Construction of Pressure Vessels.
 - 4. ASTM International (ASTM):
 - a. B68/B68M, Standard Specification for Seamless Copper Tube, Bright Annealed.
 - b. B75/B75M, Standard Specification for Seamless Copper Tube.
 - c. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - d. B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - e. D523, Standard Test Method for Specular Gloss.
 - f. D870, Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
 - g. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - h. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - i. D3359, Standard Test Methods for Measuring Adhesion by Tape Test.
 - j. D3363, Standard Test Method for Film Hardness by Pencil Test.
 - k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

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- 5. FM Global (FM).
- 6. Hydraulic Institute Standards (HIS).
- 7. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
- 8. National Electrical Manufacturers' Association (NEMA):
 - a. MG 1, Motors and Generators.
 - b. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- 9. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - c. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
- 10. Nationally Recognized Testing Laboratory (NRTL).
- 11. Occupational Safety and Health Act (OSHA).
- 12. UL:
 - a. 674, Standard for Safety Electric Motors and Generators for Use in Hazardous (Classified) Locations.
 - b. 1995, Standard for Safety Heating and Cooling Equipment.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Complete specifications, descriptive drawings, catalog cuts, and descriptive literature including make, model, dimensions, weight of equipment, and electrical schematics for equipment specified.
 - b. Cabinet dimensional drawings to scale, including location and sizes of access doors, control panels, and electrical cabinets and panels. Indicate required maintenance and electrical clearances for all access and maintenance locations.
 - c. Complete piping schematic for condenser unit(s).
- B. Informational Submittals:
 - 1. Manufacturer's installation instructions.
 - 2. Recommended procedures for protection and handling of materials prior to installation.
 - 3. Manufacturers' service reports.
 - 4. Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement or details shown to equipment furnished.
 - 5. Include as-built version of equipment schedules.

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- 6. Field test results.
- 7. List of recommended spare parts for equipment.
- 8. Special guarantees.
- C. LEED Submittals:
 - 1. Documentation required indicating compliance with Fundamental Refrigerant Management—EA Prerequisite 3.
 - 2. Documentation required indicating compliance with Optimize Energy Performance—EA Credit 1 with regards to mandatory provision for minimum equipment efficiencies of ASHRAE 90.1 Standard, Section 6.4.
 - 3. Documentation required indicating compliance with Enhanced Refrigerant Management—EA Credit 4.

1.03 QUALITY ASSURANCE

- A. Air handler coil data shall be reviewed by condensing unit manufacturer for compatibility with installed refrigeration system.
- B. Regulatory Requirements: Cooling equipment shall have minimum operating efficiencies as specified in ASHRAE 90.1 and the State of Florida Energy Code.

1.04 SPECIAL GUARANTEE

A. Provide manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of Work specified in this Specification found defective during a period of 5 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work as specified in General Conditions.

PART 2 PRODUCTS

2.01 AIR-COOLED CONDENSING UNIT CU-1, CU-2, AND CU-3.

- A. Factory assembled, single-piece, air-cooled condensing unit suitable for ground or rooftop installation.
- B. Condenser:
 - 1. Coil(s): constructed of aluminum fins mechanically bonded into seamless copper tubes.

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- 2. Direct drive fan, propeller type.
- 3. Totally enclosed motor.
- 4. Contained in a weatherproof casing.
- 5. Bearing UL mark.
- C. Casing:
 - 1. 18-gauge zinc-coated steel phosphatized and finished in manufacturer's standard enamel paint.
 - 2. Supported on steel full-length mounting rails.
 - 3. Removable access panels to internal components.
 - 4. Protective guards on each fan discharge and each coil inlet.
- D. Cooling Components:
 - 1. Crankcase heater.
 - 2. Liquid line solenoid.
 - 3. Suction line accumulator.
 - 4. Condenser coil with seamless copper tubes bonded to aluminum fins.
 - 5. Rubber mounted upflow propeller condenser fans with direct-drive motor with integral thermal overload protection.
 - 6. Connections for refrigerant piping and specialties.
- E. Capacity: Refer to the Drawing schedule.

2.02 REFRIGERANT PIPING AND INSULATION

- A. As specified in Section 23 23 00, Refrigerant Piping, and Section 22 07 00, Plumbing Piping Insulation.
- B. Tubing:
 - 1. Hard-drawn copper tubing in accordance with ASTM B75/B75M or ACR copper tubing in accordance with ASTM B68/B68M and ASTM B280.
 - 2. Wrought copper fittings.
 - 3. Piping to be evacuated, charged with dry nitrogen, and capped at factory.
- C. Insulation:
 - 1. Flexible elastomer.
 - 2. Rated for 25/50 flame spread/smoke developed.
 - 3. Expanded, closed-cell.
 - 4. 1/2-inch thick.
 - 5. Thermal conductivity equals 0.27 or less.

CENTRAL COOLING EQUIPMENT 23 60 00 - 4 6. Armstrong, Armaflex AP.

2.03 ACCESSORIES

- A. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.
- B. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component control panel in a readily visible location. Plate shall bear 3/8 or 1/4-inch high engraved or die-stamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.
- C. Anchor Bolts: Factory furnished.
- D. Equipment Screens:
 - 1. Where shown on the Drawings, provide cottonwood and insect screen fabricated from a two-ply stackable material with first ply construction of heavy-duty commercial-grade bonded mesh and the second ply constructed of a fine unbonded mesh. Edge mesh ply with 1-inch width of fiber reinforced vinyl with grommets. Mount screen on an anodized aluminum track with UV-resistant spin knob fasteners.
 - 2. Manufacturers and Products:
 - a. Air Solution Company; Stackable HD Commercial. Permatron.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Condensing Units: Install refrigeration specialties, combination temperature/pressure gauges, piping, and refrigerant as required by manufacturer's installation instructions.
- B. Refrigerant Piping:
 - 1. Size, arrange, and install in accordance with condensing unit manufacturer's instructions for actual piping configuration.
 - 2. Provide silvaloy joints.
 - 3. Continuously purge piping with dry nitrogen during soldering.
 - 4. Evacuate piping system to 29.9 inches mercury. System shall hold vacuum for 24 hours without significant loss.

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- C. Refrigerant Pipe Insulation:
 - 1. Install on suction and hot gas bypass lines.
 - 2. Install in accordance with manufacturer's instructions.
 - 3. Coat UV-exposed insulation to protect from deterioration in accordance with manufacturer's recommendation.

3.02 FIELD QUALITY CONTROL

- A. Functional Tests: Conduct on each chiller, condensing unit, and cooling tower as follows:
 - 1. Alignment: Prior to facility startup, test complete assemblies for correct rotation, proper alignment and connection, quiet operation, and satisfactory specified performance.
- B. Performance Test: Conduct on each condensing unit assisted by manufacturer's representative.
 - 1. Perform under actual or approved simulated operating conditions.
 - 2. Test for continuous 3-hour period without malfunction.
 - 3. Perform with Engineer present.
 - 4. Test Log: Upon completion of test, record and report results.
 - 5. Adjust, realign, or modify units and retest if necessary.

END OF SECTION

SECTION 23 77 00 AIR HANDLING UNITS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 410, Forced-Circulation Air-Cooling and Air-Heating Coils.
 - 2. Air Movement and Control Association International, Inc. (AMCA):
 - a. 201, Fans and Systems.
 - b. 203, Field Performance Measurement of Fan Systems.
 - c. 204, Balance Quality and Vibration Levels for Fans.
 - d. 300, Reverberant Room Method for Sound Testing of Fans.
 - e. 301, Methods for Calculating Fan Sound Ratings From Laboratory Test Data.
 - f. 99-0401, Classifications for Spark Resistant Construction.
 - g. 99-2408, Operating Limits for Centrifugal Fans.
 - 3. American Bearing Manufacturers Association (ABMA): 9, Load Ratings and Fatigue Life for Ball Bearings.
 - 4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - a. 15, Safety Standard for Refrigeration Systems.
 - b. 52.1, Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - d. 62.1, Ventilation for Acceptable Indoor Air Quality.
 - 5. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. D2247, Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity.
 - c. D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - d. D3363, Standard Test Method for Film Hardness by Pencil Test.
 - e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 6. CSA America (CSA):
 - a. B149.1, Natural Gas and Propane Installation Code.

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- b. Z83.4, Non-Recirculating Direct Gas-Fired Industrial Air Heaters.
- c. Z83.18, Recirculating Direct Gas-Fired Industrial Air Heaters.
- Institute of Electrical and Electronics Engineers, Inc. (IEEE): 841, Standard for Petroleum and Chemical Industry - Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 370 kW (500 hp).
- 8. International Standards Organization (ISO): 9001, Quality Management Systems Requirements.
- 9. National Electrical Manufacturers Association (NEMA).
- 10. National Fire Protection Association (NFPA):
 - a. 54, National Fuel Gas Code.
 - b. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - c. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
- 11. Occupational Safety and Health Act (OSHA).
- 12. Society of Protective Coatings (SSPC):
 - a. SP 3, Power Tool Cleaning.
 - b. SP 5, White Metal Blast Cleaning.
 - c. SP 6, Commercial Blast Cleaning.
 - d. SP 10, Near-White Blast Cleaning.
- 13. UL:
 - a. 181, Standard for Safety Factory-Made Air Ducts and Connectors.
 - b. 723, Standard for Safety Test for Surface Burning Characteristics of Building Materials.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. ac: alternating current.
 - 2. AFD: Adjustable Frequency Drive.
 - 3. AHU: Air Handling Unit.
 - 4. cfm: cubic feet per minute.
 - 5. CISD: Chemical Industry, Severe-Duty.
 - 6. dB: Decibel.
 - 7. DX: Direct Expansion.
 - 8. DWDI: Double Width, Double Inlet.
 - 9. ETL: ETL Testing Laboratories, Inc.
 - 10. FM: Factory Mutual Insurance.
 - 11. fpm: feet per minute.
 - 12. hp: Horsepower.
 - 13. IAQ: Indoor Air Quality.
 - 14. IEC: International Electro-technical Commission.

- 15. IRI: Industrial Risk Insurance.
- 16. MAU: Make-Up Air Unit.
- 17. NRC: Noise Reduction Coefficient.
- 18. OD: Outside Diameter.
- 19. ODP: Open Drip Proof.
- 20. O&M: Operations and Maintenance.
- 21. psi: pounds per square inch.
- 22. PVC: Polyvinyl Chloride.
- 23. rpm: revolutions per minute.
- 24. SCR: Silicon Control Rectifier.
- 25. SWSI: Single Width, Single Inlet.
- 26. TEFC: Totally Enclosed, Fan Cooled.
- 27. UV: Ultra Violet.
- 28. VFD: Variable Frequency Drive.
- 29. WC: Water Column.
- 30. XP: Explosion Proof.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Provide Shop Drawings for products specified, including, as a minimum:
 - a. Unit identification as referenced in Contract Documents.
 - b. Manufacturer's name and model number.
 - c. Descriptive specifications, literature, and drawings.
 - d. Dimensions and weights for unit, including fully assembled and shipping sections.
 - e. Acoustics:
 - Fan sound power level data (ref. 10 to power minus 12 Watts) at design operating point, based on AMCA 300 for unit discharge, inlet and casing.
 - 2) Additional requirements (including by others) to achieve specified sound performance levels.
 - f. Fans:
 - 1) Type, size, quantity, class, drive arrangement, discharge, rotation and bearings.
 - 2) Wheel type, diameter, rpm, and tip speed.
 - 3) Performance curves indicating:
 - a) Relationship of flow rate to static pressure for various fan speeds.
 - b) Brake horsepower curves.
 - c) Acceptable selection range (surge curves, maximum safe operating rpm).

- d) Static pressure, capacity, horsepower demand and overall efficiency required at the duty point, including drive losses.
- 4) For variable air volume applications, indicate operating points at 100, 80, 60, and 40 percent of design capacity on fan curves including data to indicate effect of capacity control devices such as inlet vanes on flow, pressure and brake horsepower.
- g. Coils:
 - Type, quantity, dimensions, material of construction, coatings, if applicable, energy transfer capacity, air pressure drop, air inlet, and discharge temperature at design conditions.
 - 2) Hydronic Coils: Water pressure drop at design conditions, water inlet and discharge temperature at design conditions, piping connection data, coil fin spacing, coil row depth.
 - 3) DX Coils: Refrigerant saturated suction temperature at design conditions, refrigerant piping configuration (row split, face split, intertwined), coil fin spacing, coil row depth.
 - 4) Steam Coils: Air pressure drop at design conditions, air discharge temperature and humidity at design conditions, piping connection data, steam consumption.
 - 5) Evaporative Coolers: Media air pressure drop at design conditions, make-up water consumption, air discharge temperature and humidity at design conditions, piping connection data.
 - 6) Electric Resistance Coils: Voltage, phase, number of stages, safety features, controls.
 - 7) Drain pan details.
 - 8) Coil pull details and dimensions for service.
- h. Motor(s) type, quantity, and performance data.
- i. Air filter(s) type, quantity, and performance data.
- j. Unit capacities and ratings, including airflow and static pressure summary.
- k. Construction materials.
- 1. Power and control wiring diagrams, including terminals and numbers.
- m. Vibration Isolation:
 - 1) Vibration isolation methods with maximum deflection data.
 - 2) Additional requirements (including by others) to achieve specified vibration isolation levels.
- n. Factory finish system, with color selection charts where applicable.

- 2. "Or-equal" Equipment:
 - a. Where submitted equipment results in change to fan inlet or outlet ductwork configuration shown on the Drawings, submit system effect factor calculations indicating increased static pressure requirements as described in AMCA 201.
 - b. Where submitted equipment results in change to ductwork and equipment configuration shown on the Drawings, submit detailed information on structural, mechanical, electrical, or other modifications necessary to adapt arrangement or details shown to equipment furnished.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate of Compliance, in accordance with Section 01 61 00, Common Product Requirements.
 - 2. Sample copy of guarantee.
 - 3. Manufacturer's Test Reports for the following:
 - a. DX cooling coil.
 - b. Air handling unit leak tests.
 - c. Acoustical tests.
 - d. Vibration tests.
 - 4. Recommended procedures for protection and handling of products prior to installation.
 - 5. Manufacturer's installation instructions, including component spacing requirements.
 - 6. Operation and Maintenance Data:
 - a. Include as-built version of equipment schedules.
 - b. Methods for accessing components for maintenance with required service clearances.

1.04 QUALITY ASSURANCE

- A. Fans: Licensed to bear AMCA seal for air flow and sound performance.
- B. Manufacturer's Qualifications:
 - 1. The air handling unit manufacturer shall have been successfully manufacturing air handling units for a period of no less than 5 years.
 - 2. Manufacturer's qualifications are subject to review by the Owner/Engineer to determine acceptance.
- C. Fan Performance:
 - 1. Fan shall operate at single stable point as indicated by fan curve. Fans having two potential operating points are not acceptable.
- 2. Fan and motor combination shall be capable of delivering 110 percent of scheduled air quantity and static pressure.
- 3. Motor shall not operate into motor service factor in any listed case.
- 4. Accommodate drive efficiency in motor selection according to manufacturer's published recommendation, or according to AMCA 203, Appendix L.
- D. Thermal Insulation: Shall meet the erosion requirements of UL 181 facing the air stream and fire hazard classification of 25/50 (per ASTM E84 and UL 723).

1.05 DELIVERY, STORAGE, AND HANDLING

A. Air handling unit manufacturer shall coordinate with the Contractor as to the requirements for proper delivery, storage, and handling of the air handling unit and its components required in this Specification to ensure that the unit is properly cared for prior to final installation.

1.06 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials.

Item	Quantity							
High Efficiency Filters	Two complete sets per unit							
Special tools required to maintain or dismantle	One complete set for each different size unit							

B. Delivery: In accordance with Section 01 61 00, Common Product Requirements.

PART 2 PRODUCTS

- 2.01 EQUIPMENT SCHEDULES
 - A. Refer to the Drawings.
- 2.02 OPERATING LIMITS
 - A. Fans designated to meet a specified Fan Class shall comply with requirements of AMCA 99-2408.

2.03 ACOUSTICAL LEVELS

- A. Equipment selections shall produce sound power levels in each octave band no greater than shown in fan equipment schedule.
- B. Perform noise tests in accordance with AMCA 300.

2.04 FINISHES

- A. Carbon Steel Parts: Factory finished as follows, unless indicated otherwise.
 - 1. Parts cleaned and chemically pretreated with a phosphatizing process.
 - 2. Alkyd enamel primer.
 - 3. Air-dry enamel topcoat.
- B. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
- C. Stainless Steel Parts: Finished smooth and left unpainted.

2.05 AIR HANDLING UNITS—MODULAR

- A. General:
 - 1. Modular air handling unit, constructed by assembly of factoryfabricated modules containing components such as fan units, motor and drive assembly, heat transfer devices, dampers, plenums, filters, condensate pans, heating units, control devices, and accessories.
 - 2. Required module types as indicated on plans and equipment schedule.
 - 3. Assembly shall be a complete and fully functioning system with all components and accessories as specified.
 - 4. Fan Air and Sound Performance: Tested and rated in accordance with AMCA and guaranteed by manufacturer.
- B. Module Casing:
 - 1. General:
 - a. Each module fully enclosed housing, with casing consisting of sheet metal side, floor and roof panels, mechanically fastened to structural metal internal frame.
 - b. Wall panels shall be easily removable. Panel removal shall not affect structural integrity of unit.
 - c. Height and width dimensions identical for each module type, for a given unit size.
 - d. Lifting lugs and unit support frames, factory installed, to facilitate installation.

- e. All casing insulated, formed and reinforced sheet metal panels; flat panel design not acceptable.
- f. For double wall units, distance between inner and outer panels as required to accommodate insulation thickness specified in Paragraph Insulation. Units are double wall, unless noted otherwise.
- g. Each panel shall be removable from outside of unit without affecting unit structural integrity.
- 2. Fasteners: Constructed of same material as respective module panel materials.
- 3. Outer Panels:
 - a. Material: manufacturer specified.
 - b. Indoor Units:
 - 1) Walls: Minimum 16-gauge (0.0625-inch minimum) thickness sheet metal.
 - 2) Roof: Minimum 16-gauge (0.0625-inch minimum) thickness sheet metal.
- 4. Inner Panels:
 - a. Walls and Roof:
 - 1) Material: manufacturer specified.
 - 2) Minimum 20-gauge (0.0348-inch minimum) thickness sheet metal
 - b. Floor Plate:
 - 1) Material: Type 304 stainless.
 - 2) Minimum 14-gauge (0.0800-inch) thickness sheet metal.
- 5. Frame:
 - a. Material: manufacturer specified.
 - b. Fabricated from minimum 16-gauge metal sections.
 - c. Metal sections joined to form a unitized assembly, for support of module internal components.
- 6. Joints:
 - a. Joints between exterior panels and structural frames shall have seals and gaskets with appropriate material type for air seal and acoustical break.
 - b. All seams caulked and sealed for an airtight unit.
 - c. Fully through-bolted module to module joints sealed with bulb type gasketing on both mating modules.
- 7. Insulation:
 - a. Single Wall Casing Units:
 - 1) Insulation secured with adhesive and metal pins.
 - 2) Longitudinal insulation joints and butt ends covered by a sheet metal break to prevent erosion of exposed edges.
 - b. Double Wall Casing Units: Insulation fully encased between outside and inside panels. Units are double wall, unless noted otherwise.

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- c. Properties:
 - 1) Units with Perforated Liner:
 - a) Black composite protective coating on surface exposed to airstream.
 - b) Exposed insulation is not acceptable.
 - 2) Maximum effective thermal conductivity (C) of 0.24 Btu inch per square foot degrees F.
 - 3) Minimum NRC of 0.70 per inch thickness.
- 8. Access Doors:
 - a. Heavy-gauge, oversized access doors insulated, double wall construction, internal sheet metal skin.
 - b. Sized and located to provide easy access to unit internal components.
 - c. Hinged, latched, and gasketed to provide a weatherproof seal.
 - d. Provide doors on one sides of each module.
 - e. Latches:
 - 1) "Ventlok" style noncorrosive alloy latches operable from inside and outside of unit.
 - 2) For access doors configured to open against unit operating pressure, provide safety latches that allow access doors to partially open after first handle movement and fully open after second handle movement.
- 9. Air Leakage: Maximum of 0.5 cfm per square foot of cabinet area at 5-inch WC static pressure.
- C. Module Drain Pans:
 - 1. Location: Inside each module, under each cooling coil and where indicated in these Specifications.
 - 2. IAQ style drain pans, complying with requirements of ASHRAE 62.1.
 - 3. Formed sections of minimum 16-gauge (0.0625 in.) Type 304 stainless steel or Type 316 stainless steel.
 - 4. Triple pitched for complete drainage, with no standing water in unit.
 - 5. Double Wall Construction:
 - a. Space between walls filled with foam insulation.
 - b. Sealed moisture tight.
 - c. Welded corners.
 - 6. Drain Connections:
 - a. Type 304 stainless steel, male pipe thread.
 - b. Both ends of pan.
 - c. Extended to exterior of unit cabinet.
 - d. Connection centerline shall be a minimum of 3 inches above base rail. Drain connections that protrude from the base rail are not acceptable.

- D. Unit Base:
 - 1. Full perimeter base frame.
 - 2. Minimum10-gauge (0.135-inch) structural steel construction, with C channel cross support members, on close centers.
 - 3. Joints fully welded.
 - 4. Fitted with lifting lugs at corner of unit or module.
 - 5. Attached to unit at factory unless noted otherwise for field assembly.
- E. Supply Fan Module:
 - 1. General:
 - a. Supply air module with fan assembly, consisting of housing (where applicable), wheel, fan shaft, bearings, motor, lockable disconnect switch, drive assembly, support structure and accessories.
 - b. Casing constructed in accordance with Article Module Casing.
 - c. Suitable to convey air at temperatures up to 250 degrees F.
 - d. Fan Performance: AMCA 99-2408 class rating corresponding to the static pressure at which the fan is designed to operate.
 - e. Fan Assemblies: Statically and dynamically balanced, designed for continuous operation at maximum rated fan speed and motor horsepower.
 - 2. Centrifugal Fan Housing:
 - a. Material: manufacturer specified.
 - b. Construction:
 - 1) Formed and reinforced sheet metal panels, curved scroll configuration with shaped cutoff, continuous seam welding and side angle reinforcement.
 - 2) Flanged and drilled outlet to permit duct connection.
 - 3) Spun-formed aerodynamic bell mouth inlet.
 - 4) Access doors or panels to allow entry to internal parts and components.
 - 5) Base:
 - a) All-welded heavy-gauge metal.
 - b) Fan and motor mounted on common base.
 - c) Motor Mount: Adjustable slide mount.
 - c. Plug Fans: Fabricate without fan scroll and volute housing.
 - d. Hardware: Plated steel.
 - 3. Fan Wheel:
 - a. Centrifugal, one-piece, blade type as scheduled.
 - b. Forward-Curved Fans:
 - 1) DWDI forward curved fan wheel.

- 2) Shallow blades with inlet and tip curved forward in direction of airflow, metal construction, mechanically secured to backplate and inlet flange.
- c. Backward Inclined Fans:
 - 1) DWDI backward inclined fan wheel.
 - 2) Nonoverloading performance characteristics.
 - 3) Backward inclined blades, heavy-gauge metal construction, continuously welded to backplate and curved inlet flange.
- d. Airfoil Fans:
 - 1) DWDI backward inclined fan wheel.
 - 2) Nonoverloading performance characteristics.
 - Backward inclined blades, hollow die-formed airfoil design, heavy gauge metal construction, continuously welded to backplate and smooth curved inlet flange.
- e. Plenum Fans:
 - 1) SWSI backward inclined fan wheel.
 - 2) Nonoverloading performance characteristics.
 - 3) Backward inclined blades, hollow die-formed airfoil design, heavy-gauge metal construction, continuously welded to backplate and smooth curved inlet flange.
- f. Material: manufacturer specified.
- g. Attached to fan shaft with split taper lock bushing.
- 4. Fan Shaft, Bearings, Drive:
 - a. Shafts:
 - 1) Turned, ground, and polished carbon steel.
 - 2) Ends drilled and countersunk for tachometer readings.
 - 3) Keyed for sheave installation.
 - 4) Coated with lubricating oil.
 - b. Bearings:
 - 1) Grease lubricated, precision anti-friction ball, self-aligning type.
 - 2) Mounted in cast iron pillow block housing.
 - Selected for average life (ABMA 9 L₅₀) of not less than 200,000 hours operation at maximum cataloged operating speed.
 - c. Drives:
 - 1) In accordance with Article Fan Drives.
 - 2) Factory set to specified fan revolutions per minute.
 - 3) Type: Direct.
 - 4) Arrangement: As specified.
- 5. Internal Vibration Isolation:
 - a. Fan/Motor Base: Isolate base from unit casing with open spring isolators with 2-inch deflection.

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- F. Refrigerant Coil Module:
 - 1. General:
 - a. Fin-tube direct expansion refrigerant cooling and heating coil, complete with refrigerant controls, and related accessories.
 - b. Casing constructed in accordance with Article Module Casing.
 - c. AHRI 410 performance rated and certified.
 - d. Factory tested with air at 300 psig while immersed in an illuminated water tank.
 - e. Designed and tested in accordance with ASHRAE 15.
 - f. Coil shipped with end connections sealed and filled with a charge of dry nitrogen.
 - g. Coils designed for use with refrigerant type in associated refrigerant compressor.
 - 2. Coil Assembly:
 - a. Refrigerant Piping Connections:
 - 1) On same side of module.
 - 2) Extended a minimum of 5 inches beyond the exterior of the unit casing, by the manufacturer.
 - b. Coils removable from the unit at header end, unless shown otherwise on the Drawings.
 - c. Clearly label liquid and suction headers on outside of module.
 - 3. Refrigerant Circuiting:
 - a. Distributor arrangement as scheduled.
 - b. Alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions.
 - c. Refrigerant Distributors: Brass, replaceable nozzle type, connected to the coil by copper tubes.
 - 4. Fins:
 - a. Die-formed plate type, rippled for maximum heat transfer.
 - b. Continuous metal across coil casing; split fins not acceptable.
 - c. Shall have fully drawn collars and be mechanically bonded to tubes by mechanical expansion of tubes.
 - d. Material: Specified by manufacturer.
 - e. Fin density no greater than 12 fins per inch.
 - 5. Tubes:
 - a. Material: Specified by manufacturer.
 - b. Intermediate tube supports shall be supplied on coils over 44-inch fin length with an additional support every 42-inch multiple thereafter.
 - 6. Headers:
 - a. Located inside module.
 - b. Constructed from seamless copper tubing with die formed tube holes and brazed joints.

- c. Refrigerant Piping Connections: Terminate with OD sweat copper.
- 7. Casings:
 - a. Construct from minimum 16-gauge (0.0625-inch)
 - b. Formed end supports and top and bottom channels.
- 8. Drain Pan:
 - a. Construction in accordance with Paragraph, Module Drain Pans.
 - b. Furnish drain pan under each cooling coil.
 - c. Intermediate Drain Pan:
 - 1) Provide intermediate drain pans on all stacked cooling coils.
 - 2) Intermediate pan shall drain to main drain pan through a copper downspout.
- G. Access Module:
 - 1. Access module to allow improved access to air handling internal components.
 - 2. Casing constructed in accordance with Article Module Casing.
 - 3. Double wall, hinged, removable access doors on one side of module.
 - 4. Minimum depth of 16 inches, larger where shown on the Drawings.
- H. Filter Module:
 - 1. General:
 - a. Air filtration module, complete with filter media and filter racks.
 - b. Casing constructed in accordance with Article Module Casing.
 - c. Double wall, hinged, removable access doors on one side of module.
 - d. Maximum 500 fpm face velocity across filters.
 - 2. Media Schedule:
 - a. Main Filter:
 - 1) Vertical arrangement.
 - 2) Disposable Pleated Type.
 - 3. Media Construction:
 - a. General:
 - 1) Contain in a rigid frame.
 - 2) Meet UL Class 2 standards.
 - 3) Rigid supporting mesh across the leaving face of media.
 - 4) Quality certified by ISO 9001.
 - b. Preformed, Disposable Dry Extended Area Type: Rated at mean efficiency of 60 percent to 65 percent and average arrestance of 98 percent in accordance with ASHRAE 52.1, by ASHRAE Atmospheric Dust Test Method.
 - c. Disposable Pleated Type:
 - 1) Pleated panel disposable filters.

- 2) Nonwoven reinforced cotton/poly fabric media with a metal support grid and heavy duty beverage board-enclosing frame.
- 3) 2-inch thickness.
- 4) MERV 8 efficiency per ASHRAE 52.2.
- 5) Minimum 30 percent dust spot efficiency and 90 percent average arrestance in accordance with ASHRAE 52.1.
- 4. Frame and Filter Assembly:
 - a. Suitable for space indicated.
 - b. Permanent re-usable, side-loading 20-gauge (0.0625-inch) galvanized steel holding frame, retainer, and sealer frame.
 - c. Filter blank-offs to prevent air bypass around filters, same material as frame.
- 5. Manufacturers:
 - a. Farr.
 - b. Flanders.
 - c. Tri-Dim.
 - d. American Air Filter.
- I. Outside Air Intake Module:
 - 1. Weather Hood: Fully welded construction, fabricated from same material as unit casing.
 - 2. Louver: Drainable type, S-shaped rainproof blades, spaced 2 inches maximum.
 - 3. 1/2-inch mesh PVC-coated galvanized bird screen on inside face of louver.
- J. Control Dampers:
 - 1. Internally mounted ultra low leak dampers.
 - 2. Parallel blade action for two-position applications and opposed blade action for modulating applications.
 - 3. Construction: See the Drawing Schedule.
- K. Unit Electrical and Controls:
 - 1. General:
 - a. Electrical and control components shall meet requirements of Division 26 Electrical.
 - b. All electrical and controls components and assemblies UL or ETL listed and labeled.
 - c. Factory wired units shall bear an ETL or UL label with all necessary identification marks, electrical data, and cautions, as required by NEC.

- d. Provide as-built wiring diagrams and schematics for electrical and control systems, secured to inside of control panel door, or enclosed in plastic jackets placed inside control panel.
- e. For additional requirements, refer to Specification paragraphs for individual modules, and Section 23 09 00, Instrumentation and Control Devices for HVAC.
- 2. Factory Installed Disconnects:
 - a. Provide main electric power disconnect for unit.
 - b. Provide electric power lockable disconnect for each module containing electrical components.
 - c. Nonfused type.
- 3. Control Damper Actuators:
 - a. To suit factory installed control dampers.
 - b. Type: Electric, 120V factory installed, and wired to junction box.
 - c. Manufacturer: Belimo.
- 4. Factory Installed Control System.
- L. Manufacturers and Products:
 - 1. Trane.

2.06 MOTORS

- A. General:
 - 1. Provide integral manual reset or self-resetting overload protection on single-phase motors. Provide IEEE 841 motor, unless noted otherwise.
 - 2. Motors for fans specified for use with variable frequency drives shall be inverter duty type.
 - 3. Fan motors shall not operate into service factor in any case.
- B. Motor requirements shall be as follows unless designated otherwise on fan equipment schedule:
 - 1. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - 2. Winding Thermal Protection: None.
 - 3. Space Heater: No.
 - 4. Number of Speeds: Single.
 - 5. Number of Windings: One.
 - 6. Motor Efficiency: Energy efficient.
 - 7. Shaft Type: Solid, carbon steel.
 - 8. Mounting: As required for fan arrangement.

2.07 ACCESSORIES

- A. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear engraved or diestamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown.
- B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

2.08 SOURCE QUALITY CONTROL

- A. Factory Tests and Adjustments: Test equipment actually identical to that furnished.
- B. Testing Provisions:
 - 1. Provide tachometer access holes large enough to accept standard tachometer drive shaft.
 - 2. Center punch fan shaft to accommodate tachometer readings.
- C. Manufacturer's Tests:
 - 1. DX Coil Test: Leak tested under water with 300 psi air.
 - 2. Electrical Circuits:
 - a. Tested and checked as to proper function.
 - b. Perform dielectric strength test.
 - 3. Air Handling Unit Cabinet Tests:
 - a. Air Pressure Leak Testing: For modules under positive pressure located on discharge side of a fan, maximum permissible air leakage shall not exceed one percent of specified airflow, when subject to 8-inch water gauge differential pressure.
 - Panel Deflection Testing: For modules under negative pressure located on the suction side of the fan, maximum permissible panel deflection shall not exceed 1/200th of panel length, when subject to 8-inch water gauge differential pressure.
 - c. Leakage Test Failure Guarantee: Upon completion of leakage test, if unit does not meet specified performance for deflection or leakage, Owner may elect to have unit modified to meet specified performance or may request a credit according to performance failure.

- D. Acoustical Test:
 - 1. Perform factory noise tests in accordance with AMCA 300 and AMCA 301.
 - 2. Fan sound power levels (dB, Reference 10⁻¹² Watts) shall be no greater than scheduled values.
- E. Balancing:
 - 1. Completed fan assemblies shall be dynamically balanced to minimum grade of G 6.3 per AMCA 204 at design operating speed.
 - 2. Fans controlled by variable frequency drives shall be dynamically balanced at speeds 25 percent, 50 percent, 75 percent, and 100 percent of design RPM.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units level and plumb.
- B. Install floor-mounted units on concrete bases designed to withstand, without damage to equipment, the seismic force required by code.
- C. Secure vibration controls to concrete bases using anchor bolts cast in concrete base.
- D. Inspect internal casing insulation, seal all exposed edges, and butt joints with mastic to ensure insulation will not be loosened during operation.
- E. All condensate drain connections piped and trapped separately for proper drainage.
- F. Labeling: In accordance with Article Accessories.
- G. Service Access: Locate units to provide access spaces required for filter changing; motor, drive, and bearing servicing; and fan shaft and coil removal.
- H. Equipment Restraints:
 - 1. Restrain equipment against seismic forces as required by Code.
 - 2. Restrain equipment against wind loads as required by Code.
- I. Connections:
 - 1. Isolate sheet metal duct connections from all noninternally spring-isolated fan units or other rotating equipment.

- 2. Install ductwork adjacent to fans so as to allow proper service and maintenance.
- 3. Pipe drain pan connection through trap running to floor drain.

3.02 FIELD QUALITY CONTROL

- A. Functional Tests:
 - 1. Verify shipping blocking and bracing are removed.
 - 2. Verify unit is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.
 - 3. Verify proper thermal-overload protection is installed in motors, starters and disconnect switches.
 - 4. Verify cleaning and adjusting are complete.
 - 5. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.
 - 6. Reconnect fan drive system, align and adjust belts and install belt guards.
 - 7. Verify lubrication for bearings and other moving parts.
 - 8. Verify manual and automatic volume control and fire and smoke dampers in connected ductwork are in fully open position.
- B. Performance Tests:
 - 1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated rpm.
 - b. Measure and record motor voltage and amperage.
 - 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.

3.03 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate non-sealed bearings prior to startup.
- D. Air Balancing: Perform air system balancing as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.04 CLEANING

- A. On completion of installation, internally clean fans according to manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.
- B. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

END OF SECTION

SPLIT SYSTEM DX INDOOR UNITS 23 81 00.0					81 00.01								IN	IDOOR	UNITS									
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DX COOLING DATA	NET CAPACITY	BTU/HR					AC-3	ING BU	12,000	80	67	95	381	75	0.5	0.1	230	1	21 - 5/8	17	9 - 13/1	93	TRANE	MT12A
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A: HARD SHUTOFF TXV F: UNIT SUBBASE B: DUAL REFRIGERATION CIRCUITS G: ECONOMIZER C: HOT GAS REHEAT COL H: OVERHEAD SUSPENSION PACKAGE D: AIR DISCHARGE PLENUM I: PREMIUM ELECTRONIC THERMOSTAT E: RETURN-AIR GRILLE J: ELECTRO-MECHANICAL THERMOSTAT																								

SPLIT SYSTEM DX OUTDOOR UNITS 23 81 00.03													OUTD	OOR UN	NITS						
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DX HEATING DATA		BTI I/HP					CI1-2		20,000	80	12.7	1	3/2/1 /	230	1	13	33 - 1/16	35 - 1/9	126	TRANE	MX20A4
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B: CONDENSER HAIL GUARDS I: FACTORY INSTALLED ACCUMULATOR			ULATOR																		
C: 5-YEAR COMPRESSOR WARRANTY J: LOW-AMBIENT COOLING KIT																					
FOR EACH COMPRESSOR K: WALL-MOUNT KIT																					
D: DIP APPLIED ANTI-CORROSION COATING ON L: COMPRESSOR START ASSIST																					
CONDENSER COIL (NOT SPRAY APPLIED) M: CABINET CORROSION PROTECTION			CTION																		
E: COPPER CONDENSER COLLENS N: COMPRESSOR CYCLE DELAY																					
G: HOT GAS BYPASS ON LEAD COMPRESSOR P: LIQUID LINE FILTER DRIFE																					
Q: LIQUID SOLENOID VALVE																					

SECTION 23 84 00 HUMIDITY CONTROL EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Air-Conditioning, Heating, and Refrigeration Institute (AHRI): 410, Forced-Circulation Air-Cooling and Air-Heating Coils.
 - 2. Air Moving and Conditioning Association (AMCA): 300, Reverberant Room Method for Sound Testing of Fans.
 - 3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
 - a. 52.1, Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - b. 84, Method of Testing Air-to-Air Heat Exchangers.
 - c. 90.1 IP/SI, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 4. ASTM International (ASTM):
 - a. B117, Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - b. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - c. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning Plastics in a Horizontal Position.
 - d. D2370, Standard Test Method for Tensile of Organic Coatings.
 - e. D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 5. Canadian Standards Association (CSA).
 - 6. Electrical Test Laboratories (ETL).
 - 7. International Standards Organization (ISO): 9001, Quality Management Systems Requirements.
 - 8. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - b. 90B, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - c. 255, Standard Method of Test for Surface Burning Characteristics of Building Materials.

- 9. Nationally Recognized Testing Laboratories (NRTL).
- 10. UL: 1995, UL Standard for Safety Heating and Cooling Equipment.

1.02 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
 - 1. AC: Air Conditioning.
 - 2. COP: Coefficient of Performance.
 - 3. DX: Direct Expansion.
 - 4. EER: Energy Efficiency Ratio.
 - 5. HP: Heat Pump.
 - 6. IR: Infrared.
 - 7. LED: Light Emitting Diode.
 - 8. OSA: Outside Air.
 - 9. PSC: Permanent Split Capacitor.
 - 10. PTAC: Packaged Terminal Air Conditioner.
 - 11. SPST: Single Pole, Single Throw.
 - 12. TXV: Thermostatic Expansion Valve.
 - 13. UV: Ultraviolet.

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings.
 - Specifications, descriptive drawings, catalog cuts, and descriptive literature; include make, model, dimensions, weight of products, and electrical schematics for the following equipment:

 AC-1.
 - 3. Manufacturer's standard finish color selection for enclosure finishes.
 - 4. Complete performance data that indicates full compliance with Specifications:
 - a. Include fan sound power level data (ref. 10 watts to 12 watts) at design operating point, based on AMCA 300, Setup No. 1.
 - b. Include heating and cooling performance data at design operating conditions.
- B. Informational Submittals:
 - 1. Manufacturer's Certificate of Compliance, in accordance with Section air-conditioning units motors.
 - 2. Recommended procedures for protection and handling of equipment and materials prior to installation.

- 3. Detailed information on structural, mechanical, electrical, or other modifications necessary to adapt the arrangement or details shown to equipment furnished.
- 4. Operation and maintenance data.
- 5. Special guarantees.

1.04 QUALITY ASSURANCE

A. Heating and Cooling Equipment: Minimum operating efficiencies, defined as Coefficient of Performance (COP) and Energy Efficiency Ratio (EER), specified in Chapter 6 of ASHRAE 90.1 IP/SI.

1.05 SPECIAL GUARANTEE

- A. Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee.
- B. Special guarantee shall provide for correction, or at the option of Owner, removal and replacement of the Work specified in this Specification found defective during a period of 5 years after date of Substantial Completion.
- C. Duties and obligations for correction or removal and replacement of defective Work as specified in the General Conditions.

1.06 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:

Item	Quantity							
Filters	One complete set per unit							
Special tools required to maintain or dismantle	One complete set for each different size unit							

PART 2 PRODUCTS

2.01 GENERAL

A. Specified components of this section, including insulation, facings, mastics, and adhesives shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.

ROGER SCOTT POOL FACILITIES

2.02 EQUIPMENT SCHEDULES

A. Refer to the Drawings.

2.03 DEHUMIDIFIER, PACKAGED DX 100 PERCENT OSA

A. General:

- 1. Match with associated indoor unit.
- 2. Consisting of the following components:
 - a. Condenser coil.
 - b. Fan.
 - c. Motor.
 - d. Reciprocating or scroll compressor.
 - e. Refrigerant specialties.
 - f. Controls.
- 3. Contained in a weatherproof casing.
- 4. Bearing UL label.
- 5. Unit shall be designed to conform to ETL or CSA standards.
- 6. Coils shall be UL or CSA listed.
- 7. Fan motor and compressor shall be UL or CSA listed.
- 8. Refrigerant Pipe: Type L Copper; vinyl coated for corrosion prevention.
- 9. Units shall be completely factory assembled, wired, piped, precharged with R-410A, and fully tested in all modes of operation.
- 10. Controls shall be factory adjusted and preset to design conditions.
- 11. Test report shall be available on request. Engineer reserves the right to witness factory performance testing.
- 12. Manufacturer shall have a minimum of 5 years' experience in the production of dehumidification systems.
- B. Cabinet:
 - 1. Supported on steel full-length mounting rails.
 - 2. Removable access panels to internal components and electrical panel without impairing unit operation.
 - 3. Protective guards on each fan discharge and each coil inlet.
- C. Paint Finish: Manufacturer typical finish.
- D. Compressor: Manufacturer specified.
- E. Evaporator Coil:
 - 1. AHRI 410 rated.
 - 2. Designed for heavy moisture removal.

HUMIDITY CONTROL EQUIPMENT 23 84 00 - 4

- 3. Aluminum or Copper plate fins formed on multiple rows of seamless copper tubing arranged in a staggered tube configuration.
- 4. Tubes shall be mechanically expanded, firmly bonding tube to shoulder of each fin.
- F. Condenser Coil:
 - 1. Aluminum or Copper plate fins formed on multiple rows of seamless copper tubing arranged in a staggered tube configuration.
 - 2. Tubes shall be mechanically expanded, firmly bonding tube to shoulder of each fin.
- G. Condenser Fan and Motor: Manufacturer Specified.
- H. Evaporator Fan and Motor: Manufacturer Specified.
- I. Refrigerant Circuit:
 - 1. Manufacturer Specified.
 - 2. Compressor.
 - 3. Crankcase heater.
 - 4. Liquid line solenoid.
 - 5. Suction line accumulator.
 - 6. Condenser coil.
 - 7. Rubber mounted upflow propeller condenser fans.
 - 8. Connections for refrigerant piping and specialties.
 - 9. High latent heat evaporator coil.
 - 10. Thermal expansion valve.
 - 11. Filter drier.
 - 12. Sight glass moisture indicator.
 - 13. Suction line accumulator.
 - 14. Refrigerant pressure service valves.
- J. Controls:
 - 1. Compressor, fan, and fan motor contactors or starters with thermal protection (auto-reset) on all inductive loads.
 - 2. Overload protection in each leg.
 - 3. Control transformer.
 - 4. Complete with transducers, thermostats, and electrical control circuit factory pre-wired in the control panel.
 - 5. Terminal strip for connection of remote controls.
 - 6. Compressor winding and overheat protection.
 - 7. Hot gas bypass valve and compressor unloader shall provide capacity modulation of the first-stage cooling coil.

- 8. Refrigerant controls shall include a high pressure control (manual-reset), low pressure control (auto-reset), head pressure control, field adjustable refrigerant system lock-out, and compressor antishort cycle timer.
- K. Filters: 2-inch disposable type.
- L. Accessories: Provide as scheduled in Equipment Schedule.
- M. Manufacturers:
 - 1. Trane.
 - 2. Mitsubishi.

2.04 OUTDOOR UNIT, SPLIT SYSTEM DX COOLING SYSTEM

- A. General:
 - 1. Match with associated indoor unit.
 - 2. Consisting of the following components:
 - a. Condenser coil.
 - b. Fan.
 - c. Motor.
 - d. Reciprocating or scroll compressor.
 - e. Refrigerant specialties.
 - f. Controls.
 - 3. Contained in a weatherproof casing.
 - 4. Bearing the UL label.
 - 5. Design to conform to ETL or CSA standards.
 - 6. Coils shall be UL or CSA listed.
 - 7. Fan motor and compressor shall be UL or CSA listed.
 - 8. Refrigerant Pipe: Type L copper; vinyl coated for corrosion prevention.
 - 9. Units shall be completely factory assembled, wired, piped, precharged with R-410A, and fully tested in all modes of operation.
 - 10. Controls shall be factory adjusted and preset to design conditions.
 - 11. Test report shall be available on request. Engineer reserves right to witness factory performance testing.
 - 12. Manufacturer shall have a minimum of 5 years' experience in production of dehumidification systems.
- B. Cabinet:
 - 1. Supported on steel full-length mounting rails.
 - 2. Removable access panels to internal components and electrical panel without impairing unit operation.
 - 3. Protective guards on each fan discharge and each coil inlet.

HUMIDITY CONTROL EQUIPMENT 23 84 00 - 6 PW\JA\CITY OF PENSACOLA\D3754400 JUNE 8, 2024 ©COPYRIGHT 2024 JACOBS

- 4. Constructed of G-90 galvanized steel with minimum gauge of:
 - a. Base: 16 gauge (0.0625 in.).
 - b. Corner Posts and Tops: 18 gauge (0.0475 in.).
 - c. Access Panels: 20 gauge (0.0348 in.).
- 5. Paint internally and externally, as detailed below.
- C. Base:
 - 1. Unit base pan shall be poured with minimum 1/4-inch hot asphalt (tar) to prevent rain or condensate from contacting steel on the bottom of the base pan.
 - 2. Asphalt shall be poured prior to final factory assembly to assure protection of all steel areas.
- D. Paint Finish:
 - 1. Thoroughly clean exterior parts chemically, zinc-phosphate coat, and seal with chromic rinse.
 - 2. Electrically deposited by immersion dipping in a cationic electrodeposition paint system.
 - 3. Baked for a minimum of twenty minutes at 400 degrees F.
 - 4. Minimum paint film thickness of 1 mil.
 - 5. Finish shall meet or exceed a 1,000-hour salt spray test per ASTM B117.
- E. Hardware:
 - 1. Exterior Nuts, Bolts, and Washers: Type 304 stainless steel.
 - 2. Exterior Screws: Type 304 stainless steel or coated with an epoxy finish that meets or exceeds minimum 4,000-hour salt spray test per ASTM B117.
- F. Compressor:
 - 1. Hermetic type, scroll type suction gas cooled, suitable for refrigerant R-410A, equipped with internal thermal protection, and resilient type external mounting.
 - 2. Provide with crankcase heaters and motors equipped with internal overheat-overload protection.
 - 3. Compressor manufacturer shall have a wholesale outlet for replacement parts in nearest major city.
 - 4. Warranty: 5 years.

- G. Condenser Coil:
 - 1. Aluminum plate fins formed on multiple rows of seamless copper tubing arranged in a staggered tube configuration.
 - 2. Tubes shall be mechanically expanded, firmly bonding tube to shoulder of each fin.
- H. Condenser Fan and Motor:
 - 1. Fan: Propeller type, electronically balanced, and direct-driven by fan motor.
 - 2. Motor: Inherent protected, with sealed ball bearings that do not require lubrication.
 - 3. Outdoor air shall be discharged through a vinyl coated fan guard.
- I. Refrigerant Circuit:
 - 1. Spring mounted hermetic compressor.
 - 2. Crankcase heater.
 - 3. Liquid line solenoid.
 - 4. Suction line accumulator.
 - 5. Condenser coil.
 - 6. Rubber mounted upflow propeller condenser fans.
 - 7. Connections for refrigerant piping and specialties.
 - 8. Filter-drier.
 - 9. Sight glass-moisture indicator.
 - 10. Suction line accumulator.
 - 11. Refrigerant pressure service valves.
- J. Controls:
 - 1. Compressor and fan motor contactors or starters with thermal protection (auto-reset) on inductive loads.
 - 2. Overload protection in each leg.
 - 3. Complete with transducers, thermostats, and electrical control circuit factory prewired in control panel.
 - 4. Terminal strip for connection of remote controls.
 - 5. Compressor winding and overheat protection.
 - 6. Hot gas bypass valve and compressor unloader shall provide capacity modulation of the first-stage cooling coil.
 - 7. Refrigerant controls shall include a high pressure control (manual-reset), low pressure control (auto-reset), head pressure control, field adjustable refrigerant system lock-out, and compressor anti-short cycle timer.
- K. Manufacturer: Trane or Mitsubishi.

HUMIDITY CONTROL EQUIPMENT 23 84 00 - 8

2.05 FACTORY DIP-APPLIED PROTECTIVE COATING

A. General:

- 1. Factory dip-applied protective coating for application to plate fin and tube coils.
- 2. Coil factory assembled and tested before coating application.
- 3. Coating suitable for coils with maximum 30 fins per inch fin density. Bridging of product across coil fins is unacceptable.
- 4. After application and proper curing, product shall endure bending of coil assembly in standard manufacturing process without cracking.
- B. Use one of the following coating materials:
 - 1. Epoxy modified phenolic. Straight phenolic materials are not acceptable.
 - 2. Epoxy or epoxy-urethane.
 - 3. Polyelastomer: Complex chain linked polyelastomer material.
- C. Coating Process:
 - 1. Coil Inspection and Sealing:
 - a. Inspect coil for open tubes, headers, capillary tubes; repair as necessary.
 - b. Fill with dry nitrogen, cap and seal, to prevent contamination of internal coil surfaces with cleaning or coating solutions.
 - 2. Coil Cleaning:
 - a. Immerse coil in heated alkaline cleaning solution to remove lubricants, machining oils, and residual factory contamination.
 - b. Followed with immersion in potable water bath to neutralize and remove cleaning solution.
 - 3. Coating Application:
 - a. Immerse coil assembly in coating bath, including headers, casing, and heat exchange surfaces.
 - b. Coil shall be completely removed from equipment during coating application.
 - c. Spray-on coatings are not acceptable.
 - 4. Curing: Oven baked at a metal temperature not to exceed 400 degrees F.
 - 5. Quality Control: Free from voids, checks, cracks and blisters.
- D. Coil finish shall meet or exceed the following criteria:
 - 1. Salt Spray Test: In accordance with ASTM B117, minimum 3,000-hour duration, with no fin corrosion or degradation.
 - 2. Thermal Efficiency: Loss no greater than 1 percent after coating application.

- 3. UV inhibited life of minimum 10 years when exposed to sun in the State of Florida.
- E. Manufacturers and Products:
 - 1. Aero-Marine Engineering Inc.; Technicoat 10-1.
 - 2. AST ElectroFin Inc; ElectroFin.

2.06 ELECTRICAL

- A. General:
 - 1. Units shall include high and low voltage terminal block connections.
 - 2. Motor Starters/Contactors: Factory installed with equipment, unless otherwise noted.
 - 3. Disconnects: Factory installed nonfused disconnects or circuit breakers on each unit, unless otherwise noted.
- B. Motors:
 - 1. Unless otherwise stated, electric motors shall comply with the following:
 - a. Voltage, Phase, Horsepower, Synchronous Speed: Refer to Equipment Schedule for motor driven equipment.
 - b. Enclosure: ODP, unless specified otherwise.
 - c. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - d. Winding Thermal Protection: Manufacturer's standard.
 - e. Space Heater: Manufacturer's standard.
 - f. Multispeed Motors, Synchronous Speed, Number of Windings: Manufacturer's standard.
 - g. Motor Efficiency: Energy efficient.
 - h. Shaft Type: Solid, carbon steel.
 - i. Mounting: As required for fan arrangement.
 - j. Service Factor: 1.15.

2.07 ACCESSORIES

A. Equipment Identification Plates: Furnish 16-gauge stainless steel identification plate securely mounted on each separate equipment component and control panel in a readily visible location. Plate shall bear 3/8 or 1/4-inch high engraved or die-stamped block type black enamel filled equipment identification number and letters indicated in this Specification and as shown on the Drawings.

HUMIDITY CONTROL EQUIPMENT 23 84 00 - 10 B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

PART 3 EXECUTION

3.01 INSTALLATION

A. Filters: Install a complete set of filters in each unit before operating, and leave in place during startup and testing to keep equipment and ductwork clean.

3.02 ADJUSTING AND CLEANING

- A. Air System Balancing: As specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- B. Air Handlers:
 - 1. Lubricate nonsealed bearings prior to startup.
 - 2. Do not operate units until filters are installed. If operated without filters, completely clean coils and interior of units.
- C. Vibration:
 - 1. Statically and dynamically balance fan equipment.
 - 2. Perform field testing on rotating equipment, as specified in Section 23 05 93, Testing, Adjusting, and Balancing for HVAC, to determine actual operating vibration.
 - 3. If vibration limits described therein are exceeded, rebalance equipment in-place, if directed by Engineer, until design tolerances are met.

END OF SECTION

SECTION 26 00 00 SUMMARY OF ELECTRICAL WORK

PART 1 BACKGROUND

1.01 EXISTING

- A. Office/Ticket Building:
 - 1. This building is an elevated office building, with a basement area and a separate ticket booth.
 - 2. The basement area has an existing Office Main Breaker Panel, and conduit runs to office building branch circuits, main pool equipment circuits, main pool lighting and other circuits. The Office Main Breaker Panel also powers the shed building breaker panel and the bathroom building circuits.
 - 3. The sole 200A service meter and the associated disconnect are located between the ticket building and the office mounted on a utility pole. There are two circuits running out of the disconnect: to the Office Main Breaker Panel in the office basement, and to the Kid Pool PP1 Panel.
 - 4. Outside of the west wall of office, there is a small area with an overhanging roof for pool pumps and equipment. Existing control panels, switches, outlets, pool light transformers and a twist-lock outlet are some items located on the west wall.
 - 5. Two pool light transformers are located under the stairs that run up into office building.
 - 6. The office and ticket building are to be demolished and replaced with a joint office-ticket building in same location.
 - 7. The service meter is to be demolished when the new building is built, as well as the pole it is mounted on since the pole will be conflicting with location for the proposed office entrance ramp.
- B. Bathroom Building:
 - 1. The existing bathroom building was located on the South East corner of site, adjacent to the wading pool.
 - 2. Pool equipment was located on the outside south wall of building.
 - 3. Power to the bathroom building was supplied by the Office Main Breaker Panel. Power to some equipment located outside the south wall of building is supplied by PP1 at kid pool.
 - 4. The bathroom building has been demolished and replaced temporarily with portable bathroom trailers for the 2024 pool season. Trailers will be replaced with a new bathroom building in the 2025 construction process.

C. Shed Building:

- 1. There is a Shed building existing at the South area of site.
- 2. This Shed serves as a breakroom for the lifeguards, as well as a storage and a vending machine area.
- 3. The breaker panel located in the shed is supplied from the Office Main Breaker Panel.
- 4. The Shed breaker panel supplies power for shed building circuits, 4 pool lights, the sign on exterior of facility, some outside lighting and the wading pool filter pump.
- 5. The Shed building will be demolished but not replaced with new building.

1.02 PROPOSED

- A. Office/Ticket Building:
 - 1. A office and ticket building is to be constructed in place of the old one.
 - 2. The basement area is to be abandoned and filled in during new construction.
 - 3. A new 400A service meter panel and a disconnect will be located on the outside north wall of the new office building's electrical/maintenance room, and will be fed power from existing utility pole on north exterior of site.
 - 4. 2 new breaker panels to be constructed inside the electrical/mechanical room: MCB-1A (3-phase) and MCB-1B (1-phase).
 - a. MCB-1A will supply power to PP1 (Kid Pool), MCB-3A (New Bathroom Building Electrical Room), MCB-1B, and the 3-phase power required for main pool/office area equipment.
 - b. MCB-1A will receive power from disconnect on other side of wall via conduit run horizontal through wall.
 - 5. Outside of the west wall of the new office, the small area with overhanging roof, the existing pool pumps and equipment is to be reconnected to new office panels MCB-1A or MCB-1B. Existing control panels, switches, outlets, four pool light transformers and a twist-lock outlet is to be relocated on the west wall. All equipment to be at least 6 feet north of a new shower located at the south end on the west wall.
 - 6. The two pool light transformers located under stairs that run up into office building are to be relocated to west wall with four other transformers, and in-ground conduit runs are to be tied into new location to avoid tearing up the pool deck. This will require pulling new wire to the lights.
 - 7. A ticket area will be located inside the office building, and a bathroom will also be inside this office building.

- 8. Main power fed from the local utility will be connected to weatherhead above the meter on north wall. Follow the suppling utility (FPL) requirements for the meter and weatherhead.
- B. Bathroom Building:
 - 1. The new bathroom building will be located in same general location as the demolished bathroom building.
 - 2. The pool equipment located outside south wall of the bathroom building is to be preserved and not moved.
 - 3. Power to bathroom building to be supplied from the MCB-1A (Office Building Electrical Room) to new breaker panel MCB-3A located in the bathroom building electrical/maintenance room.
 - 4. MCB-3A will supply power to MCB-3B. MCB-3A is a 3-phase power panel.
 - 5. The bathroom building will have a men's restroom, women's restroom, and family restroom along with the electrical/maintenance room.
 - 6. Entrances to restrooms will be on north wall, and the maintenance/electrical room entrance is on the south wall.
 - 7. Bathroom building breaker panels will supply power to circuits previously powered by shed breaker panel that require power in this location.
- C. Shed Building:
 - 1. Shed building will cease to exist, and will be demolished and not replaced.
 - 2. All cables and raceways, except for the four pool lighting and the two sign power in-ground conduits, are to be demolished with the shed building. Remove the cable and cap the six in-ground conduits noted for later use.
 - 3. A new Utility Junction Cabinet is to be put in place on top of a concrete pad, furnished and installed by this contract, at the south side of the existing shed building location. This cabinet will house four pool light transformers, previously located on the shed wall, a photocell for the sign backlighting and a spare receptacle mounted on the outside of the cabinet.
 - 4. Existing in-ground conduit runs for pool lights and sign power to be preserved in-place, and this cabinet will be located on top of these conduits, where the enter/exit the ground. Power to this cabinet will be supplied from MCB-3B.

1.03 EXECUTION

- A. The following is a partial list of work to be performed. It is intended to be supplemental to highlight of some work details required. See the drawings and the specifications for the complete scope.
- B. Demolition Notes:
 - 1. Yard Lighting:
 - a. There are five light mounted on poles powered from the existing electrical panels. Contractor shall verify source/location of the existing power prior to demo and ensure power is restored to the lights as part of this work. These lights are identified by the large red circles in the Drawing below.



SUMMARY OF ELECTRICAL WORK 26 00 00 - 4

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- 2. Pool Lighting:
 - a. There are ten pool lights powered from ten transformers. Because the conduit runs are below the pol concrete deck, care must be taken to preserve these existing conduit runs so they can be reutilized. A sketch of the pool lighting is below. The contractor should verify this information prior to demo.



- 3. Partial list of the office Building Equipment to be preserved:
 - a. Motor Starters, existing pumps, blowers, specialized pool electrical equipment.
 - b. In-ground conduit runs to pool lights two location.
 - c. In-ground conduit run to Kid pool, PP1.
 - d. In-ground conduit runs to the outside, pole-mounted lighting.
 - e. Local control switches and specialized pool equipment mounted on the inside (basement) and the outside (under roof) West wall. Contractor should make careful notes and sketches of this equipment and its associated wiring to ensure it is properly re-wired when completing this work. Photo showing four switches that control the blower and pumps are shown below.


West Wall Office Building, outside under roof

- 4. Shed: In addition to the pool lighting, there are two conduit runs to the sign that should be preserved during demolition.
- 5. Motor Rotation: Motor rotation should be verified for all 3-phase motors including motors powered from Kid Pool PP1. A clear mark of the rotation direction should be made on the motor as needed. Submit the plans for checking motor rotation before project demolition and for project turnover/startup.
- C. Construction Notes:
 - 1. Coordinate with local utility (FPL) as needed in a timely manner.
 - 2. Upgrade the 200 amp incoming service to 400 amp.
 - 3. Install and wire up new weatherhead, meter service panel and main fused disconnect.
 - 4. Install ground rods per NEC requirements.
 - 5. The ground rods are to be bonded to the neutral in the disconnect housing. From the disconnect to MCB-1A the wiring is three phases, the neutral and the ground. All panels require separated grounds and neutrals.
 - 6. Pool and outside pole-mounted lights will need an additional conduit and new wire pulls as identified from pre-demolition checks. No belowground splices will be allowed.
 - 7. Furnish and install a disconnect for the following electrical-equipment connected by the new wiring:
 - a. 40 A 3 phase blower on the west side of the new office.
 - b. 60 A 3 phase 15 Hp pump on the west side of the new office.
 - c. 30 A 1 phase HVAC on the north side of the new office.

SUMMARY OF ELECTRICAL WORK 26 00 00 - 6

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- d. 20 A 1 phase grinder pump located on the north side of the new office.
- e. 25 A 1 phase HVAC on the east side of the new bathroom building.
- f. 35 A 3 phase HVAC on the east side of the new bathroom building.
- g. 20 A 1 phase Wading Pool Filter Pump on the south side of the new bathroom building.
- h. 15 A 1 phase indoor HVAC unit located in the new bathroom building.
- 8. Motor rotation should be check before turn-over of any panel. The owner or engineer should be given the opportunity to witness the rotational checks.

PART 2 GENERAL

2.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The completed Work will provide Owner with improvements to their electrical infrastructure as follows:
 - 1. Upgrade from 200A service to 400A service.
 - 2. Four new breaker panels: two in office building electrical room, and two in bathroom building electrical room.
 - 3. New power and branch circuits for the new office and bathroom buildings.
 - 4. All existing pool equipment, the street sign, pool lights and outdoor pole-mounted lights to be repowered as needed from the new panels.

END OF SECTION

SECTION 26 05 01 ELECTRICAL

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American Association of State Highway Transportation Officials (AASHTO).
 - 2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. A240/A240M, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
 - c. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - d. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - e. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
 - 3. Electronic Industries Association (EIA/TIA): 569, Commercial Building Standard for Telecommunications Pathways and Spaces.
 - 4. Federal Specifications (FS):
 - a. W-C-596, Connector, Electrical, Power, General Specification for.
 - b. W-S-896, Switch, Toggle (Toggle and Lock), Flush Mounted (General Specification).
 - 5. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - b. PC62.41.1, Draft Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - c. 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
 - d. 114, IEEE Standard Test Procedure for Single-Phase Induction Motors.
 - 6. International Electrical Testing Association (NETA): ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - 7. National Electrical Contractor's Association, Inc. (NECA): 1, Standard Practices for Good Workmanship in Electrical Contracting.

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- 8. National Electrical Manufacturers Association (NEMA):
 - a. C80.1, Rigid Steel Conduit-Zinc Coated.
 - b. C80.3, Electrical Metallic Tubing-Zinc Coated.
 - c. C80.6, Intermediate Metal Conduit-Zinc Coated (IMC).
 - d. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - e. ICS 1, Industrial Control and Systems: General Requirements.
 - f. MG 1, Motors and Generators.
 - g. PB 1, Panelboards.
 - h. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - i. ST 20, Dry Type Transformers for General Applications.
 - j. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - k. TC 3, PVC Fittings for Use with Rigid PVC Conduit and Tubing.
 - 1. WC 55, Instrumentation Cables and Thermocouple Wire.
 - m. WC 70, Standard for Non-Shielded Power Cables Rated 2000 V or Less for the Distribution of Electrical Energy.
 - n. WD 1, General Color Requirements for Wiring Devices.
- 9. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
- 10. UL:
 - a. 1, Flexible Metal Conduit.
 - b. 6, Electrical Rigid Metal Conduit—Steel.
 - c. 44, Thermoset Insulated Wires and Cables.
 - d. 62, Flexible Cord and Fixture Wire.
 - e. 67, Panelboards.
 - f. 98, Enclosed and Dead-Front Switches.
 - g. 198C, High Interrupting Capacity Fuses, Current Limiting Types.
 - h. 198E, Class R Fuses.
 - i. 360, Liquid-Tight Flexible Steel Conduit.
 - j. 486A, Wire Connectors and Soldering Lugs for Use with Copper Conductors.
 - k. 486C, Splicing Wire Connectors.
 - 1. 489, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - m. 510, Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
 - n. 514B, Fittings for Cable and Conduit.
 - o. 651, Schedule 40 and 80 PVC Conduit.
 - p. 797, Electrical Metallic Tubing.
 - q. 854, Service-Entrance Cables.
 - r. 870, Wireways, Auxiliary Gutters, and Associated Fittings.
 - s. 943, Ground-Fault Circuit Interrupters.
 - t. 1059, Terminal Blocks.
 - u. 1242, Intermediate Metal Conduit.

- v. 1449, Surge Protection Devices (SPDs).
- w. 1561, Dry-Type General Purpose and Power Transformers.
- x. 2111, Overheating Protection for Motors.

1.02 DEFINITIONS

- A. AHJ: Authority Having Jurisdiction.
- B. MCOV: Maximum Allowable Continuous Operating Voltage.
- C. MOV: Metal Oxide Varistor.
- D. SASD: Silicon Avalanche Suppressor Diode.
- E. SVR: Surge Voltage Rating.
- F. SPD: Surge Protective Device

1.03 SUBMITTALS

- A. Action Submittals:
 - 1. Service entrance and metering equipment.
 - 2. Boxes and device plates.
 - 3. Junction and pullboxes.
 - 4. Enclosures and panelboards.
 - 5. Circuit breakers and switches.
 - 6. Conduit, fittings, and accessories.
 - 7. Conductors, cable, and accessories.
 - 8. Grounding materials.
 - 9. Luminaires.
- B. Informational Submittals:
 - 1. Field test reports.
 - 2. Signed permits indicating Work is acceptable to regulatory authorities having jurisdiction.
 - 3. Operation and Maintenance Data:
 - a. Provide for all equipment, as well as each device having features that can require adjustment, configuration, or maintenance.
 - b. Minimum information shall include manufacturer's preprinted instruction manual, one copy of the approved submittal information for the item, tabulation of any settings, and copies of any test reports.

1.04 APPROVAL BY AUTHORITY HAVING JURISDICTION

- A. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.
- B. Materials and equipment manufactured within the scope of standards published by UL, shall conform to those standards and shall have an applied UL listing mark or label.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Products shall comply with all applicable provisions of NFPA 70.
 - B. Like Items of Equipment: End products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts, and manufacturer's service.
 - C. Equipment Finish:
 - 1. Manufacturer's standard finish color, except where specific color is indicated.
 - 2. If manufacturer has no standard color, finish equipment in accordance with color finish as approved by Engineer.

2.02 SERVICE ENTRANCE EQUIPMENT AND METERING

A. Equipment, installation arrangement, and scope of work shall be provided in accordance with requirements of the local electric utility.

2.03 OUTLET AND DEVICE BOXES

- A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.
- B. Cast Metal:
 - 1. Box: Cast ferrous metal.
 - 2. Cover: Gasketed, weatherproof, and cast ferrous metal with stainless steel screws.
 - 3. Hubs: Threaded.
 - 4. Lugs: Cast Mounting.

- 5. Manufacturers and Products, Nonhazardous Locations:
 - a. Crouse-Hinds; Type FS or FD.
 - b. Appleton; Type FS or FD.
- 6. Manufacturers and Products, Hazardous Locations:
 - a. Crouse-Hinds; Type GUA or EAJ.
 - b. Appleton; Type GR.
- C. PVC-Coated Cast Metal:
 - 1. Type: One-piece.
 - 2. Material: cast aluminum.
 - 3. Coating:
 - a. All Exterior Surfaces; 40 mils PVC.
 - b. All Interior Surfaces, 2 mils urethane.
 - 4. Manufacturers:
 - a. Robroy Industries.
 - b. Ocal.

2.04 JUNCTION AND PULL BOXES

- A. Outlet Boxes Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.
- B. Conduit Bodies Used as Junction Boxes: As specified under Article Conduit and Fittings.
- C. Large Sheet Steel Box:
 - 1. NEMA 250, Type 1.
 - 2. Box: Code-gauge, galvanized steel.
 - 3. Cover: Full access, screw type.
 - 4. Machine Screws: Corrosion-resistant.
- D. Large Cast Metal Box:
 - 1. NEMA 250, Type 4
 - 2. Box: Cast ferrous metal, electrogalvanized finished, with drilled and tapped conduit entrances and exterior mounting lugs.
 - 3. Cover: Nonhinged with clamps.
 - 4. Gasket: Neoprene.
 - 5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
 - 6. Manufacturers and Products, Surface Mounted Nonhinged Type:
 - a. Crouse-Hinds; Series W.
 - b. O-Z/Gedney; Series Y.
 - 7. Manufacturer and Product, Surface Mounted, Hinged Type: O-Z/Gedney; Series YW.

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- 8. Manufacturers and Products, Recessed Type:
 - a. Crouse-Hinds; Type WJBF.
 - b. O-Z/Gedney; Series YR.

2.05 WIRING DEVICES

- A. Switches:
 - 1. NEMA WD 1 and FS W-S-896.
 - 2. Industrial grade, totally enclosed, ac type, with quiet tumbler switches and screw terminals.
 - 3. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
 - 4. Rating: 20 amps, 120/277 volts.
 - 5. Color: Gray.
 - 6. Automatic grounding clip and integral grounding terminal on mounting strap.
 - 7. Manufacturers and Products:
 - a. Leviton; 1221 Series.
 - b. Bryant; 4901 Series.
 - c. Hubbell; 1221 Series.
- B. Receptacle, Single, Duplex and Quadplex:
 - 1. NEMA WD 1 and FS W-C-596.
 - 2. Specification grade, two-pole, three-wire grounding type with screw type wire terminals suitable for No. 10 AWG.
 - 3. High strength, thermoplastic base color.
 - 4. Color: Gray.
 - 5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
 - 6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
 - 7. One-piece mounting strap with integral ground contact (rivetless construction).
 - 8. Manufacturers and Products:
 - a. Arrow Hart; 5262 Series.
 - b. Leviton; 5262/5362 Series.
 - c. Bryant; 5262/5362 Series.
 - d. Hubbell; 5262/5362 Series.
- C. Receptacle, Ground Fault Circuit Interrupter:
 - 1. Duplex, listed Class A to UL Standard 943, tripping at 5 mA.
 - 2. Color: Gray.
 - 3. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
 - 4. Size: For 2-inch by 4-inch outlet boxes.

- 5. Standard Model: NEMA WD 1, with provisions for testing.
- 6. Feed-Through Model: NEMA WD 1, with provisions for testing.
- 7. Impact resistant nylon face.
- 8. Manufacturers:
 - a. Bryant.
 - b. Hubbell.
 - c. Leviton.
- D. Receptacle, Special-Purpose: Rating and number of poles as shown or as required for anticipated purpose.

2.06 DEVICE PLATES

- A. General: Sectional type plates not permitted.
- B. Plastic:
 - 1. Material: Specification grade, 0.10-inch minimum thickness, noncombustible, thermosetting.
 - 2. Color: To match associated wiring device.
 - 3. Mounting Screw: Oval-head metal, color matched to plate.
- C. Metal:
 - 1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
 - 2. Finish: ASTM A167, Type 302/304, satin.
 - 3. Mounting Screw: Oval-head, finish matched to plate.
- D. Engraved:
 - 1. Character Height: 1/4-inch.
 - 2. Filler: White.
- E. Weatherproof:
 - 1. For Receptacles, Damp Locations:
 - a. Gasketed, cast-aluminum, with individual cap over each receptacle opening.
 - b. Mounting Screw and Cap Spring: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; Type WLRD-1.
 - 2) Appleton; Type FSK-WRD.
 - 2. For Receptacles, Wet Locations:
 - a. Impact-resistant, nonmetallic, single-gang, horizontal-mounting, providing, while in-use, NEMA 3R rating.

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- b. Stainless steel mounting and hinge hardware.
- c. Lockable, paintable.
- d. Color: Gray.
- e. Manufacturers:
 - 1) Carlon.
 - 2) Leviton.
- 3. For Switches:
 - a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
 - b. Mounting Screw: Stainless steel.
 - c. Manufacturers and Products:
 - 1) Crouse-Hinds; DS-181 or DS-185.
 - 2) Appleton; FSK-1VTS or FSK-1VS.

2.07 LIGHTING AND POWER DISTRIBUTION PANELBOARD

- A. NEMA PB 1, NFPA 70, and UL 67.
- B. Panelboards and Circuit Breakers: Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- C. Short-Circuit Current Equipment Rating: Fully rated; series connected unacceptable.
- D. Rating: Applicable to a system with available short-circuit current of at least 10,000 amperes rms symmetrical at 120/240 volts. 22,000 ampere rating could be required based on utility transformer impedance.
- E. Cabinet:
 - 1. NEMA 250, Type 1.
 - 2. Material: Code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
 - 3. Wiring Gutter: Minimum 4-inch square; both sides, top and bottom.
 - 4. Front: Fastened with adjustable clamps.
 - a. Trim Size: As required by mounting.
 - b. Finish: Manufacturer's standard.
 - 5. Interior:
 - a. Factory assembled; complete with circuit breakers.
 - b. Spaces: Cover openings with easily removable metal cover.
 - 6. Door Hinges: Concealed.
 - 7. Locking Device:
 - a. Flush type.
 - b. Doors Over 30 inches in Height: Multipoint.
 - c. Identical keylocks, with two milled keys each lock.

- 8. Circuit Directory: Metal frame with transparent plastic face and enclosed card on interior of door.
- F. Bus Bar:
 - 1. Material: Copper full sized throughout length.
 - 2. Neutral: Insulated, rated same as phase bus bars with at least one terminal screw for each branch circuit.
 - 3. Ground: Copper, installed on panelboard frame, bonded to box with at least one terminal screw for each circuit.
 - 4. Lugs and Connection Points:
 - a. Suitable for either copper or aluminum conductors.
 - b. Solderless main lugs for main, neutral, and ground bus bars.
 - c. Subfeed or through-feed lugs as shown.
- G. Circuit Breakers:
 - 1. UL 489.
 - 2. Thermal-magnetic, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle.
 - 3. Type: Bolt-on circuit breakers in all panelboards.
 - 4. Multipole circuit breakers designed to automatically open all poles when an overload occurs on one pole.
 - 5. Do not use tandem or dual circuit breakers in normal single-pole spaces.
 - 6. Ground Fault Circuit Interrupter (GFCI): UL Class A GFCI, 5 mA trip, and 10,000 amps interrupting capacity circuit breakers. This rating may be increased after the short circuit calculations are final.
- H. Manufacturers:
 - 1. Eaton.
 - 2. ABB/GE.
 - 3. Square D Co./Schneider Electric
 - 4. Siemens

2.08 FUSED SWITCH, INDIVIDUAL, 0 TO 600 VOLTS

- A. UL 98 listed for use and location of installation.
- B. NEMA KS 1 and UL 98 Listed for application to system with available shortcircuit current of as specified amps rms symmetrical.
- C. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

- D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- E. Fuse mountings shall reject Class H fuses and accept only current-limiting fuses specified.
- F. Enclosure: As specified under Execution.
- G. Interlock: Enclosure and switch to prevent opening cover with switch in ON position.
- H. Manufacturers:
 - 1. Eaton.
 - 2. ABB/GE.
 - 3. Square D Co. / Schneider Electric.
 - 4. Siemens.

2.09 NONFUSED SWITCH, INDIVIDUAL, 0 TO 600 VOLTS

- A. NEMA KS 1.
- B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- C. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
- D. Enclosure: As specified under Execution.
- E. Interlock: Enclosure and switch to prevent opening cover with switch in the ON position.
- F. Manufacturers:
 - 1. Eaton.
 - 2. ABB/GE.
 - 3. Square D Co. / Schneider Electric.
 - 4. Siemens.

2.10 SWITCH, MOTOR-RATED

A. Type: Two- or three-pole, manual motor starting/disconnect switch without overload protection.

- B. Enclosure/Mounting and Rating:
 - 1. General Purpose:
 - a. Totally enclosed snap-action switch. Quick-make, slow-break design with silver alloy contacts. Listed UL 508.
 - b. General Purpose Rating: 30 amperes, 600V ac.
 - c. Minimum Motor Ratings:
 - 1) 2 hp for 120V ac, single-phase, two-pole.
 - 2) 3 hp for 240V ac, single-phase, two-pole.
 - d. Screw-type terminals.
- C. Manufacturers:
 - 1. General Purpose:
 - a. Bryant.
 - b. Hubbell.

2.11 FUSE, 0 TO 600 VOLTS

- A. Current-limiting, with 200,000 ampere rms interrupting rating.
- B. Provide to fit mountings specified with switches and features to reject Class H fuses.
- C. Feeder and Service Circuits, 0 to 250 Volt:
 - 1. Amperage: 0 to 600.
 - 2. UL 198E, Class RK-1, dual element, with time delay.
 - 3. Manufacturers and Products:
 - a. Bussmann; Type LPN-RK.
 - b. Littelfuse, Inc.; Type LLN-RK.

2.12 PUSHBUTTONS, INDICATING LIGHTS, AND SELECTOR SWITCHES

- A. Type: Heavy-duty, oiltight. Provide contact arrangements, colors, inscriptions, and functions as shown.
- B. Contact Rating: NEMA ICS 2, Type A600.
- C. Unless otherwise shown, provide the following features:
 - 1. Selector Switch Operating Lever: Standard.
 - 2. Indicating Lights: Push-to-test, transformer-type.
 - 3. Pushbutton Color:
 - a. ON or START: Red.
 - b. OFF or STOP: Green.

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- 4. Pushbuttons and selector switches lockable in OFF position where indicated.
- D. Legend Plate:
 - 1. Material: Aluminum.
 - 2. Engraving: Indicating specific function, or as shown.
 - 3. Letter Height: 7/64-inch.
- E. Manufacturers and Products:
 - 1. General Electric Co.; Type CR 104P.
 - 2. Square D Co.; Type T.
 - 3. Eaton; Type 10250T.

2.13 TERMINAL BLOCKS

- A. Type: UL 1059. Compression screw clamp, with current bar providing direct contact with wire and yoke, with individual rail mounted terminals. Marking system shall permit use of preprinted or field-marked tags.
- B. Yokes and Clamping Screws: Zinc-plated, hardened steel.
- C. Rating:600V ac.
- D. Manufacturers:
 - 1. Weidmuller, Inc.
 - 2. Ideal.

2.14 SUPPORT AND FRAMING CHANNELS

- A. Carbon Steel Framing Channel:
 - 1. Material: Rolled, mild strip steel, 12 gauge, ASTM A1011/A1011M, Grade 33.
 - 2. Finish: Hot-dip galvanized after fabrication.
- B. Stainless Steel Framing Channel: Rolled, ASTM A167, Type 316 stainless steel, 12 gauge.
- C. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Unistrut Corp.

2.15 NAMEPLATES

- A. Material: Laminated plastic.
- B. Attachment: Adhesive.
- C. Color: Black, engraved to a white core.
- D. Engraving:
 - 1. Devices and Equipment: Name or tag shown, or as required.
 - 2. Panelboards:
 - a. Designation.
 - b. Service voltage.
 - c. Phases.
 - 3. Minimum Requirement: Label metering and power distribution equipment, local control panels, junction boxes, motor controls, and transformers.
- E. Letter Height:
 - 1. Pushbuttons, Selector Switches, and Other Devices: 1/8-inch.
 - 2. Equipment and Panelboards: 1/4-inch.

2.16 SURGE PROTECTIVE DEVICES (SPD) EQUIPMENT

- A. General:
 - 1. Units shall be suitable for the service voltage and configuration (phases and wires) shown.
 - 2. Protection Modes:
 - a. Normal, differential, and common.
 - b. Bipolar or bi-directional.
 - 3. Ratings: Short-circuit current rating shall equal or exceed that of protected distribution equipment. Surge Voltage Rating (SVR) shall not exceed those specified under UL 1449 for the associated nominal system voltage. Maximum Allowable Continuous Operating Voltage (MCOV) shall be at least 115 percent of the nominal system voltage.
 - 4. Unit shall be UL-listed.
 - 5. Provide status indicators for unit ON-LINE and unit operation NORMAL.
 - 6. Provide common alarm contact output.
 - 7. Provide fusible disconnect switch (integral with TVSS unit, where available) where not shown connected via branch circuit device of protected distribution equipment.

- 8. Minimum Enclosure Rating: NEMA 250, Type 2. Provide Type 4/4X for outdoor or wet locations.
- B. Type 1 SPD:
 - 1. Requirements: High surge current device designed for location/exposure Category C3, per IEEE C62.41. Provide surge current rating per phase as shown. Unit shall utilize symmetrically balanced Metal Oxide Varistor (MOV) technology.
 - 2. Manufacturer and Product: Transtector; Model Aegis SP.
- C. Type 2 SPD:
 - 1. Requirements: Designed for critical loads at service equipment (Category C3/B3) or distribution panelboard (Category C2/B3) locations. Unit shall utilize voltage-matched Silicon Avalanche Suppressor Diode (SASD) technology. Unit shall utilize modular, plug-in suppressor design.
 - 2. Manufacturer and Product: Transtector; Model Apex III (nonservice entrance distribution panelboard) or Apex IV (service equipment).
- D. Type 3 SPD:
 - 1. Requirements: Designed for noncritical loads at distribution panelboards with location/exposure Category C3. Unit shall utilize symmetrically balanced Metal Oxide Varistor (MOV) technology. Unit shall utilize modular, plug-in suppressor design.
 - 2. Manufacturer and Product: Transtector; Model SPD.

2.17 CONDUIT AND FITTINGS

- A. Rigid Galvanized Steel Conduit (RGS):
 - 1. Meet requirements of NEMA C80.1 and UL 6.
 - 2. Material: Hot-dip galvanized, with chromated protective layer.
- B. Intermediate Metal Conduit (IMC):
 - 1. Meet requirements of NEMA C80.6 and UL 1242.
 - 2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.
- C. Electrical Metallic Tubing (EMT):
 - 1. Meet requirements of NEMA C80.3 and UL 797.

- 2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.
- D. PVC Schedule 40 Conduit:
 - 1. Meet requirements of NEMA TC 2 and UL 651.
 - 2. UL listed for concrete encasement, underground direct burial, concealed, or direct sunlight exposure, and 90 degrees C insulated conductors.
- E. PVC-Coated Rigid Galvanized Steel Conduit:
 - 1. Meet requirements of NEMA RN 1.
 - 2. Material:
 - a. Meet requirements of NEMA C80.1 and UL 6.
 - b. Exterior Finish : PVC coating, 40 mils nominal thickness, bond to metal shall have tensile strength greater than PVC.
 - c. Interior finish: Urethane coating, 2 mils nominal thickness.
 - 3. Threads: Hot-dipped galvanized and factory coated with urethane.
 - 4. Bendable without damage to either interior or exterior coating.
- F. Flexible Metal, Liquid-Tight Conduit:
 - 1. UL 360 listed for 105 degrees C insulated conductors.
 - 2. Material: Galvanized steel, with an extruded PVC jacket.
- G. Fittings:
 - 1. Provide bushings, grounding bushings, conduit hubs, conduit bodies, couplings, unions, conduit sealing fittings, drain seals, drain/breather fittings, expansion fittings, and cable sealing fittings, as applicable.
 - 2. Rigid Galvanized Steel and Intermediate Metal Conduit:
 - a. Meet requirements of UL 514B.
 - b. Type: Threaded, galvanized.
 - 3. Electrical Metallic Tubing:
 - a. Meet requirements of UL 514B.
 - b. Type: Steel body and locknuts with steel or malleable iron compression nuts. Setscrew and drive-on fittings not permitted.
 - c. Electro zinc-plated inside and out.
 - d. Raintight.
 - 4. PVC Conduit:
 - a. Meet requirements of NEMA TC 3.
 - b. Type: PVC, slip-on.
 - 5. PVC-Coated Rigid Galvanized Steel Conduit:
 - a. Meet requirements of UL 514B.

- b. Fittings: Rigid galvanized steel type, PVC-coated by conduit manufacturer.
- c. Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC-coated by conduit manufacturer.
- d. Finish: 40-mil PVC exterior, 2-mil urethane interior.
- e. Overlapping pressure sealing sleeves.
- f. Conduit Hangers, Attachments, and Accessories: PVC-coated.
- g. Manufacturers:
 - 1) Robroy Industries.
 - 2) Ocal.
- h. Expansion Fitting Manufacturer and Product: Ocal; Ocal-Blue XJG.
- 6. Flexible Metal, Liquid-Tight Conduit:
 - a. Metal insulated throat connectors with integral nylon or plastic bushing rated for 105 degrees C.
 - b. Insulated throat and sealing O-rings.

2.18 CONDUCTORS AND CABLES

- A. Conductors 600 Volts and Below:
 - 1. Conform to applicable requirements of NEMA WC 71, WC 72, and WC 74.
 - 2. Conductor Type:
 - a. 120-Volt Lighting, No. 10 AWG and Smaller: Solid copper.
 - b. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
 - c. All Other Circuits: Stranded copper.
 - 3. Insulation: Type THHN/THWN. XHHW-2 for #6AWG or larger.
 - 4. Direct Burial and Aerial Conductors and Cables:
 - a. Type USE/RHH/RHW insulation, UL 854 listed or Type RHW-2/USE-2.
 - b. Conform to physical and minimum thickness requirements of NEMA WC 70.

B. Accessories:

- 1. Tape:
 - a. General Purpose, Flame Retardant: 7 mils, vinyl plastic, Scotch Brand 33, rated for 90 degrees C minimum, meeting requirements of UL 510.
 - b. Flame Retardant, Cold and Weather Resistant: 8.5 mils, vinyl plastic, Scotch Brand 88.

- c. Arc and Fireproofing:
 - 1) 30 mils, elastomer.
 - 2) Manufacturers and Products:
 - a) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - b) Plymount; Plyarc 53, with Plyglas 77 glass cloth tapebinder.
- 2. Identification Devices:
 - a. Sleeve-type, permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturer and Products: Raychem; Type D-SCE or ZH-SCE.
- 3. Connectors and Terminations:
 - a. Nylon, Self-Insulated Crimp Connectors:
 - 1) Manufacturers and Products:
 - a) Thomas & Betts; Sta-Kon.
 - b) Burndy; Insulug.
 - c) ILSCO.
- 4. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. Plated steel, square wire springs.
 - b. UL Standard 486C.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
- 5. Cable Lugs:
 - a. In accordance with NEMA CC 1.
 - b. Rated 600 volts of same material as conductor metal.
 - c. Uninsulated Crimp Connectors and Terminators:
 - Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - 2) Manufacturers and Products:
 - a) Thomas & Betts; Color-Keyed.
 - b) Burndy; Hydent.
 - c) ILSCO.
 - d. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - 1) Manufacturers and Products:
 - a) Thomas & Betts; Locktite.
 - b) Burndy; Quiklug.
 - c) ILSCO.
- 6. Cable Ties:
 - a. Nylon, adjustable, self-locking, and reusable.
 - b. Manufacturer and Product: Thomas & Betts; TY-RAP.
- 7. Heat Shrinkable Insulation:
 - a. Thermally stabilized, crosslinked polyolefin.
 - b. Manufacturer and Product: Thomas & Betts; SHRINK-KON.

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2.19 GROUNDING

- A. Ground Rods: Provide a minimum at each location of two copper or copper-clad with minimum diameter of 5/8-inch, and minimum length of 20 feet.
- B. Ground Conductors: As specified in Section 26 05 05, Conductors, paragraph Conductors and Cable.
- C. Connectors:
 - 1. Exothermic Weld Type:
 - a. Outdoor Weld: Suitable for exposure to elements or direct burial.
 - b. Indoor Weld: Use low-smoke, low-emission process.
 - c. Manufacturers:
 - 1) Erico Products, Inc.; Cadweld and Cadweld Exolon.
 - 2) Thermoweld.
 - 2. Compression Type:
 - a. Compress-deforming type; wrought copper extrusion material.
 - b. Single indentation for conductors 6 AWG and smaller.
 - c. Double indentation with extended barrel for conductors 4 AWG and larger.
 - d. Single barrels prefilled with oxide-inhibiting and antiseizing compound.
 - e. Manufacturers:
 - 1) Burndy Corp.
 - 2) Thomas and Betts Co.
 - 3) ILSCO.

2.20 LUMINAIRES AND ACCESSORIES

A. Specific requirements relating to fixture type, lamp type, and mounting hardware are provided in the Luminaire Schedule on the Drawings.

2.21 LIGHTING CONTROL

- A. Photocell:
 - 1. Automatic ON/OFF switching photo control.
 - 2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
 - 3. Setting: ON at dusk and OFF at dawn.
 - 4. Time delay feature to prevent false switching.
 - 5. Field adjustable to control operating levels.

- 6. Manufacturers:
 - a. Tork.
 - b. Paragon Electric Company.

PART 3 EXECUTION

3.01 GENERAL

- A. Install materials and equipment in accordance with manufacturer's instructions and recommendations.
- B. Work shall comply with all applicable provisions of NECA 1.
- C. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

3.02 DEMOLITION

- A. General Demolition:
 - 1. Where shown, de-energize and disconnect nonelectrical equipment for removal by others.
 - 2. Where shown, de-energize, disconnect, and remove electrical equipment.
 - 3. Remove affected circuits and raceways back to serving panelboard or control panel. Where affected circuits are consolidated with others, remove raceways back to first shared condulet or box. Where underground or embedded raceways are to be abandoned, remove raceway to 1-inch below surface of structure or 12 inches belowgrade and restore existing surface.
 - 4. Client has a right of refusal for any electrical equipment.

3.03 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation.
- B. Cap conduit runs during construction with manufactured seals.
- C. Close openings in boxes or equipment during construction.
- D. Energize space heaters furnished with equipment.

3.04 SERVICE ENTRANCE EQUIPMENT AND METERING

A. Unless otherwise specified or shown, schedule and coordinate work of serving utility as required to provide electric service to the Work.

B. Provide weatherhead at height specified by providing utility, at location indicated and with wiring to meet providing utility's requirements.

3.05 OUTLET AND DEVICE BOXES

- A. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.
- B. Size:
 - 1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
 - a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
 - 2. Ceiling Outlet: Minimum 4-inch octagonal sheet steel device box, unless otherwise required for installed fixture.
 - 3. Switch and Receptacle: Minimum 2-inch by 4-inch sheet steel device box.
- C. Locations:
 - 1. Drawing locations are approximate.
 - 2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
 - 3. Light Switch: Install on lock side of doors.
- D. Mounting Height:
 - 1. General:
 - a. Dimensions given to centerline of box.
 - b. Where specified heights do not suit building construction or finish, mount as directed by Engineer.
 - 2. Switches: 48 inches above floor.
 - 3. Thermostat: 54 inches above floor.
 - 4. Telephone Outlet: 6 inches above counter tops or 15 inches above floor.
 - 5. Wall Mounted Telephone Outlet: 52 inches above floor.
 - 6. Receptacles:
 - a. General Indoor Areas: 15 inches above floor.
 - b. General Indoor Areas (Counter Tops): Install device plate bottom or side flush with top of splashback, or 6 inches above counter tops without splashback.
 - c. Industrial Areas, Workshops: 48 inches above floor.
 - d. Outdoor, All Areas: 24 inches above finished grade.
- E. Install plumb and level.

- F. Flush Mounted:
 - 1. Install with concealed conduit.
 - 2. Install proper type extension rings or plaster covers to make edges of boxes flush with finished surface.
- G. Support boxes independently of conduit by attachment to building structure or structural member.
 - 1. Indoor Wet Locations:
 - a. Exposed Raceways: Cast metal.
 - b. Concealed Raceways: Cast metal.
 - 2. Cast-in-Place Concrete Slabs: Sheet steel.
- H. Box Type, Corrosive Locations (PVC-Coated rigid Galvanized Steel Raceway System): PVC-coated cast metal with matching cover.

3.06 JUNCTION AND PULL BOXES

- A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.
- B. Install pull boxes where necessary in raceway system to facilitate conductor installation.
- C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.
- D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.
- E. Use conduit bodies as junction and pull boxes where no splices are required and their use is allowed by applicable codes.
- F. Installed boxes shall be accessible.
- G. Do not install on finished surfaces.
- H. Install plumb and level.
- I. Support boxes independently of conduit by attachment to building structure or structural member.
- J. At or Belowgrade:
 - 1. Install boxes for belowgrade conduit flush with finished grade in locations outside of paved areas, roadways, or walkways.

- 2. If adjacent structure is available, box may be mounted on structure surface just above finished grade in accessible but unobtrusive location.
- 3. Obtain Engineer's written acceptance prior to installation in paved areas, roadways, or walkways.
- 4. Use boxes and covers suitable to support anticipated weights.
- K. Flush Mounted:
 - 1. Install with concealed conduit.
 - 2. Holes in surrounding surface shall be no larger than required to receive box.
 - 3. Make edges of boxes flush with final surface.
- L. Mounting Hardware:
 - 1. Noncorrosive Indoor Dry Areas: Galvanized.
 - 2. Outdoor or Noncorrosive Indoor Wet Areas: Stainless steel.
 - 3. Corrosive Areas: Stainless steel.
- M. Location/Type:
 - 1. Indoor, Dry: NEMA 250, Type 1.
 - 2. Indoor and Outdoor, Wet: NEMA 250, Type 4.
 - 3. Indoor and Outdoor, Wet and Corrosive: NEMA 250, Type 4X, stainless steel.
 - 4. Indoor and Outdoor, Wet, Dust, or Oil: NEMA 250, Type 13.
 - 5. Underground Conduit: Concrete.
 - 6. Corrosive: NEMA 250, Type 4X, stainless steel.
 - 7. Outdoor, Where Indicated Weatherproof (WP): NEMA 250, Type 3R.
 - 8. Industrial Use in Areas Not Otherwise Classified: NEMA 250, Type 12, unless otherwise shown.

3.07 PRECAST HANDHOLES

- A. Do not install until final raceway grading has been determined.
- B. Install such that raceways enter at nearly right angles and as near as possible to one end of wall, unless otherwise shown.

3.08 WIRING DEVICES

- A. Switches:
 - 1. Mounting Height: See Article Outlet and Device Boxes.
 - 2. Install with switch operation in vertical position.

- 3. Install single-pole, two-way switches such that toggle is in up position when switch is on.
- B. Receptacles:
 - 1. Install with grounding slot down, except where horizontal mounting is shown, in which case install with neutral slot down.
 - 2. Weatherproof Receptacles:
 - a. Install in cast metal box.
 - b. Install such that hinge for protective cover is above receptacle opening.
 - 3. Ground Fault Interrupter: Install feed-through model at locations where ground fault protection is specified for "downstream" conventional receptacles.
 - 4. Special-Purpose Receptacles: Install in accordance with manufacturer's instructions.

3.09 DEVICE PLATES

- A. Securely fasten to wiring device; ensure a tight fit to box.
- B. Flush Mounted: Install with all four edges in continuous contact with finished wall surfaces without use of mats or similar materials. Plaster fillings will not be acceptable.
- C. Surface Mounted: Plate shall not extend beyond sides of box, unless plates have no sharp corners or edges.
- D. Install with alignment tolerance to box of 1/16-inch.
- E. Engrave with designated titles.
- F. Types (Unless Otherwise Shown):
 - 1. Outdoor: Weatherproof.
 - 2. Indoor:
 - a. Flush Mounted Boxes: Metal.
 - b. Surface Mounted, Metal Boxes: Cast.

3.10 PANELBOARDS

- A. Install securely, plumb, in-line and square with walls.
- B. Install top of cabinet 6 feet above floor, unless otherwise shown.
- C. Provide typewritten circuit directory for each panelboard.

ROGER SCOTT POOL FACILITIES

- D. Cabinet Location/Type:
 - 1. Indoor Dry: NEMA 250, Type 1.
 - 2. Wet or Outdoor: NEMA 250, Type 3R, Outdoor.
 - 3. Industrial Use in Areas Not Otherwise Classified: NEMA 250, Type 12, unless otherwise shown.

3.11 CIRCUIT BREAKERS AND SWITCHES

- A. Location and Enclosure Type:
 - 1. Wet or Outdoor: NEMA 250, Type 4.
 - 2. Corrosive: NEMA 250, Type 4X.
 - 3. Wet and Corrosive: NEMA 250, Type 4X.
 - 4. Indoor Dry, Industrial Use: NEMA 250, Type 12.
 - 5. Indoor Dry, General Purpose: NEMA 250, Type 1.
 - 6. Where Denoted WP: NEMA 250, Type 3R.

3.12 SWITCH, MOTOR RATED

- A. Install with switch operation in vertical position such that toggle is in up position when ON.
- B. Install within sight of motor when used as a disconnect switch.
- C. Mounting Height: See Article Outlet and Device Boxes.
- D. Enclosure Type:
 - 1. General Purpose: See Articles Outlet and Device Boxes and Device Plates.
 - 2. Explosion-proof: See product specification.

3.13 NAMEPLATES

A. Provide identifying nameplate on all equipment.

3.14 SURGE PROTECTION DEVICE (SPD) EQUIPMENT

- A. Install in accordance with manufacturer's instructions, including lead length, overcurrent protection, and grounding.
- 3.15 CONDUIT AND FITTINGS
 - A. General:
 - 1. Crushed or deformed raceways not permitted.

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- 2. Maintain raceway entirely free of obstructions and moisture.
- 3. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.
- 4. Sealing Fittings: Provide drain seal in vertical raceways where condensate may collect above sealing fitting.
- 5. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.
- 6. Group raceways installed in same area.
- 7. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.
- 8. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.
- 9. Block Walls: Do not install raceways in same horizontal course with reinforcing steel.
- 10. Install watertight fittings in outdoor, underground, or wet locations.
- 11. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.
- 12. Metal conduit to be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.
- 13. Do not install raceways in concrete equipment pads, foundations, or beams.
- 14. Horizontal raceways installed under floor slabs shall lie completely under slab, with no part embedded within slab.
- 15. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.
- 16. Install conduits for fiber optic cables, telephone cables, and Category 5 data cables in strict conformance with the requirements of EIA/TIA 569.
- B. Installation in Cast-in-Place Structural Concrete:
 - 1. Minimum cover 2 inches, including all fittings.
 - 2. Conduit placement shall not require changes in reinforcing steel location or configuration.
 - 3. Provide nonmetallic support during placement of concrete to ensure raceways remain in position.
 - 4. Conduit larger than 1-inch shall not be embedded in concrete slabs, walls, foundations, columns or beams, unless approved by Engineer.
 - 5. Slabs and Walls:
 - a. Trade size of conduit not to exceed one-fourth of the slab or wall thickness.
 - b. Install within middle two-fourths of slab or wall.
 - c. Separate conduit less than 2-inch trade size by a minimum ten times conduit trade size, center-to-center, unless otherwise shown.

- d. Separate conduit 2 inches and greater trade size by a minimum eight times conduit trade size, center-to-center, unless otherwise shown.
- e. Cross conduit at an angle greater than 45 degrees, with minimum separation of 1-inch.
- f. Separate conduit by a minimum six times the outside dimension of expansion and deflection fittings at expansion joints.
- g. Conduit shall not be installed below the maximum water surface elevation in walls of water holding structures.
- 6. Columns and Beams:
 - a. Trade size of conduit not to exceed one-fourth of beam thickness.
 - b. Conduit cross-sectional area not to exceed 4 percent of beam or column cross section.
- C. Conduit Application:
 - 1. Diameter:
 - a. Interior Minimum: 1/2-inch.
 - b. Exterior Minimum: 3/4-inch.
 - 2. Outdoor, Exposed: Rigid galvanized steel.
 - 3. Indoor, Exposed: Rigid galvanized steel.
 - 4. Indoor, Concealed (Not Embedded in Concrete): Rigid galvanized steel.
 - 5. Aboveground, Embedded in Concrete Walls, Ceilings, or Floors: Intermediate metal.
 - 6. Direct Earth Burial: PVC Schedule 40.
 - 7. Under Slabs-On-Grade: PVC Schedule 40.PVC-coated rigid galvanized steel.
 - 8. Corrosive Areas: PVC-coated rigid galvanized steel.
- D. Connections:
 - 1. For motors-, wall-, or ceiling-mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:
 - a. General: Flexible metal, liquid-tight conduit.
 - b. Hazardous Areas: Flexible coupling suitable for Class I, Division 1 and 2 areas.
 - c. Wet or Corrosive Areas: Flexible metal liquid-tight.
 - d. Length: 18 inches minimum, 60 inches maximum, sufficient to allow movement or adjustment of equipment.
 - 2. Lighting Fixtures in Dry Areas: Flexible metal, liquid-tight conduit.
 - 3. Outdoor areas, process areas exposed to moisture, and areas required to be oiltight and dust-tight: Flexible metal, liquid-tight conduit.
 - 4. Transition From Underground or Concrete Embedded to Exposed: PVC-coated rigid steel conduit.

- 5. Under Equipment Mounting Pads: Rigid galvanized steel.
- 6. Exterior Light Pole Foundations: Rigid galvanized steel.
- E. Penetrations:
 - 1. Make at right angles, unless otherwise shown.
 - 2. Notching or penetration of structural members, including footings and beams, not permitted.
 - 3. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating using fire penetration seal as specified in Section 07 92 00, Joint Sealants.
 - 4. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack.
 - 5. Entering Structures:
 - a. General: Seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the entrance of gases or liquids from one area to another.
 - b. Concrete Roof or Membrane Waterproofed Wall or Floor: Provide watertight seal.
 - c. Heating, Ventilating, and Air Conditioning Equipment:
 - 1) Penetrate equipment in area established by manufacturer.
 - 2) Terminate conduit with flexible metal conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.
 - Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
 - d. Corrosive-Sensitive Areas:
 - 1) Seal all conduit passing through chlorine room walls.
 - 2) Seal conduit entering equipment panelboards and field panels containing electronic equipment.
 - 3) Seal penetration with Type 5 sealant, as specified in Section 07 92 00, Joint Sealants.
 - e. Existing or Precast Wall (Underground): Core drill wall and install watertight entrance seal device.
 - f. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
 - 1) Provide Schedule 40 galvanized pipe sleeve or watertight entrance seal device.
 - 2) Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint on each side.
 - g. Handholes:
 - 1) Metallic Raceways: Provide insulated grounding bushings.
 - 2) Nonmetallic Raceways: Provide bell ends flush with wall.

- F. Support:
 - 1. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 10 feet. Do not support from piping, pipe supports, or other raceways.
 - 2. Application/Type of Conduit Strap:
 - a. Steel Conduit: Zinc-coated steel, pregalvanized steel, or malleable iron.
 - b. PVC-Coated Rigid Steel Conduit: PVC-coated metal.
 - c. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.
 - 3. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:
 - a. Hollow Masonry Units: Toggle bolts.
 - b. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
 - c. Steelwork: Machine screws.
 - d. Location/Type of Hardware:
 - 1) Dry, Noncorrosive Areas: Galvanized.
 - 2) Wet, Noncorrosive Areas: Stainless steel.
 - 3) Corrosive Areas: Stainless steel.
- G. Bends:
 - 1. Install concealed raceways with a minimum of bends in the shortest practical distance.
 - 2. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches minimum.
 - 3. Install with symmetrical bends or cast metal fittings.
 - 4. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.
 - 5. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.
 - 6. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run and raceways are same size.
 - 7. PVC Conduit:
 - a. Bends 30 Degrees and Larger: Provide factory-made elbows.
 - b. Use manufacturer's recommended method for forming smaller bends.
 - 8. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

- H. Expansion and Deflection Fittings: Provide on all raceways at structural expansion joints and in long tangential runs.
- I. PVC Conduit:
 - 1. Solvent Welding:
 - a. Provide manufacturer recommended solvent; apply to all joints.
 - b. Install such that joint is watertight.
 - 2. Adapters:
 - a. PVC to Metallic Fittings: PVC terminal type.
 - b. PVC to Rigid Metal Conduit or IMC: PVC female adapter.
 - 3. Belled-End Conduit: Bevel the unbelled end of the joint prior to joining.
- J. PVC-Coated Rigid Steel Conduit:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. All tools and equipment used in the cutting, bending, threading, and installation of PVC-coated rigid steel conduit shall be designed to limit damage to the PVC coating.
 - 3. Provide PVC boot to cover all exposed threading.
- K. Termination at Enclosures:
 - 1. Cast Metal Enclosure: Provide manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.
 - 2. Nonmetallic, Cabinets, and Enclosures: Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.
 - 3. Sheet Metal Boxes, Cabinets, and Enclosures:
 - a. Rigid Galvanized and Intermediate Metal Conduit:
 - 1) Provide one lock nut each on inside and outside of enclosure.
 - 2) Install grounding bushing.
 - 3) Provide bonding jumper from grounding bushing to equipment ground bus or ground pad; if neither ground bus nor pad exists, connect jumper to lag bolt attached to metal enclosure.
 - 4) Install insulated bushing on ends of conduit where grounding is not required.
 - 5) Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
 - 6) Utilize sealing locknuts or threaded hubs on outside of NEMA 3R and NEMA 12 enclosures.
 - 7) Terminate conduits with threaded conduit hubs at NEMA 4 and 4X boxes and enclosures.

- b. Electric Metallic Tubing: Provide gland compression, insulated connectors.
- c. Flexible Metal Conduit: Provide two-screw type, insulated, malleable iron connectors.
- d. PVC-Coated Rigid Galvanized Steel Conduit: Provide PVC-coated, liquid-tight, metallic connector.
- e. PVC Schedule 40 Conduit: Provide PVC terminal adapter with locknut.
- 4. Free-Standing Enclosures:
 - a. Terminate metal conduit entering bottom with grounding bushing; provide a grounding jumper extending to equipment ground bus or grounding pad.
 - b. Terminate PVC conduit entering bottom with bell end fittings.
- L. Underground Raceways:
 - 1. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.
 - 2. Cover: Maintain minimum 2-foot cover above conduit, unless otherwise shown.
 - 3. Make routing changes as necessary to avoid obstructions or conflicts.
 - 4. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.
 - 5. Union type fittings not permitted.
 - 6. Spacers:
 - a. Provide preformed, nonmetallic spacers, designed for such purpose, to secure and separate parallel conduit runs in a trench.
 - b. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.
 - 7. Support conduit so as to prevent bending or displacement during backfilling.
 - 8. Installation with Other Piping Systems:
 - a. Crossings: Maintain minimum 12-inch vertical separation.
 - b. Parallel Runs: Maintain minimum 12-inch separation.
 - c. Installation over valves or couplings not permitted.
 - 9. Metallic Raceway Coating: Along entire length, coat with raceway coating.
 - 10. Provide expansion fittings that allow minimum of 4 inches of movement in vertical 1.5-inch or larger conduit runs from underground where exposed conduit will be fastened to or will enter building or structure.
 - 11. Provide deflectional/expansion fittings in conduit runs that exit building or structure belowgrade. Conduit from building wall to fitting shall be PVC-coated rigid steel.

- M. Empty Raceways:
 - 1. Provide permanent, removable cap over each end.
 - 2. Provide PVC plug with pull tab for underground raceways with end bells.
 - 3. Provide nylon pull cord.
 - 4. Identify, as specified in Article Identification Devices, with waterproof tags attached to pull cord at each end, and at intermediate pull point.
- N. Identification Devices:
 - 1. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of runs.
- O. Raceway Band: Install wherever metallic conduit emerges from concrete slabs. Not required with PVC-coated RGS conduit. Center band at slab surface and install according to manufacturer's instructions.
 - 1. Slip-on Type: Clean conduit surface at installation location. Cut tubing to 4-inch minimum lengths and slip onto raceway prior to slab placement and termination of conduit. Heat-shrink onto conduit.
 - 2. Wrap-around Type: Use where slip-on access to conduit is not possible. Clean conduit surface at installation location. Apply primer. Apply wraps to provide two layers of tape. Neatly finish tape end to prevent unraveling.

3.16 CONDUCTORS AND CABLES

- A. Conductor storage, handling, and installation shall be in accordance with manufacturer's recommendations.
- B. Do not exceed manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
- C. Conduit system shall be complete prior to drawing conductors. Lubricate prior to pulling into conduit. Lubrication type shall be as approved by conductor manufacturer.
- D. Terminate all conductors and cables, unless otherwise shown.
- E. Do not splice conductors, unless specifically indicated or approved by Engineer.

- F. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches.
- G. Wiring within Equipment and Local Control Panels: Remove surplus wire, dress, bundle, and secure.
- H. Power Conductor Color Coding:
 - 1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 inches to 2 inches wide.
 - 2. No. 8 AWG and Smaller: Provide colored conductors.
 - 3. Colors:
 - a. Neutral Wire: White.
 - b. Live Wires, 120/240-Volt, Single-Phase System: Black, red.
 - c. Live Wires, 120/208-Volt, Three-Phase System: Black, red, or blue.
 - d. Live Wires, 277/480-Volt, Three-Phase System: Brown, orange, or yellow.
 - e. Ground Wire: Green.
- I. Circuit Identification:
 - 1. Circuits Appearing in Circuit Schedules: Identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
 - 2. Circuits Not Appearing in Circuit Schedules: Assign circuit name based on device or equipment at load end of circuit. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.
 - 3. Method: Identify with sleeves. Taped-on markers or tags relying on adhesives not permitted.
- J. Connections and Terminations:
 - 1. Install wire nuts only on solid conductors.
 - 2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control circuit conductors.
 - 3. Tape insulate all uninsulated connections.
 - 4. Install crimp connectors and compression lugs with tools approved by connector manufacturer.

3.17 GROUNDING

- A. Grounding shall be in compliance with NFPA 70 and as shown.
- B. Ground electrical service neutral at service entrance equipment to supplementary grounding electrodes.
- C. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.
- D. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.
- E. Shielded Instrumentation Cables:
 - 1. Ground shield to ground bus at power supply for analog signal.
 - 2. Expose shield minimum 1-inch at termination to field instrument and apply heat shrink tube.
 - 3. Do not ground instrumentation cable shield at more than one point.
- F. Equipment Grounding Conductors: Provide in all conduits containing power conductors and control circuits above 50 volts.
- G. Ground Rods: Install full length with conductor connection at upper end. Install one ground rod in each handhole.

3.18 LUMINAIRES AND ACCESSORIES

- A. Install in accordance with manufacturer's recommendations.
- B. Install plumb and level at mounting heights shown.
- C. Provide proper hangers, pendants, and canopies as necessary for complete installation.
- D. Install symmetrically with suspended ceiling pattern in finished areas.
- E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.
- F. Building Exterior: Provide flush-mounted back box and concealed conduit, unless otherwise shown.
3.19 LIGHTING CONTROL

A. Outdoor Luminaires: Photocells shall switch lights ON at dusk and OFF at dawn.

3.20 FIELD QUALITY CONTROL

- A. General:
 - 1. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.
 - 2. Test instrument calibration shall be in accordance with NETA ATS.
 - 3. Perform inspection and electrical tests after equipment has been installed.
 - 4. Perform tests with apparatus de-energized whenever feasible.
 - 5. Inspection and electrical tests on energized equipment are to be:
 - a. Scheduled with Owner prior to de-energization.
 - b. Minimized to avoid extended period of interruption to the operating plant equipment.
- B. Tests and inspection shall establish that:
 - 1. Electrical equipment is operational within industry and manufacturer's tolerances.
 - 2. Installation operates properly.
 - 3. Equipment is suitable for energization.
 - 4. Installation conforms to requirements of Contract Documents and NFPA 70.
- C. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.
- D. Adjust mechanisms and moving parts for free mechanical movement.
- E. Adjust adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.
- F. Verify nameplate data for conformance to Contract Documents.
- G. Realign equipment not properly aligned and correct unlevelness.
- H. Properly anchor electrical equipment found to be inadequately anchored.
- I. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or as otherwise specified.

- J. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- K. Provide proper lubrication of applicable moving parts.
- L. Investigate and repair or replace:
 - 1. Electrical items that fail tests.
 - 2. Active components not operating in accordance with manufacturer's instructions.
 - 3. Damaged electrical equipment.
- M. Electrical Enclosures:
 - 1. Remove foreign material and moisture from enclosure interior.
 - 2. Vacuum and wipe clean enclosure interior.
 - 3. Remove corrosion found on metal surfaces.
 - 4. Repair or replace, as determined by Engineer, door and panel sections having damaged surfaces.
 - 5. Replace missing or damaged hardware.
- N. Provide certified test report(s) documenting the successful completion of specified testing. Include field test measurement data.
- O. Test the following equipment and materials:
 - 1. Conductors: Insulation resistance, No. 4 and larger only.
 - 2. Panelboards, switches, and circuit breakers.
 - 3. Motor controls.
 - 4. Grounding electrodes.
 - 5. Motors.
- P. Controls:
 - 1. Test control and signal wiring for proper termination and function.
 - 2. Test local control panels and other control devices for proper terminations, configuration and settings, and functions.
 - 3. Demonstrate control, monitoring, and indication functions in presence of Owner and Engineer.
- Q. Balance electrical load between phases on panelboards and mini-power centers after installation.

R. Voltage Testing:

- 1. When installation is complete and facility is in operation, check voltage at point of termination of electric utility supply system to Project.
- 2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.
- If unbalance exceeds 1 percent, or if voltage varies throughout the day and from loaded to unloaded conditions more than plus or minus 4 percent of nominal, make written request to electric utility to correct condition.
- 4. If corrections are not made, obtain written statement from a responsible electric utility official that voltage variations and/or unbalance are within their normal standards.
- S. Equipment Line Current:
 - 1. Check line current in each phase for each piece of equipment.
 - 2. If electric utility makes adjustments to supply voltage magnitude or balance, make line current check after adjustments are made.

END OF SECTION

SECTION 26 05 02 BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Requirements specified within this section apply to Division 26, Electrical. Work specified herein shall be performed as if specified in the individual sections.

1.02 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. National Electrical Contractors Association (NECA): National Electrical Installation Standards.
 - National Electrical Manufacturers Association (NEMA):
 a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. Z535.4, Product Safety Signs and Labels.
 - 3. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).

1.03 ELECTRIC SERVICE DIVISION OF RESPONSIBILITY

A. Incoming aerial electrical service facilities provided by the serving utility as part of its normal obligation to customers is work provided outside this Contract. Schedule and coordinate work of serving utility as required to provide electric service to the Work.

1.04 SUBMITTALS

- A. Action Submittals:
 - 1. Provide manufacturers' data for the following:
 - a. Electrical service components.
 - b. Nameplates, signs, and labels.

1.05 QUALITY ASSURANCE

A. Provide the Work in accordance with NFPA 70. Where required by Authority Having Jurisdiction (AHJ), material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ, in order to provide a basis for approval under the NEC.

B. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark or label.

1.06 ENVIRONMENTAL CONDITIONS

- A. The following areas are classified nonhazardous and wet. Use materials and methods required for such areas.
 - 1. Outdoor abovegrade areas.
 - 2. Below grade areas.
- B. The following areas are classified as indoor and dry:
 - 1. Office and Restroom Buildings.
 - 2. Electrical Maintenance Rooms.

PART 2 PRODUCTS

- 2.01 GENERAL
 - A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
 - B. Material and equipment installed in heated and ventilated areas shall be capable of continuous operation at their specified ratings within an ambient temperature range of 40 degrees F to 104 degrees F.
 - C. Materials and equipment installed outdoors shall be capable of continuous operation at their specified rating within the ambient temperature range stated in Section 01 61 00, Common Product Requirements.

2.02 EQUIPMENT FINISH

- A. Manufacturer's standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with gray color finish as approved by Engineer.
- 2.03 NAMEPLATES
 - A. Material: Laminated plastic.

- B. Attachment Screws: Stainless steel.
- C. Color: Black, engraved to a white core.
- D. Letter Height:
 - 1. Pushbuttons/Selector Switches: 1/4-inch.
 - 2. Other Electrical Equipment: 3/8-inch.

2.04 SIGNS AND LABELS

- A. Sign size, lettering, and color shall be in accordance with NEMA Z535.4.
- B. Warning labels for arc flash shall be provided per NEC code.
- C. Based on the results of arc-flash calculations performed as specified in Section 26 05 70, Electrical Systems Analysis, provide adequate warning labels on all electrical equipment.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Electrical Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned. Contractor shall be responsible for actual location of equipment and devices and for proper routing and support of raceways, subject to approval of Engineer.
 - B. Coordinate the conduit installation with other trades and the actual supplied equipment. Obtain information relevant to the placement of electrical work and in case of any interference with other work, process as directed by the Engineer and furnished all labor and materials necessary to complete the Work in an approved manner.
 - C. Check approximate locations of light fixtures, switches, electrical outlets, equipment, and other electrical system components shown on the Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify Engineer in writing.
 - D. Install work in accordance with NECA Standard of Installation, unless otherwise specified.
 - E. Keep openings in boxes and equipment closed during construction.

- F. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer. Carefully perform cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces to original condition.
- G. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting, and other electrical systems shown. Additional circuits shall be installed wherever needed to conform to the specific requirements of the approved equipment at no additional cost to the Owner.
- H. Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement, or equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the Engineer for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.
- I. Surface-mounted panel boxes, junction boxes, conduit, etc., shall be supported with 1/2-inch spacers to provide a clearance between the wall and equipment.
- J. All floor-mounted electrical equipment shall be placed on 4-inch thick (3/4-inch, 45-degree chamfer at all exposed edges) concrete pads, provide reinforcement, anchors, etc.
- K. The Contractor shall coordinate with the work of the different trades so that interferences between conduits, piping, equipment, architectural and structural work will be avoided. All necessary offsets shall be furnished to take up a minimum space and all such offsets, fittings, etc., required to accomplish this shall be furnished and installed by the Contractor without additional expense to the Owner. In case interference develops, the Engineer is to decide which equipment, piping, etc., must be relocated, regardless of which was installed first.
- L. Raceways and conductors for lighting, switches, receptacles, and other miscellaneous low voltage power and signal system as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or

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along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

- M. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.
- N. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment.

3.02 COMBINING CIRCUITS INTO COMMON RACEWAY

- A. Homerun circuits shown on the Drawings indicate functional wiring requirements for power and control circuits. Circuits may be combined into common raceways in accordance with the following requirements:
 - 1. Power circuits from loads in same general area to same source location (such as: panelboard, switchboard, low voltage motor control center).
 - a. Lighting Circuits: Combine no more than three circuits to a single raceway. Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - b. Receptacle Circuits, 120 Volt Only: Contractor shall be responsible for increasing conduit and conductor size if derating is required by NEC.
 - c. All Other Power Circuits: Do not combine power circuits without authorization of Engineer.

3.03 NAMEPLATES, SIGNS, AND LABELS

- A. Arc Flash Protection Warning Signs:
 - 1. Field mark panelboards to warn qualified persons of potential arc-flash hazards. Locate marking so to be clearly visible to persons before working on energized equipment.
 - 2. Use arc flash hazard boundary, energy level, PPE level and description, shock hazard, bolted fault current, and equipment name from study required in Section 26 05 70, Electrical Systems Analysis as basis for warning signs.

- B. Available Fault Current Signs:
 - 1. Install label on service equipment to indicate the maximum available fault current at the equipment. Labels shall be of sufficient durability for the environment in which the equipment is installed. Labels shall include the following information:
 - a. Equipment name or identification.
 - b. Available fault current at the equipment.
 - c. Date the fault current calculations were performed.
 - 2. Use bolted fault current and equipment name from study required in Section 26 05 70, Electrical Systems Analysis as basis for the label.
 - 3. Where existing electrical systems are modified, completely remove existing fault current labels if present, and install new labels in accordance with the above requirements.
- C. Equipment Nameplates:
 - 1. Provide a nameplate to label electrical equipment including switchgear, switchboards, motor control centers, panelboards, motor starters, transformers, terminal junction boxes, disconnect switches, switches and control stations.
 - 2. Switchgear, motor control center, transformer, and terminal junction box nameplates shall include equipment designation.
 - 3. Disconnect switch, starter, and control station nameplates shall include name and number of equipment powered or controlled by that device.
 - 4. Switchboard and panelboard nameplates shall include equipment designation, service voltage, and phases.

3.04 LOAD BALANCE

- A. Drawings and Specifications indicate circuiting to electrical loads and distribution equipment.
- B. Balance electrical load between phases as nearly as possible on switchboards, panelboards, motor control centers, and other equipment where balancing is required.
- C. When loads must be reconnected to different circuits to balance phase loads, maintain accurate record of changes made, and provide circuit directory that lists final circuit arrangement.

3.05 SLEEVES AND FORMS FOR OPENINGS

A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all necessary slots for electrical work and form before concrete is poured.

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- B. Exact locations are required for stubbing-up and terminating concealed conduit. Obtain Shop Drawings and templates from equipment vendors or other subcontractors and locate the concealed conduits before the floor slab is poured.
- C. Where setting Drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installation of such conduits to be exposed. Request for this deviation must be submitted in writing. No additional compensation for such change will be allowed.
- D. Seal all openings, sleeves, penetrations, and slots as specified in Section 26 05 01, Electrical.

3.06 CUTTING AND PATCHING

- A. Cutting and patching shall be done in a thoroughly workmanlike manner.
- B. Install work at such time as to require the minimum amount of cutting and patching.
- C. Do not cut joists, beams, girders, columns, or any other structural members.
- D. Cut openings only large enough to allow easy installation of the conduit.
- E. Patching to be of the same kind and quality of material as was removed.
- F. The completed patching work shall restore the surface to its original appearance or better.
- G. Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.
- H. Remove rubble and excess patching materials from the premises.

3.07 CLEANING AND TOUCHUP PAINTING

- A. Cleaning: Throughout the Work, clean interior and exterior of devices and equipment by removing debris and vacuuming.
- B. Touchup Paint:
 - 1. Touchup scratches, scrapes and chips on exterior and interior surfaces of devices and equipment with finish matching type, color, and consistency and type of surface of original finish.

2. If extensive damage is done to equipment paint surfaces, refinish entire equipment in a manner that provides a finish equal to or better than factory finish, that meets requirements of Specification, and is acceptable to Engineer.

3.08 PROTECTION FOLLOWING INSTALLATION

- A. Protect materials and equipment from corrosion, physical damage, and effects of moisture on insulation and contact surfaces.
- B. When equipment intended for indoor installation is installed at Contractor's convenience in areas where subject to dampness, moisture, dirt or other adverse atmosphere until completion of construction, ensure adequate protection from these atmospheres is provided and acceptable to Engineer.

END OF SECTION

SECTION 26 05 04 BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
 - b. E814, Method of Fire Tests of Through-Penetration Fire Stops.
 - 2. Canadian Standards Association (CSA).
 - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
 - 4. International Society of Automation (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
 - b. C12.1, Code for Electricity Metering.
 - c. C12.6, Phase-Shifting Devices Used in Metering, Marking and Arrangement of Terminals.
 - d. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - e. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
 - f. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
 - 6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 7. UL:
 - a. 98, Standard for Enclosed and Dead-Front Switches.
 - b. 248, Standard for Low Voltage Fuses.
 - c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
 - d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
 - e. 508, Standard for Industrial Control Equipment.
 - f. 810, Standard for Capacitors.
 - g. 943, Standard for Ground-Fault Circuit-Interrupters.

- h. 1059, Standard for Terminal Blocks.
- i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Provide manufacturers' data for the following:
 - a. Control devices.
 - b. Control relays.
 - c. Circuit breakers.
 - d. Fused switches.
 - e. Nonfused switches.
 - f. Timers.
 - g. Fuses.
 - h. Magnetic contactors.
 - i. Intrinsic safety barriers.
 - j. Firestopping.
 - k. Enclosures: Include enclosure data for products having enclosures.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

- A. General:
 - 1. Type: Molded case.
 - 2. Trip Ratings: 15 amps to 800 amps.
 - 3. Voltage Ratings: 120, 240, 277, 480, and 600V ac.
 - 4. Suitable for mounting and operating in any position.
 - 5. UL 489.
- B. Operating Mechanism:
 - 1. Overcenter, trip-free, toggle type handle.
 - 2. Quick-make, quick-break action.
 - 3. Locking provisions for padlocking breaker in OPEN position.
 - 4. ON/OFF and TRIPPED indicating positions of operating handle.
 - 5. Operating handle to assume a CENTER position when tripped.
- C. Trip Mechanism:
 - 1. Individual permanent thermal and magnetic trip elements in each pole.

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- 2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
- 3. Two and three pole, common trip.
- 4. Automatically opens all poles when overcurrent occurs on one pole.
- 5. Test button on cover.
- 6. Calibrated for 40 degrees C ambient, unless shown otherwise.
- 7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.
- D. Short Circuit Interrupting Ratings:
 - 1. Not less than the following rms symmetrical currents for the indicated trip ratings:
 - a. Up to 100A, less than 250V ac: 10,000 amps.
 - b. Over 100A22,000amps.
- E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).
 - 1. Ground fault sensor shall be rated same as circuit breaker.
 - 2. Push-to-test button.
- F. Equipment Ground Fault Interrupter (EGFI): Where indicated, equip breaker specified above with ground fault sensor and rated to trip on 30-mA ground fault (UL-listed for equipment ground fault protection).
- G. Connections:
 - 1. Supply (line side) at either end.
 - 2. Mechanical wire lugs, except crimp compression lugs where shown.
 - 3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
 - 4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.
- H. Enclosures for Independent Mounting:
 - 1. See Article Enclosures.
 - 2. Service Entrance Use: Breakers in required enclosure and required accessories shall be UL 489 listed.
 - 3. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.02 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

- A. UL 98 listed for use and location of installation.
- B. NEMA KS 1.
- C. Short Circuit Rating: 200,000 amps rms symmetrical with Class R, Class J, or Class L fuses installed.
- D. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- E. Connections:
 - 1. Mechanical lugs, except crimp compression lugs where shown.
 - 2. Lugs removable/replaceable.
 - 3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.
- F. Fuse Provisions:
 - 1. 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.
 - 2. 601-amp rated and greater shall accept Class L fuses, unless otherwise shown.
- G. Enclosures: See Article Enclosures.
- H. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.03 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

- A. NEMA KS 1.
- B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.
- C. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.
- D. Enclosures: See Article Enclosures.
- E. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.04 FUSE, 250-VOLT AND 600-VOLT

- A. Power Distribution, General:
 - 1. Current-limiting, with 200,000 ampere rms interrupting rating.
 - 2. Provide to fit mountings specified with switches.
 - 3. UL 248.
- B. Power Distribution, Ampere Ratings 1 Amp to 600 Amps:
 - 1. Class: RK-1.
 - 2. Type: Dual element, with time delay.
 - 3. Manufacturers and Products:
 - a. Bussmann; Types LPS-RK (600 volts) and LPN-RK (250 volts).
 - b. Littelfuse; Types LLS-RK (600 volts) and LLN-RK (250 volts).
- C. Cable Limiters:
 - 1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
 - 2. Manufacturer and Product: Bussmann; K Series.
- D. Ferrule:
 - 1. 600V or less, rated for applied voltage, small dimension.
 - 2. Ampere Ratings: 1/10 amp to 30 amps.
 - 3. Dual-element time-delay, time-delay, or nontime-delay as required.
 - 4. Provide with blocks or holders as indicated and suitable for location and use.
 - 5. Manufacturers:
 - a. Bussmann.
 - b. Littlefuse, Inc.

2.05 TERMINAL BLOCK, 600 VOLTS

- A. UL 486E and UL 1059.
- B. Size components to allow insertion of necessary wire sizes.
- C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.
- D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.
- E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

- F. Yoke shall guide all strands of wire into terminal.
- G. Current bar shall ensure vibration-proof connection.
- H. Terminals:
 - 1. Capable of wire connections without special preparation other than stripping.
 - 2. Capable of jumper installation with no loss of terminal or rail space.
 - 3. Individual, rail mounted.
- I. Marking system, allowing use of preprinted or field-marked tags.
- J. Manufacturers:
 - 1. Weidmuller, Inc.
 - 2. Ideal.
 - 3. Electrovert USA Corp.

2.06 SUPPORT AND FRAMING CHANNELS

- A. PVC-Coated Framing Channel: Aluminum steel framing channel with 40-mil polyvinyl chloride coating.
- B. Stainless Steel Framing Channel: Rolled, Type 316 stainless steel, 12-gauge minimum.
- C. Extruded Aluminum Framing Channel:
 - 1. Material: Extruded from Type 6063-T6 aluminum alloy.
 - 2. Fittings fabricated from Alloy 5052-H32.
- D. Manufacturers:
 - 1. B-Line Systems, Inc.
 - 2. Unistrut Corp.
 - 3. Aickinstrut.

2.07 INTRINSIC SAFETY BARRIER

A. Provides a safe energy level for exposed wiring in a Class I, Division 1 or Division 2 hazardous area when circuit is connected to power source in nonhazardous area.

- B. Rating: Power source shall be rated 24 volts dc, nominal, with not more than 250 volts available under fault conditions.
- C. Contact Rating: 5 amps, 250 volts ac.
- D. Mounting: Rail or surface.
- E. Manufacturers and Products:
 - 1. MTL, Inc.; Series 2000 or Series 3000.
 - 2. R. Stahl, Inc.

2.08 SWITCHBOARD MATTING

- A. Provide matting having a breakdown of 20 kV minimum.
- B. Manufacturer: U.S. Mat and Rubber Company.

2.09 FIRESTOPS

- A. General:
 - 1. Provide UL 1479 classified hourly fire rating equal to, or greater than, the assembly penetrated.
 - 2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
 - 3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by UL, or other testing and inspection agency acceptable to authorities having jurisdiction.

2.10 ENCLOSURES

- A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.
- B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.
- C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

- D. Enclosure Selections:
 - 1. Except as shown otherwise, provide electrical enclosures according to the following table:

Enclosures						
Location	Finish	Environment	NEMA 250 Type			
Indoor	Finished	Dry	1			
Indoor	Unfinished	Dry	1			
Indoor	Unfinished	Industrial Use	12			
Indoor and Outdoor	Any	Wet	4			
Indoor and Outdoor	Any	Denoted "WP"	3R			
Indoor and Outdoor	Any	Wet and Corrosive	4X			
Indoor and Outdoor	Any	Wet, Dust or Oil	13			
Indoor and Outdoor	Any	Hazardous Gas	7			
Indoor and Outdoor	Any	Hazardous Dust	9			

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Install equipment in accordance with manufacturer's recommendations.

3.02 SUPPORT AND FRAMING CHANNEL

- A. Install where required for mounting and supporting electrical equipment, raceway, and cable tray systems.
- B. Channel Type:
 - 1. Interior, Wet or Dry (Noncorrosive) Locations:
 - a. Aluminum Raceway: Extruded aluminum or stainless steel with neoprene material isolators.
 - b. PVC-Coated Conduit: PVC coated.
 - c. Steel Raceway and Other Systems Not Covered: Stainless steel or paint coated.
 - 2. Interior, Corrosive (Wet or Dry) Locations:
 - a. Aluminum Raceway: Extruded aluminum.
 - b. PVC Conduit: Type 316 stainless steel or nonmetallic.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered:
 - Type 316 stainless steel, nonmetallic, or PVC-coated steel.
 - 3. Outdoor, Noncorrosive Locations:
 - a. Steel Raceway: Stainless steel or paint coated framing channel.

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- b. Aluminum Raceway and Other Systems Not Covered: Aluminum framing channel or carbon steel with neoprene material isolators.
- 4. Outdoor Corrosive Locations:
 - a. PVC Conduit: Type 316 stainless steel.
 - b. Aluminum Raceway: Aluminum with neoprene material isolators.
 - c. PVC-Coated Steel Conduit and Other Systems Not Covered: Type 316 stainless steel.
- C. Paint cut ends prior to installation with the following:
 - 1. Painted Channel: Rust-inhibiting epoxy or acrylic paint.
 - 2. Nonmetallic Channel: Epoxy resin sealer.
 - 3. PVC-Coated Channel: PVC patch.

3.03 INTRINSIC SAFETY BARRIERS

- A. Install in compliance with ISA RP12.06.01.
- B. Arrange conductors such that wiring from hazardous areas cannot short to wiring from nonhazardous area.
- C. Stencil "INTRINSICALLY SAFE CIRCUIT" on all boxes enclosing barriers.

3.04 SWITCHBOARD MATTING

- A. Install 36-inch width at switchgear, switchboard, motor control centers, and panelboards.
- B. Matting shall run full length of all sides of equipment that have operator controls or afford access to devices.

3.05 FIRESTOPS

- A. Install in strict conformance with manufacturer's instructions. Comply with installation requirements established by testing and inspecting agency.
- B. Sealant: Install sealant including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

SECTION 26 05 05 CONDUCTORS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - Association of Edison Illuminating Companies (AEIC): CS 8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 kV through 46 kV.
 - 2. ASTM International (ASTM):
 - a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - b. B3, Standard Specification for Soft or Annealed Copper Wire.
 - c. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - d. B496, Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors.
 - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV Through 500 kV.
 - b. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
 - c. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500000 V.
 - 4. Insulated Cable Engineer's Association, Inc. (ICEA):
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 - b. S-73-532, Standard for Control Thermocouple Extensions and Instrumentation Cables.
 - c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
 - 5. National Electrical Manufacturers' Association (NEMA):
 - a. CC 1, Electric Power Connectors for Substations.
 - b. WC 57, Standard for Control, Thermocouple Extension, and Instrumentation Cables.
 - c. WC 70, Standard for Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

- d. WC 71, Standard for Nonshielded Cables Rated 2001-5000 Volts for Use in the Distribution of Electric Energy.
- e. WC 74, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- 7. Telecommunications Industry Association (TIA): TIA-568-C, Commercial Building Telecommunications Cabling Standard.
- 8. UL:
 - a. 13, Standard for Safety for Power-Limited Circuit Cables.
 - b. 44, Standard for Safety for Thermoset-Insulated Wires and Cables.
 - c. 62, Standard for Safety for Flexible Cord and Cables.
 - d. 486A-486B, Standard for Safety for Wire Connectors.
 - e. 486C, Standard for Safety for Splicing Wire Connectors.
 - f. 510, Standard for Safety for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 - g. 854, Standard for Safety for Service-Entrance Cables.
 - h. 1072, Standard for Safety for Medium-Voltage Power Cables.
 - i. 1277, Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
 - j. 1569, Standard for Safety for Metal-Clad Cables.
 - k. 1581, Standard for Safety for Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product Data:
 - a. Wire and cable.
 - b. Wire and cable accessories.
 - c. Cable fault detection system.
 - 2. Cable Pulling Calculations:
 - a. Ensure submitted and reviewed before cable installation.
 - b. Provide for the following cable installations: Multiconductor 600-volt cable sizes larger than 2 AWG that cannot be hand pulled.

1.03 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within the scope of standards published by UL shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

- 2.01 CONDUCTORS 600 VOLTS AND BELOW
 - A. Conform to applicable requirements of NEMA WC 70.
 - B. Conductor Type:
 - 1. 120-Volt and 277-Volt Lighting, 10 AWG and Smaller: Solid copper.
 - 2. 120-Volt Receptacle Circuits, 10 AWG and Smaller: Solid copper.
 - 3. All Other Circuits: Stranded copper.
 - C. Insulation: Type THHN/THWN-2 except for AWG No 6 and larger, with XHHW-2 insulation.
 - D. Direct Burial and Aerial Conductors and Cables:
 - 1. Type USE/RHH/RHW insulation, UL 854 listed, or Type RHW-2/USE-2.
 - 2. Conform to physical and minimum thickness requirements of NEMA WC 70.
 - E. Flexible Cords and Cables:
 - 1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
 - 2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.02 600-VOLT RATED CABLE

- A. General:
 - 1. Type TC, meeting requirements of UL 1277, including Vertical Tray Flame Test at 70,000 Btu per hour, and NFPA 70, Article 340, or UL 13 meeting requirements of NFPA 70, Article 725.
 - 2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
 - 3. Suitable for installation in open air, in cable trays, or conduit.
 - 4. Minimum Temperature Rating: 90 degrees C dry locations, 75 degrees C wet locations.
 - 5. Overall Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.
- B. Type 2, Multiconductor Power Cable:
 - 1. General:
 - a. Meet or exceed UL 1581 for cable tray use.
 - b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
 - c. Overall Jacket: PVC.
 - 2. Conductors:
 - a. Class B stranded, coated copper.
 - b. Insulation: Chemically cross-linked ethylene-propylene or crosslinked polyethylene.
 - c. UL rated VW-1 or listed Type XHHW-2.
 - d. Color Code:
 - 1) Conductors, size 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
 - 2) Conductors, size 6 AWG and larger, ICEA S-73-532, Method 4.
 - 3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
 - 4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2	0.42	45
		3	0.45	
		4	0.49	
10	10	2	0.54	60
		3	0.58	
		4	0.63	

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Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
8	10	3 4	0.66 0.75	60
6	8	3 4	0.74 0.88	60
4	6	3 4	0.88 1.04	60 80
2	6	3 4	1.01 1.16	80
1	6	3 4	1.10 1.25	80
1/0	6	3 4	1.22 1.35	80
2/0	4	3 4	1.32 1.53	80
3/0	4	3 4	1.40 1.60	80
4/0	4	3 4	1.56 1.78	80 110

- 5. Manufacturers:
 - a. Okonite Co.
 - b. Southwire.

2.03 300-VOLT RATED CABLE

- A. General:
 - 1. Type PLTC, meeting requirements of UL 13 and NFPA 70, Article 725.
 - 2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
 - 3. Suitable for installation in open air, in cable trays, or conduit.
 - 4. Minimum Temperature Rating: 105 degrees C.
 - 5. Passes Vertical Tray Flame Test.
 - 6. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

2.04 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type USE/RHH/RHW XLPE or THHN/THWN, insulation.

B. Direct Buried: Bare stranded tinned copper.

2.05 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

- A. Tape:
 - General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
 - 2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
 - 3. Arc and Fireproofing:
 - a. 30-mil, elastomer.
 - b. Manufacturers and Products:
 - 1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
 - 2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices:

- 1. Sleeve:
 - a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
 - b. Manufacturers and Products:
 - 1) Raychem; Type D-SCE or ZH-SCE.
 - 2) Brady, Type 3PS.
- 2. Heat Bond Marker:
 - a. Transparent thermoplastic heat bonding film with acrylic pressure sensitive adhesive.
 - b. Self-laminating protective shield over text.
 - c. Machine printed black text.
 - d. Manufacturer and Product: 3M Co.; Type SCS-HB.
- 3. Marker Plate: Nylon, with legible designations permanently hot stamped on plate.
- 4. Tie-On Cable Marker Tags:
 - a. Chemical-resistant white tag.
 - b. Size: 1/2-inch by 2 inches.
 - c. Manufacturer and Product: Raychem; Type CM-SCE.
- 5. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.
- C. Connectors and Terminations:
 - 1. Nylon, Self-Insulated Crimp Connectors:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.

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- 2) Burndy; Insulug.
- 3) ILSCO.
- 2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Seamless.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts; Sta-Kon.
 - 2) Burndy; Insulink.
 - 3) ILSCO; ILSCONS.
- 3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
 - a. UL 486C.
 - b. Plated steel, square wire springs.
 - c. Manufacturers and Products:
 - 1) Thomas & Betts.
 - 2) Ideal; Twister.
- 4. Self-Insulated, Set Screw Wire Connector:
 - a. Two piece compression type with set screw in brass barrel.
 - b. Insulated by insulator cap screwed over brass barrel.
 - c. Manufacturers:
 - 1) 3M Co.
 - 2) Thomas & Betts.
 - 3) Marrette.
- D. Cable Lugs:
 - 1. In accordance with NEMA CC 1.
 - 2. Rated 600 volts of same material as conductor metal.
 - 3. Uninsulated Crimp Connectors and Terminators:
 - a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
 - b. Manufacturers and Products:
 - 1) Thomas & Betts; Color-Keyed.
 - 2) Burndy; Hydent.
 - 3) ILSCO.
 - 4. Uninsulated, Bolted, Two-Way Connectors and Terminators:
 - a. Manufacturers and Products:
 - 1) Thomas & Betts; Locktite.
 - 2) Burndy; Quiklug.
 - 3) ILSCO.
- E. Cable Ties:
 - 1. Nylon, adjustable, self-locking, and reusable.
 - 2. Manufacturer and Product: Thomas & Betts; TY-RAP.

- F. Heat Shrinkable Insulation:
 - 1. Thermally stabilized cross-linked polyolefin.
 - 2. Single wall for insulation and strain relief.
 - 3. Dual Wall, adhesive sealant lined, for sealing and corrosion resistance.
 - 4. Manufacturers and Products:
 - a. Thomas & Betts; SHRINK-KON.
 - b. Raychem; RNF-100 and ES-2000.

2.06 PULLING COMPOUND

- A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.
- B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.
- C. Approved for intended use by cable manufacturer.
- D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.
- E. Manufacturers:
 - 1. Ideal Co.
 - 2. Polywater, Inc.
 - 3. Cable Grip Co.

2.07 SOURCE QUALITY CONTROL

A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

PART 3 EXECUTION

- 3.01 GENERAL
 - A. Conductor installation shall be in accordance with manufacturer's recommendations.
 - B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.
 - C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.
 - D. Terminate conductors and cables, unless otherwise indicated.

- E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors and aluminum conductors.
- F. Cable Lugs: Provide with correct number of holes, bolt size, and center-tocenter spacing as required by equipment terminals.
- G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 18 inches on center.
- H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.
- I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

- A. Conductors 600 Volts and Below:
 - 1. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering area 1-1/2 inches to 2 inches wide.
 - 2. 8 AWG and Smaller: Provide colored conductors.
 - 3. Colors:

System	Conductor	Color	
All Systems	Equipment Grounding	Green	
240/120 Volts, Single-Phase, Three- Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red	
240/120 Volts, Three- Phase, Four-Wire, Delta, Center Tap, Ground on Single- Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue	
	1. 1	1 •	

Note: Phase A, B, C implies direction of positive phase rotation.

4. Tracer: Outer covering of white with identifiable colored strip, other than green, in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

- A. Identify power, instrumentation, and control conductor circuits at each termination, and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.
- B. Circuits Appearing in Circuit Schedules: Identify using circuit schedule designations.
- C. Circuits Not Appearing in Circuit Schedules:
 - 1. Assign circuit name based on device or equipment at load end of circuit.
 - 2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.
- D. Method:
 - 1. Conductors 3 AWG and Smaller: Identify with sleeves or heat bond markers.
 - 2. Cables and Conductors 2 AWG and Larger:
 - a. Identify with marker plates or tie-on cable marker tags.
 - b. Attach with nylon tie cord.
 - 3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

- A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.
- B. Do not splice incoming service conductors and branch power distribution conductors 6 AWG and larger, unless specifically indicated or approved by Engineer.
- C. Connections and Terminations:
 - 1. Install wire nuts only on solid conductors. Wire nuts are not allowed on stranded conductors.
 - 2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
 - 3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors 12 AWG and smaller.
 - 4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors 4 AWG through 2/0 AWG.

- 5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors 3/0 AWG and larger.
- 6. Install uninsulated terminators bolted together on motor circuit conductors 10 AWG and larger.
- 7. Place no more than one conductor in any single-barrel pressure connection.
- 8. Install crimp connectors with tools approved by connector manufacturer.
- 9. Install terminals and connectors acceptable for type of material used.
- 10. Where aluminum conductors are provided, apply oxide-inhibiting compound at joints and terminations.
- 11. Compression Lugs:
 - a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
 - b. Install connectors designed for aluminum conductors utilizing compression barrel termination of conductor and terminating in dual rated lug.
 - c. Do not use plier type crimpers.
- D. Do not use soldered mechanical joints.
- E. Splices and Terminations:
 - 1. Insulate uninsulated connections.
 - 2. Indoors: Use general purpose, flame retardant tape or single wall heat shrink.
 - 3. Outdoors, Dry Locations: Use flame retardant, cold- and weather-resistant tape or single wall heat shrink.
 - 4. Below Grade and Wet or Damp Locations: Use dual wall heat shrink.
- F. Cap spare conductors with UL listed end caps.
- G. Cabinets, Panels, and Motor Control Centers:
 - 1. Remove surplus wire, bridle and secure.
 - 2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.
- H. Control and Instrumentation Wiring:
 - 1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.

- 2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
- 3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
- 4. Cable Protection:
 - a. Under Infinite Access Floors: May install without bundling.
 - b. All Other Areas: Install individual wires, pairs, or triads in flex conduit under floor or grouped into bundles at least 1/2-inch in diameter.
 - c. Maintain integrity of shielding of instrumentation cables.
 - d. Ensure grounds do not occur because of damage to jacket over shield.

END OF SECTION

SECTION 26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
 - 2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).
 - 3. UL.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. Product data for the following:
 - 1) Ground rod.

1.03 QUALITY ASSURANCE

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.
 - 2. Materials and equipment manufactured within scope of standards published by UL:
 - a. Confirm conformance with UL standards.
 - b. Supply with an applied UL listing mark.

PART 2 PRODUCTS

- 2.01 GROUND ROD
 - A. Material: Copper or Copper-clad.
 - B. Diameter: Minimum 5/8-inch.
 - C. Length: 20 feet.

2.02 GROUND CONDUCTORS

A. As specified in Section 26 05 05, Conductors.

2.03 CONNECTORS

- A. Exothermic Weld Type:
 - 1. Outdoor Weld: Suitable for exposure to elements or direct burial.
 - 2. Indoor Weld: Use low-smoke, low-emission process.
 - 3. Manufacturers and Product:
 - a. NVent ERICO Products, Inc.
 - b. ThermOweld.
- B. Compression Type:
 - 1. Compress-deforming irreversible type; wrought copper extrusion material.
 - 2. Single indentation for conductors 6 AWG and smaller.
 - 3. Double indentation with extended barrel for conductors 4 AWG and larger.
 - 4. Barrels prefilled with oxide-inhibiting and anti-seizing compound and sealed.
 - 5. Manufacturers and Products:
 - a. Burndy Corp.; Hyground Compression.
 - b. Thomas and Betts Co.; EZGround Compression.
 - c. NVent ILSCO.
- C. Mechanical Type: Split-bolt, saddle, or cone screw type; copper alloy material.
 - 1. Manufacturers:
 - a. Burndy Corp.
 - b. Thomas and Betts Co.
 - c. O-Z Gedney.

2.04 GROUNDING WELLS

- A. Precast Concrete: Ground rod box complete with cast-iron riser ring and H-20 rated cast iron traffic cover marked "GROUND ROD".
- B. Manufacturers and Products:
 - 1. Christy Co.
 - 2. Harger Lightning and Grounding.
 - 3. Oldcastle Infrastructure; Non-Traffic rated.

PART 3 EXECUTION

3.01 GENERAL

- A. Provide Grounding in compliance with NFPA 70 and IEEE C2.
- B. Bond electrical service neutral at service entrance equipment with grounding electrode conductor to grounding electrode system.
- C. Bond each separately derived system neutral with common grounding electrode conductor to grounding electrode system.
- D. Bond together all grounding electrodes that are present at each building or structure served to form one common grounding electrode system.
- E. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

3.02 WIRE CONNECTIONS

- A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.
- B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.
- C. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.
- D. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.
- E. Metallic Equipment Enclosures: Use furnished ground lug; if none furnished, tap equipment housing and install solderless terminal connected to box with machine screw. For circuits greater than 20 amps use minimum 5/16-inch diameter bolt.

3.03 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.
- B. Motors Less Than 10 hp: Use furnished ground lug in motor connection box. If none furnished, provide compression, spade-type terminal connected to conduit box mounting screw.
- C. Motors 10 hp and Above: Use furnished ground lug in motor connection box. If none furnished, tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.
- D. Circuits 20 Amps or Above: Tap motor frame or equipment housing. Install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

- A. Install full length with conductor connection at upper end.
- B. Install with connection point below finished grade, unless otherwise shown.
- C. Space multiple ground rods by a minimum of one rod length.
- D. Install to 8 feet below local frost depth.

3.05 GROUNDING WELLS

- A. Install for ground rods located inside buildings, asphalt and paved areas, and where shown on the Drawings.
- B. Install riser ring and cover flush with surface.
- C. Place 6 inches of crushed rock in bottom of each well.

3.06 CONNECTIONS

- A. General:
 - 1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
 - 2. Belowgrade Connections: Install exothermic weld or compression type connectors.
 - 3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.
 - 4. Notify Engineer prior to backfilling ground connections.
- B. Exothermic Weld Type:
 - 1. Wire brush or file contact point to bare metal surface.

- 2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
- 3. Avoid using badly worn molds.
- 4. Mold to be completely filled with metal when making welds.
- 5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.
- C. Compression Type:
 - 1. Install in accordance with connector manufacturer's recommendations.
 - 2. Install connectors of proper size for grounding conductors and ground rods specified.
 - 3. Install using connector manufacturer's compression tool having proper sized dies and operate per manufacturer's instructions.
- D. Mechanical Type:
 - 1. Apply homogeneous blend of colloidal copper and rust and corrosion inhibitor before making connection.
 - 2. Install in accordance with connector manufacturer's recommendations.
 - 3. Do not conceal mechanical connections.

END OF SECTION

SECTION 26 05 70 ELECTRICAL SYSTEMS ANALYSIS

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI).
 - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - b. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - c. 399, Recommended Practice for Industrial and Commercial Power System Analysis.
 - d. 1584, Guide for Performing Arc Flash Hazard Calculations.
 - 3. National Electrical Manufacturers Association (NEMA): Z535.4, Product Safety Signs and Labels.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 - 5. Occupational Safety and Health Standards (OSHA): 29 CFR, Part 1910 Subpart S, Electrical.

1.02 SUBMITTALS

- A. Action Submittals Signed and Sealed by Professional Engineer (PE) in Florida::
 - 1. Short circuit study.
 - 2. Protective Device Coordination Study.
 - 3. Arc Flash Study.
 - 4. Arc flash warning labels.

1.03 QUALITY ASSURANCE

- A. Short circuit and protective device coordination and arc flash studies shall be prepared by manufacturer furnishing equipment for incoming service or a professional electrical engineer registered in the State of Florida.
- B. The short circuit, protective device coordination and arc flash studies shall be signed and sealed by a professional engineer (PE) registered in the State of Florida.

1.04 SEQUENCING AND SCHEDULING

- A. Initial complete short circuit study shall be submitted and reviewed before Engineer will review Shop Drawings for overcurrent protective equipment for incoming service equipment.
- B. Initial complete protective device coordination and arc flash studies shall be submitted within 90 days after approval of initial short circuit study. It is imperative that the electrical subcontractor begin this Work immediately after award of the Contract. This task requires extensive coordination and work with numerous Vendors. Failure of the electrical subcontractor to provide the initial complete short circuit study before any Shop Drawing for any overcurrent protective equipment will result in rejection of the Shop Drawing without revie
- C. Revised short circuit, protective device coordination, and arc flash studies, and arc flash labels shall be submitted 10 days before energizing electrical equipment.
- D. Final short circuit, protective device coordination, and arc flash studies shall be completed prior to Project Substantial Completion. Final version of study shall include as-installed equipment, materials, and parameter data or settings entered into equipment based on study.
- E. Submit final arc flash labels described herein and in compliance with NEMA Z535.4 prior to Project Substantial Completion.

1.05 GENERAL STUDY REQUIREMENTS

- A. Equipment and component titles used in the studies shall be identical to equipment and component titles shown on the Drawings.
- B. Short circuit, protective device coordination and arc-flash studies shall be performed as a minimum on the following pieces of equipment:
 - 1. Main Disconnect
 - 2. Panelboards: MBC-1A, MCB-1B, MCB-3A and MCB-3B.
- C. Perform studies using one of the following electrical engineering software packages:
 - 1. SKM Power Tools for Windows.
 - 2. ETAP.
 - 3. Easy Power.

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- D. Perform complete fault calculations for each ultimate source combination.
 - 1. Source combination may include present and future power company supply circuits, large motors, or generators. Obtain and verify with the Power Company in writing all information needed to conduct this study. Provide this correspondence and information including contacts and phone numbers with the Study Submittal.
- E. Utilize proposed load data for study obtained from Contract Documents and field investigation of system configuration, wiring information, and equipment.
- F. Existing System and Equipment:
 - 1. Extent of existing system to be included in study is limited to system elements that affect new system and equipment.
 - 2. Include fault contribution of existing motors and equipment in study.
 - 3. Include impedance elements that affect new system and equipment.
 - 4. Include protective devices in series with new equipment.
- G. Device coordination time-current curves for low voltage distribution system; include individual protective device time-current characteristics.

1.06 SHORT CIRCUIT STUDY

- A. General:
 - 1. Prepare in accordance with IEEE 399.
 - 2. Use cable impedances based on copper conductors, except where aluminum conductors are specified or shown.
 - 3. Use bus impedances based on copper bus bars, except where aluminum bus bars are specified or shown.
 - 4. Use cable and bus resistances calculated at 25 degrees C.
 - 5. Use medium-voltage cable reactances based on use of typical dimensions of shielded cables with 133 percent insulation levels.
 - 6. Use 600-volt cable reactances based on use of typical dimensions of THHN/THWN conductors.
 - 7. Use transformer impedances 92.5 percent of "nominal" impedance based on tolerances specified in IEEE C57.12.00.
- B. Provide:
 - 1. Calculation methods and assumptions.
 - 2. Typical calculation.
 - 3. Tabulations of calculated quantities.
 - 4. Results, conclusions, and recommendations.

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- 5. Selected base per unit quantities.
- 6. One-line diagrams.
- 7. Source impedance data, including electric utility system and motor fault contribution characteristics.
- 8. Impedance diagrams.
- 9. Zero-sequence impedance diagrams.
- C. Calculate short circuit interrupting and momentary (when applicable) duties for an assumed three-phase bolted fault at each:
 - 1. Electric utility's supply termination point.
 - 2. Main Disconnect.
 - 3. Low-voltage switchboards.
 - 4. Branch circuit panelboards.
 - 5. Future load contributions as shown on one-line diagram.
- D. Verify:
 - 1. Equipment and protective devices are applied within their ratings.
 - 2. Adequacy of bus bars to withstand short circuit stresses.
 - 3. Cable and busway sizes for ability to withstand short circuit heating, in addition to normal load currents.
- E. Tabulations:
 - 1. General Data:
 - a. Short circuit reactances of rotating machines.
 - b. Cable and conduit material data.
 - c. Bus data.
 - d. Transformer data.
 - e. Circuit resistance and reactance values.
 - 2. Short Circuit Data:
 - a. Fault impedances.
 - b. X to R ratios.
 - c. Asymmetry factors.
 - d. Motor contributions.
 - e. Short circuit kVA.
 - f. Symmetrical and asymmetrical fault currents.
 - 3. Equipment Evaluation:
 - a. Equipment bus bracing, equipment short circuit rating,
 - transformer, cable, busway.
 - b. Maximum fault current available.
- F. Written Summary:
 - 1. Scope of studies performed.

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- 2. Explanation of bus and branch numbering system.
- 3. Prevailing conditions.
- 4. Selected equipment deficiencies.
- 5. Results of short circuit study.
- 6. Comments or suggestions.
- G. Suggest changes and additions to equipment rating and/or characteristics.
- H. Notify Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.
- I. Revise data for "as-installed" condition.

1.07 PROTECTIVE DEVICE COORDINATION STUDY

- A. General:
 - 1. Prepare in accordance with IEEE 242.
 - 2. Proposed protective device coordination time-current curves for distribution system, graphically displayed on conventional log-log curve sheets.
 - a. Provide separate curve sheets for phase and ground fault coordination for each scenario.
 - b. Each curve sheet to have title and one-line diagram that applies to specific portion of system associated with time-current curves on that sheet. Limit number of devices shown to four to six.
 - c. Identify device associated with each curve by manufacturer type, function, and, if applicable, recommended tap, time delay, instantaneous and other settings recommended.
 - d. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
 - e. Apply motor protection methods that comply with NFPA 70.
- B. Plot Characteristics on Curve Sheets:
 - 1. Electric utility's relays.
 - 2. Electric utility's fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - 3. Medium-voltage equipment relays.
 - 4. Medium-voltage and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - 5. Low-voltage equipment circuit breaker trip devices, including manufacturers tolerance bands.
 - 6. Pertinent transformer full-load currents at 100 percent.
 - 7. Transformer magnetizing inrush currents.

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- 8. Transformer damage curves; appropriate for system operation and location.
- 9. ANSI transformer withstand parameters.
- 10. Significant symmetrical and asymmetrical fault currents.
- 11. Motor overload relay settings for motors greater than 40 hp.
- 12. Ground fault protective device settings.
- 13. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center.
- C. Primary Protective Device Settings for Delta-Wye Connected Transformer:
 - 1. Secondary Line-to-Ground Fault Protection: Primary protective device operating band within transformer's characteristics curve, including a point equal to 58 percent of IEEE C57.12.00 withstand point.
 - 2. Secondary Line-to-Line Faults: 16 percent current margin between primary protective device and associated secondary device characteristic curves.
- D. Tabulate Recommended Protective Device Settings:
 - 1. Relays:
 - a. Current tap.
 - b. Time dial.
 - c. Instantaneous pickup.
 - d. Electronic settings data file.
 - 2. Circuit Breakers:
 - a. Adjustable pickups.
 - b. Adjustable time-current characteristics.
 - c. Adjustable time delays.
 - d. Adjustable instantaneous pickups.
 - e. I^2t In/Out.
 - f. Zone interlocking.
 - g. Electronic settings data file.
- E. Written Summary:
 - 1. Scope of studies performed.
 - 2. Summary of protective device coordination methodology.
 - 3. Prevailing conditions.
 - 4. Selected equipment deficiencies.
 - 5. Results of coordination study.
 - 6. Appendix of complete relay and circuit breaker electronic setting files.
 - 7. Comments or suggestions.
 - 8. Suggest changes and additions to equipment rating and/or
 - characteristics for proper coordination.

F. Notify Engineer in writing of existing circuit protective devices improperly rated for new fault conditions.

1.08 ARC FLASH STUDY

- A. Perform arc flash hazard study after short circuit and protective device coordination study has been completed, reviewed and accepted.
- B. Perform arc flash study in accordance with NFPA 70E, OSHA 29 CFR, Part 1910 Subpart S, and IEEE 1584.
- C. Base Calculation: For each major part of electrical power system, determine the following:
 - 1. Arc-Flash Hazard:
 - a. Arc-flash hazard protection boundary.
 - b. Incident energy level.
 - c. Working distance.
 - 2. Shock Hazard:
 - a. Limited approach boundary.
 - b. Restricted approach boundary.
 - c. Prohibited approach boundary.
 - d. Bus voltage.
 - e. Glove class.
- D. Produce arc flash warning labels that list items in Paragraph Base Calculation and the following additional items.
 - 1. Bus name.
 - 2. Calculation Method.
 - 3. Label expiration date.
 - 4. Reference to NFPA 70 E for PPE requirements.
- E. Produce bus detail sheets that list items in Paragraph Base Calculation and the following additional items:
 - 1. Bus name.
 - 2. Upstream protective device name, type, and settings.
 - 3. Bus line-to-line voltage.
- F. Produce arc flash evaluation summary sheet listing the following additional items:
 - 1. Bus name.
 - 2. Upstream protective device name, type, settings.
 - 3. Bus line-to-line voltage.

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- 4. Bus bolted fault.
- 5. Protective device bolted fault current.
- 6. Arcing fault current.
- 7. Protective device trip/delay time.
- 8. Breaker opening time.
- 9. Solidly grounded column.
- 10. Equipment type.
- 11. Gap.
- 12. Arc flash boundary.
- 13. Working distance.
- 14. Incident energy.
- 15. Required protective fire rated clothing type and class.
- 16. Table of required PPE.
- G. Analyze short circuit, protective device coordination, and arc flash calculations and highlight equipment that is determined to be underrated or causes incident energy values greater than 8 cal/cm². Propose approaches to reduce energy levels.
- H. Prepare report summarizing arc flash study with conclusions and recommendations which may affect integrity of electric power distribution system. As a minimum, include the following:
 - 1. Equipment manufacturer's information used to prepare study.
 - 2. Assumptions made during study.
 - 3. Reduced copy of one-line drawing; 11 inches by 17 inches maximum.
 - 4. Arc flash evaluations summary spreadsheet.
 - 5. Bus detail sheets.
 - 6. Arc flash warning labels printed in color on thermally bonded adhesive backed UV and weather-resistant labels.
- I. Replace existing Arc Flash warning labels with new labels as required per Arc Flash study results.

PART 2 PRODUCTS

2.01 ARC FLASH WARNING LABELS

A. Arc flash warning labels printed in color on thermally bonded adhesive backed, UV- and weather-resistant labels.

PART 3 EXECUTION

3.01 GENERAL

- A. Adjust relay and protective device settings according to values established by coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify Engineer in writing of required major equipment modifications.
- D. Provide laminated one-line diagrams (minimum size 11 inches by 17 inches) to post on interior of electrical room doors.
- E. Provide arc flash warning labels on equipment as specified in this section.

END OF SECTION

SECTION 26 43 00 SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. American National Standards Institute (ANSI).
 - 2. Department of Defense: MIL-STD-220C, Test Method Standard Method of Insertion Loss Measurement.
 - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - b. C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
 - c. C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits.
 - 4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
 - 5. UL:
 - a. 497A, Standard for Secondary Protectors for Communications Circuits.
 - b. 1283, Standard for Electromagnetic Interference Filters.
 - c. 1449, Standard for Surge Protective Devices.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Product data on each suppressor type, indicating component values, part numbers, and conductor sizes. Include dimensional drawing for each, showing mounting arrangements.
 - 2. Electrical single-line diagram showing location of each SPD.
 - 3. Manufacturer's UL certified test data and nameplate data for each surge protective device (SPD).

1.03 QUALITY ASSURANCE

- A. UL Compliance and Labeling:
 - 1. SPDs for Power and Signal Circuits: Comply with UL 1449 and complimentary listed to UL 1283 as an electromagnetic interference filter. Provide units listed and labeled by UL.
 - 2. SPDs for Telephone Circuit Protection: Comply with UL 497A.
- B. ANSI Compliance: Use SPD devices in compliance with the recommendations of IEEE C62.41.1, IEEE C62.41.2, and IEEE C62.45.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Eaton, SPD Series.
- B. Square D, Schneider.
- C. Advanced Protection Technologies, Inc.
- D. CITEL, MDS Series.

2.02 GENERAL

- A. SPD must be appropriate and suitable for open delta with high leg.
- B. Unless indicated otherwise, provide direct bus-connected and factory-installed SPDs inside distribution equipment.
- C. SPD Operating Conditions: Capable of performing at ambient temperatures between minus 40 degrees C and 60 degrees C, at relative humidity ranging from 0 percent to 95 percent, and at altitudes ranging from sea level to 12,000 feet.
- D. Connect SPDs through a fused switch or circuit breaker as selected by manufacturer. Provide overcurrent protection to allow full surge handling capabilities and afford safety protection from thermal overloads and short circuits.
- E. SPD Short Circuit Current Rating (SCCR): No less than the SCCR of distribution equipment.
- F. Design SPD devices to protect all modes (L-L, L-N, L-G, N-G) of electrical system being used.

- G. Power Filter: Include a high-frequency extended range power filter for each SPD complimentary listed to UL 1283 as an electromagnetic interference filter.
- H. Provide SPDs with the following monitoring and diagnostics:
 - 1. LED-type indication lights to show normal and failed status of each protected phase.
 - 2. Surge event counter.
 - 3. Form C dry contact which operates when unit fails.
- I. Provide UL Type 2 SPDs.
- J. EMI/RFI Noise Suppression: -50dB attenuation at 100 kHz, tested per MIL-STD 220C.
- K. Voltage Protection Rating (VPR):

Voltage Rating	L-N	N-G	L-G	L-L
208Y/120	800	800	800	1200
480Y/277	1200	1200	1200	2000
240 Δ			1200	1200
480 Δ			2000	2000

2.03 SERVICE ENTRANCE AND DISTRIBUTION SPD

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category C.
- B. Surge Current Capacity:
 - 1. Service Entrance:
 - a. 200kA per phase.
 - b. 100kA per mode.
 - 2. Distribution:
 - a. 120kA per phase.
 - b. 60kA per mode.
- C. Maximum Continuous Operating Voltage (MCOV): Not less than 115 percent of nominal system voltage.
- D. Nominal Discharge Current (I_N): 20kA.

2.04 PANELBOARD SPD

- A. Provide SPD meeting IEEE C62.41.1 and IEEE C62.41.2 Location in accordance with Category B.
- B. Surge Current Capacity:
 - 1. Distribution: 120kA per phase; 60kA per mode.
 - 2. Branch: 80kA per phase; 40kA per mode
- C. Maximum Continuous Operating Voltage (MCOV): Not less than 125 percent of the nominal system voltage.
- D. Nominal Discharge Current (I_N): 10kA.

PART 3 EXECUTION

3.01 APPLICATION REQUIREMENTS

- A. Provide SPDs when indicated on the Drawings or in the equipment specifications.
- B. Provide factory-installed SPDs as integral components to new switchgear, switchboards, motor control centers, panelboards and transfer switches. Externally mounted SPDs are not acceptable for new distribution equipment.
- C. Externally mounted SPDs are acceptable for SPDs added to existing equipment as described below.

3.02 GENERAL INSTALLATION REQUIREMENTS

- A. Install suppressors according to manufacturer's recommendations.
- B. Install suppressors directly to the cabinet which houses the circuit to be protected so that the suppressor leads are straight and short, with conductors laced, running directly to the point of connection within the panel, without loops or bends. If bends are unavoidable, no bend may exceed 90 degrees and bending radius may not be less than 6 inches.
- C. Provide connecting wires as short as possible with gently twisted conductors, tied together, to prevent separation.
 - 1. Maximum Length: 24 inches.

- D. Field Installed Conductors: As specified for building wire, not smaller than 8 AWG and not larger than 4 AWG. Provide device leads not longer than the maximum length recommended by manufacturer, unless specifically reviewed and approved by manufacturer.
- E. Provide dedicated disconnecting means for SPD devices installed at main service entrance location, switchgear, and motor control centers. Provide dedicated 30-60-ampere circuit breakers (size dependent upon wire size used) with number of poles as required, as disconnecting means for SPD devices. Provide circuit breakers with interrupting capacity equal to that specified for other breakers at that location.

END OF SECTION

SECTION 26 50 00 LIGHTING

PART 1 GENERAL

1.01 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
 - 1. ASTM International (ASTM):
 - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. A572/A572A, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, with 50 ksi Minimum Yield Point to 4-in. Thick.
 - e. A595/A595M, Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
 - f. A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - g. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - h. D6576, Standard Specification for Flexible Cellular Rubber Chemically Blown.
 - i. G154, Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials.
 - 2. American Wood Protection Association (AWPA): M6, Brands Used on Forest Products.
 - 3. Canadian Standards Association (CSA).
 - 4. Certified Ballast Manufacturer (CBM).
 - 5. Federal Communications Commission (FCC).
 - 6. Illuminating Engineering Society of North America (IESNA).
 - a. HB-9, Lighting Handbook.
 - b. LM-79, IES Electrical and Photometric Measurements of Solid-State Lighting Products.
 - c. LM-80, IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.

- d. RP (Recommended Practices) Series.
- e. TM-21, Projecting Long Term Lumen Maintenance of LED Light Sources.
- Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- 8. National Electrical Manufacturers Association (NEMA):
- 9. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- 10. ICS 6, Industrial Control and Systems: Enclosures.
- 11. National Energy Policy Act.
- 12. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC) Softbound Version.
- 13. Rural Utilities Service (RUS): 1728F-700, Specification for Wood Poles, Stubs and Anchor Logs.
- 14. UL:
 - a. 773, UL Standard for Safety Plug-In Locking Type Photocontrols for Use with Area Lighting Fourth Edition; Reprint with Revisions Through and Including March 08, 2002.
 - b. 844, Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.
 - c. 924, Emergency Lighting and Power Equipment.
 - d. 1598, UL Standard for Safety Luminaires.
 - e. 2108, UL Standard for Safety Low Voltage Lighting Systems -First Edition; Reprint with Revisions through and Including February 24, 2014.
 - f. 8750, UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products - First Edition; Reprint with Revisions Through and Including April 1, 2015.
- 15. U.S. Environmental Protection Agency and U.S. Department of Energy: Energy Star.

1.02 SUBMITTALS

- A. Action Submittals:
 - 1. Shop Drawings:
 - a. General:
 - 1) Provide catalog data sheets and pictures for all products listed below.

- 2) Proposed Luminaire Substitutions (Interior and Exterior): Provide an electronic photometric file in standard '.ies' file format per the Illumination Engineering Society of North America (IESNA) for any proposed luminaire substitution not identified on the project Luminaire Schedule. Obtain file from the luminaire manufacturer or approved independent photometric testing laboratory. Include the proposed substitute luminaire with all options identified on the project Luminaire Schedule.
- b. Interior Luminaires:
 - 1) Catalog data sheets with pictures.
 - 2) Luminaire material, finish, dimensions, and metal gauge.
 - 3) Lens material, pattern, and thickness.
 - 4) Candle power distribution curves in two or more planes.
 - 5) Candle power chart 0 degree to 90 degrees.
 - 6) Lumen output chart.
 - 7) Average maximum brightness data in foot lamberts.
 - 8) Coefficients of utilization for zonal cavity calculations.
 - 9) Mounting or suspension details.
- c. Exterior Luminaires:
 - 1) Catalog data sheets with pictures. Luminaire material, finish, dimensions, and metal gauge.
 - 2) Lens material, pattern, and thickness. Filters.
 - 3) IESNA lighting classification (BUG rating).
 - 4) Isolux diagram.
 - 5) Lighting distribution data and lighting distribution classification type as defined in IESNA HB 9.
 - 6) Fastening details to wall, pendant, or pole.
 - 7) Ballast type, location, and method of fastening.
- d. Lamps:
 - 1) Voltages.
 - 2) Watts.
 - 3) Correlated Color Temperature (CCT).
 - 4) Color Rendering Index (CRI).
 - 5) Published rated life (in hours). Provide number of hours per start and operating temperature for published rated life hours indicated.
 - 6) Published rated initial and mean lumens.
 - 7) Lumen maintenance curve.
 - 8) Lamp type (ANSI designation, dimensions, shape, and base).
- e. LED Source Systems:
 - 1) General:
 - a) IESNA LM-80 test reports.
 - b) IESNA TM-21 ratings.

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- c) Operating temperature range. Data sheet (chart/graph) describing life as a function of temperature.
- d) Warranty: Light engine and driver.
- e) Rated life.
- f) Surge protection.
- g) Thermal control device, heat sink.
- h) Enclosure and wiring information.
- i) Operating voltage range.
- 2) Electronic Module/Light Engine:
 - a) Correlated Color Temperature (CCT).
 - b) Color Rendering Index (CRI).
- 3) Drivers:
 - a) Input Current Total Harmonic Distortion.
 - b) Power factor.
 - c) Sound rating.
- f. Photoelectric Switches (Photocells):
 - 1) Voltage.
 - 2) Power consumption.
 - 3) Load capacity (watts).
 - 4) Contact ratings and configuration.
 - 5) Time delay.
 - 6) Light operating level controls.
 - 7) Enclosure type and dimensions.
 - 8) Mounting type.
 - 9) Temperature range.
 - 10) Features and options.
 - Occupancy Sensors:
 - 1) Type.
 - 2) Switching capacity.
 - 3) Coverage.
 - 4) Time delay AUTO/OFF adjustment.
- B. Informational Submittals: Manufacturer's printed installation instructions.

1.03 QUALITY ASSURANCE

g.

- A. Authority Having Jurisdiction (AHJ):
 - 1. Provide Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, provide material and equipment labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ to provide a basis for approval under NEC.

- 2. Provide materials and equipment manufactured within the scope of standards published by UL in conformance with those standards and with an applied UL listing mark.
- B. Standard Products:
 - 1. Provide materials and equipment of manufacturers regularly engaged in the production of products specified in this section and that are of equal material, design, and workmanship.
 - 2. Provide products that have been in satisfactory commercial or industrial use for 2 years prior to Bid opening in similar applications under similar circumstances and of similar size. Provide products that have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
 - 3. Material and Equipment Manufacturing Date: Do not use products manufactured more than 3 years prior to date of delivery to Site.

PART 2 PRODUCTS

2.01 LUMINAIRES

- A. Specific requirements relative to execution of the Work of this section are located in Luminaire Schedule on the Drawings. Provide luminaires and components tested, listed, and labeled by UL, or other approved testing agency.
- B. Provide luminaires with Illumination Engineering Society of North America (IESNA) formatted photometric files, ".ies" format, certified by the luminaire manufacturer for use with lighting software.
- C. Luminaire Labels:
 - 1. External label per ANSI C136.15.
 - 2. Internal label per ANSI C136.22.
- D. Provide luminaires rated by the manufacturer to start and operate to their full lumen capacity for rated life of the luminaire at the minimum low and maximum high ambient temperatures as defined in the Contract Documents at their installation location.
- E. Feed-through type, or separate junction box.
- F. Wire Leads: Minimum 18 AWG.
- G. Component Access: Accessible and replaceable without removing luminaire from ceiling.

- H. Soffit Installations (Interior or Exterior Damp Locations):
 - 1. UL Labeled: SUITABLE FOR DAMP LOCATIONS.
 - 2. Ballast: Removable, prewired.
- I. Exterior Installations:
 - 1. UL Labeled: SUITABLE FOR WET LOCATIONS.
 - 2. Ballast: Removable, prewired.
 - 3. When factory-installed photocells are provided, entire assembly shall have UL label.
- J. Illuminated Exit Signs:
 - 1. Body: As scheduled.
 - a. Letters:
 - 1) 6-inch high by 3/4-inch stroke.
 - 2) Color: As required by the AHJ.
 - 2. Directional Arrows: As indicated on the Drawings.

2.02 LIGHTING CONTROL

- A. Photoelectric Switch (Photocell):
 - 1. Automatic Solid State ON/OFF Switching Photo Control:
 - a. Dry Contacts: Compatible with connected load device indicated on the Drawings.
 - 2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
 - 3. Mounting Type: 1/2-inch conduit entry or Single-gang plate.
 - 4. Setting: ON at dusk and OFF at dawn.
 - 5. Time delay feature to prevent false switching.
 - 6. Field adjustable to control operating light levels.
 - 7. Integral surge protection.
 - 8. Manufacturers:
 - a. Tork.
 - b. Intermatic.
 - c. Paragon Electric Company.
- B. Occupancy Sensors:
 - 1. General:
 - a. Capable of operating normally with any electronic ballast and PL lamp systems.

- b. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to cycling of air conditioner or heating fans.
- c. Provide sensors with readily accessible, user adjustable controls for time delay and sensitivity.
- d. Provide a bypass manual OVERRIDE ON key on each sensor to allow operation in the event of sensor failure. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. Recess bypass control to prevent tampering.
- 2. Sensor Technology:
 - a. Passive Infrared (PIR):
 - 1) Provide sensors that respond to human heat and movement to detect occupants in the coverage area.
 - 2) Temperature compensated pyroelectric sensor.
 - 3) High immunity to false triggering due to RFI and EMI noise.
 - 4) Provide passive infrared sensors with a multiple segmented lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue buildup.
 - b. Ultrasonic:
 - 1) Provide sensors which respond to ultrasonic disturbances within as well as outside the line of sight to detect occupants in the coverage area.
 - 2) Use advanced signal processing technology to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and airflow throughout the controlled space.
 - c. Dual Technology:
 - 1) Sensors use a combination of passive infrared and ultrasonic technologies to detect occupants in coverage area.
 - 2) Provide technology mode selection to allow installer to configure the operation mode between dual technology, passive infrared only, or ultrasonic only functionality.
 - 3) No audio dual technology units will be accepted.
- 3. Sensor Mounting:
 - a. Switch Box:
 - 1) Directional Coverage: 180 degrees.
 - 2) Coverage Area: At desk top level up to 300 square feet and gross motion up to 1,000 square feet.
 - 3) Switch Types:
 - a) Single circuit switches shall control a single switched circuit.
 - b) Bi-level switches shall accommodate up to two switched circuits.

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- 4) Loads:
 - a) Wall box switches shall include an integral power supply.
 - b) Switches shall accommodate loads from 0 watt to 800 watts at 120 volts; 0 watt to 1,200 watts at 277 volts.

2.03 LED SOURCE SYSTEMS

- A. General:
 - 1. Provide IESNA LM 80 test reports.
 - 2. Provide Energy Star compliance for solid state luminaires.
 - 3. Listed To: UL 8750 Standard for Safety for Light Emitting Diode (LED) Equipment for use in Lighting Products.
 - 4. Provide RoHS compliant LED light source(s) and driver(s).
 - 5. Rated operating temperature range as indicated on the Luminaire Schedule.
 - 6. Warranty: 5 years minimum.
- B. Electronic Module/Light Engine:
 - 1. Mount all components to a single plate and factory prewired with quick disconnect plugs.
 - 2. Include a driver, thermal control device, thermal protector device, and surge protector device.
 - a. Provide surge protector tested in accordance with IEEE/ANSI C62.41.2 to Category C Low.
 - 3. Provide LEDs mounted to a metal-core circuit board and aluminum heat sink for optimal thermal management and long life.
 - 4. Light Engine Rating per TM 21: 100,000 at 25 degrees C, L70.
 - 5. Correlated Color Temperature (CCT): As indicated on the Luminaire Schedule.
 - 6. Color Rendering Index (CRI): Minimum of 80.
- C. Drivers:
 - 1. Expected life of 60,000 hours at 65 degrees C.
 - 2. Provide drivers mounted in an all metal can.
 - 3. Operating Voltage Range: 50/60 Hz input source, voltage range as indicated on the Luminaire Schedule with sustained variations of plus or minus 10 percent voltage with no damage to the driver.
 - 4. Input Current Total Harmonic Distortion: Less than 20 percent up to 50 percent of full load rating.
 - 5. Power Factor: Greater than 0.90 for primary application up to 50 percent of full load rating.

- 6. Sound rating: Class A.
- 7. Comply with NEMA 410 for inrush current limits.

2.04 EQUIPMENT IDENTIFICATION

- A. Manufacturer's Nameplate: Provide each item of equipment with a nameplate bearing manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; nameplate of distributing agent will not be acceptable.
- B. Provide clear markings located to be readily visible to service personnel.

2.05 FACTORY FINISH

A. Provide electrical equipment with factory-applied painting systems that, at minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.01 LUMINAIRES

- A. General:
 - 1. Install in accordance with manufacturer's recommendations.
 - 2. Provide proper hangers, pendants, and canopies as necessary for complete installation.
 - 3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building required to safely mount.
 - 4. Install plumb and level.
 - 5. Install each luminaire outlet box with galvanized stud.
- B. Mounting:
 - 1. General:
 - a. Coordinate mounting, fastening, and environmental conditions with Section 26 05 02, Basic Electrical Requirements.
 - b. Refer to Fastener Schedule in Section 05 50 00, Metal Fabrications.
 - 2. Wall Mounted: Measure mounting heights from center of mounting plate to finished floor or finished grade, whichever is applicable.
 - 3. Pendant Mounted:
 - a. Provide swivel type hangers and canopies to match luminaires, unless otherwise noted.
 - b. Space single-stem hangers on continuous-row LED luminaires nominally 48 inches apart.
 - c. Provide twin-stem hangers on single luminaires.

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- d. Measure mounting heights from bottom of luminaire to finished floor or finished grade, whichever is applicable.
- C. Swinging Type: Provide, at each support, safety cable capable of supporting four times vertical load from structure to luminaire.
- D. Finished Areas:
 - 1. Install symmetrically with tile pattern.
 - 2. Locate with centerlines either on centerline of tile or on joint between adjacent tile runs.
 - 3. Install recessed luminaires tight to finished surface such that no spill light will show between ceilings and sealing rings.
 - 4. Combustible Low Density Cellulose Fiberboard: Provide spacers and mount luminaires 1-1/2 inches from ceiling surface, or use fixtures suitable for mounting on low density ceilings.
 - 5. Junction Boxes:
 - a. Flush and Recessed Luminaires: Locate minimum 1-foot from luminaire.
 - b. In concealed locations, install junction boxes to be accessible by removing luminaire.
 - 6. Wiring and Conduit:
 - a. Provide wiring of temperature rating required by luminaire.
 - b. Provide flexible steel conduit.
 - 7. Provide plaster frames when required by ceiling construction.
 - 8. Independent Supports:
 - a. Provide each recessed LED luminaire with two safety chains or two No. 12 soft-annealed galvanized steel wires of length needed to secure luminaire to building structure independent of ceiling structure.
 - b. Select chain or wire with tensile strength and method of fastening to structure adequate to support luminaire weight.
 - c. Fasten chain or wire to each end of luminaire.
- E. Unfinished Areas: Locate luminaires to avoid conflict with other building systems or blockage of luminaire light output.
 - 1. Fixture Suspension: Provide 1/4-inch threaded steel hanger rods. Scissor type hangers not permitted.
 - 2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.
- F. Building Exterior: Flush-mounted back box and concealed conduit, unless otherwise indicated.

3.02 EMERGENCY LIGHTING UNIT

- A. Install in accordance with manufacturer's recommendations.
- B. Provide permanent circuit connections with conduit and wire.
- C. Connect to branch circuit feeding normal lighting in area ahead of all local switches.
- D. Provide separate circuit wiring to luminaire.

3.03 FIELD FINISHES

A. Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.04 FIELD QUALITY CONTROL

A. Upon completion of installation, verify equipment is properly installed, connected, and adjusted. Conduct an operating test to show equipment operates in accordance with the requirements of this section.

3.05 CLEANING

- A. Remove labels and markings, except UL listing mark.
- B. Wipe luminaires inside and out to remove construction dust.
- C. Clean luminaire plastic lenses with antistatic cleaners only.
- D. Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.
- E. Replace defective lamps at time of Substantial Completion.

END OF SECTION